



**Faculty of Cognitive Sciences and Human Development**

**An Activity Theory Analysis of Discord-Mediated Online Collaborative  
Learning Among Malaysian Matriculation Students:  
A Design-Based Research**

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An Activity Theory Analysis of Discord-Mediated Online Collaborative  
Learning Among Malaysian Matriculation Students: A Design-Based  
Research

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## DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



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## ABSTRACT

This research examines the effectiveness of Discord-mediated Online Collaborative Learning (OCL) in a Biology matriculation program, focusing on how digital tools and structured pedagogical strategies can help reduce the challenges posed by an accelerated and exam-oriented curriculum. Guided by Activity Theory (AT) and employing a single-case Design-Based Research (DBR) approach, the investigation involved 30 Biology students at a Malaysian matriculation college. Data were collected via focus group interviews, lecturer reflective journals, and online observations over 15 weeks of iterative task cycles. Results indicate that Discord's channel organization, file-sharing features, and real-time notifications facilitate efficient resource management and flexible interactions. Synchronous discussions fostered immediate feedback and heightened motivation, yet scheduling conflicts and unstable internet connectivity hindered consistent engagement. Asynchronous tasks allowed for deeper reflection but also introduced risks of procrastination and fragmented participation. Group size significantly influenced collaboration: larger groups offered diverse perspectives and workload distribution but faced communication overload and free-riding, whereas smaller groups promoted accountability and cohesion yet sometimes lacked idea diversity. Lecturer–student interactions helped prevent misconceptions and increased task efficiency. However, overly prescriptive instructions such as dictating all discussion topics and pathways restricted student exploration and reduced creativity. Student–student interactions encouraged informal support and peer leadership but off-topic talk and unverified information occasionally undermined productivity. From these findings, seven design principles emerged: (1) align platform features with pedagogical goals, (2) balance synchronous and asynchronous modes, (3) use structured role assignments, (4) adopt calibrated lecturer facilitation, (5) manage group size

and composition strategically, (6) integrate clear timelines and feedback loops, and (7) promote self-regulated learning practices. The research enriches OCL theory by illustrating how contradictions in an exam-driven environment can drive iterative refinements of digital learning approaches. The findings of this research provide practical implications for Malaysian matriculation colleges by informing lecturers and policymakers on how Discord-mediated OCL can be designed to enhance student engagement, collaboration, and instructional effectiveness within accelerated and exam-oriented curricula.

**Keywords:** Discord, Online Collaborative Learning (OCL), Activity Theory (AT), Biology Matriculation, Design-Based Research (DBR)

***Penyiasatan Teori Aktiviti terhadap Pembelajaran Kolaboratif Dalam Talian yang Dimediasi oleh Discord dalam Kalangan Pelajar Matrikulasi Malaysia: Satu Kajian Berasaskan Reka Bentuk***

***ABSTRAK***

*Kajian ini meneliti keberkesanan Pembelajaran Kolaboratif Dalam Talian (PKDT) yang dimediasi oleh Discord dalam program Matrikulasi Biologi dengan memberi tumpuan kepada bagaimana alat digital dan strategi pedagogi berstruktur dapat menangani kekangan kurikulum yang dipercepat dan berorientasikan peperiksaan. Berpandukan Teori Aktiviti (TA) dan menggunakan pendekatan Penyelidikan Berasaskan Reka Bentuk (PBRB) kes tunggal, penyelidikan ini melibatkan 30 orang pelajar Biologi di sebuah kolej matrikulasi di Malaysia. Data diperoleh melalui temu bual kumpulan berfokus, jurnal reflektif pensyarah, dan pemerhatian dalam talian sepanjang 15 minggu kitaran tugas berulang. Hasil kajian menunjukkan bahawa pengurusan saluran dalam Discord, ciri perkongsian fail, serta notifikasi masa nyata membantu menguruskan sumber dengan efisien dan membolehkan interaksi yang fleksibel. Perbincangan segerak memudahkan maklum balas pantas dan meningkatkan motivasi, namun konflik jadual dan sambungan internet yang tidak stabil menghalang penglibatan secara konsisten. Tugas tidak segerak pula memberi peluang untuk refleksi yang lebih mendalam, tetapi turut meningkatkan risiko penangguhan dan penyertaan yang terpisah. Saiz kumpulan memberi pengaruh besar terhadap kerjasama: kumpulan yang lebih besar menawarkan perspektif yang pelbagai dan pembahagian beban tugas yang lebih adil, tetapi berdepan komunikasi yang berlebihan serta masalah ahli yang menumpang usaha. Sebaliknya, kumpulan yang lebih kecil dapat memupuk akauntabiliti dan kesepaduan, namun kadangkala kekurangan kepelbagaian idea. Interaksi guru–pelajar membantu mencegah salah tanggapan dan meningkatkan kecekapan*

tugasan. Walau bagaimanapun, arahan yang terlalu preskriptif seperti mengawal sepenuhnya topik dan hala tuju perbincangan telah mengehadkan penerokaan pelajar serta mengurangkan kreativiti. Interaksi pelajar–pelajar pula menyokong bantuan tidak formal dan kepimpinan rakan sebaya, tetapi perbualan di luar topik dan maklumat yang tidak disahkan kadangkala menjejaskan produktiviti. Daripada penemuan ini, tujuh prinsip reka bentuk telah dikenal pasti: (1) menyelaraskan ciri platform dengan matlamat pedagogi, (2) mengimbangi penggunaan mod segerak dan tidak segerak, (3) menggunakan pembahagian peranan yang berstruktur, (4) menerapkan bimbingan guru yang berpadanan, (5) mengurus saiz dan komposisi kumpulan secara strategik, (6) mengintegrasikan garis masa dan kitaran maklum balas yang jelas, dan (7) mempromosikan amalan pembelajaran sendiri. Kajian ini memperkayakan teori PKDT dengan menunjukkan bagaimana percanggahan dalam persekitaran yang berorientasikan peperiksaan boleh mendorong penambahbaikan berterusan dalam pendekatan pembelajaran digital. Dapatan kajian ini memberikan implikasi praktikal kepada kolej matrikulasi di Malaysia dengan menyediakan panduan kepada guru dan pembuat dasar tentang reka bentuk PKDT yang dimediasi oleh Discord bagi meningkatkan penglibatan pelajar, kerjasama, dan keberkesanan pengajaran dalam kurikulum yang dipercepat dan berorientasikan peperiksaan.

**Kata kunci:** *Discord, Pembelajaran Kolaboratif Dalam Talian (PKDT), Teori Aktiviti (TA), Biologi Matrikulasi, Penyelidikan Berasaskan Reka Bentuk (PBRB)*

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## LIST OF ABBREVIATIONS

ABO	ABO blood group system
AT	Activity Theory
CGPA	Cumulative Grade Point Averages
CoI	Community of Inquiry
COVID-19	Coronavirus Disease 2019
CSCL	Computer-Supported Collaborative Learning
DBR	Design-Based Research
DNA	Deoxyribonucleic acid
eRAS	Educational Research Application System
ICAP	Interactive–Constructive–Active–Passive
ICT	Information and Communication Technology
LMS	Learning Management System
MoE	Ministry of Education
OCL	Online Collaborative Learning
PDT	Program Dua Tahun
PPPM	Pelan Pembangunan Pendidikan Malaysia
PTPM	Pelan Transformasi Program Matrikulasi
PSPM	Peperiksaan Semester Program Matrikulasi
PST	Program Satu Tahun
SPM	Sijil Pelajaran Malaysia
STEM	Science, Technology, Engineering, and Mathematics
UNIMAS	Universiti Malaysia Sarawak
ZPD	Zone of Proximal Development

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

Education in the 21st century is undergoing significant transformation, largely driven by rapid advancements in digital technology. Learning is no longer confined to traditional classroom settings. The widespread availability of mobile devices and high-speed internet now enables students to access diverse online resources and virtual learning environments (Berezi, 2025; Hew et al., 2020). Within this evolving educational landscape, Online Collaborative Learning (OCL) has emerged as an effective pedagogical approach that integrates purposeful instructional design, social interaction, and technology to promote meaningful student engagement (Altowairiki, 2021). In the post-pandemic era, digital pedagogy has further evolved toward hybrid, AI-supported, and ecosystem-based learning environments that integrate collaborative platforms, learning analytics, and adaptive feedback systems to sustain student engagement beyond emergency remote teaching (Bergdahl et al., 2024; Syafii et al., 2024).

According to Harasim (2012), OCL involves learners in the collaborative construction of knowledge through sustained dialogue and problem-solving activities. This process closely aligns with Vygotsky's (1978) social constructivist theory, which emphasizes that learning is inherently social, culturally situated, and significantly enhanced through interaction and scaffolding. Educators have employed various strategies such as problem-based learning (Lin & Wang, 2024), discussion forums (An et al., 2018), and group projects (Gasmi, 2022) to enhance peer collaboration and promote a deeper understanding of complex subjects among students. Recent scholarship further highlights the integration of AI-supported collaborative tools, generative feedback systems, learning analytics

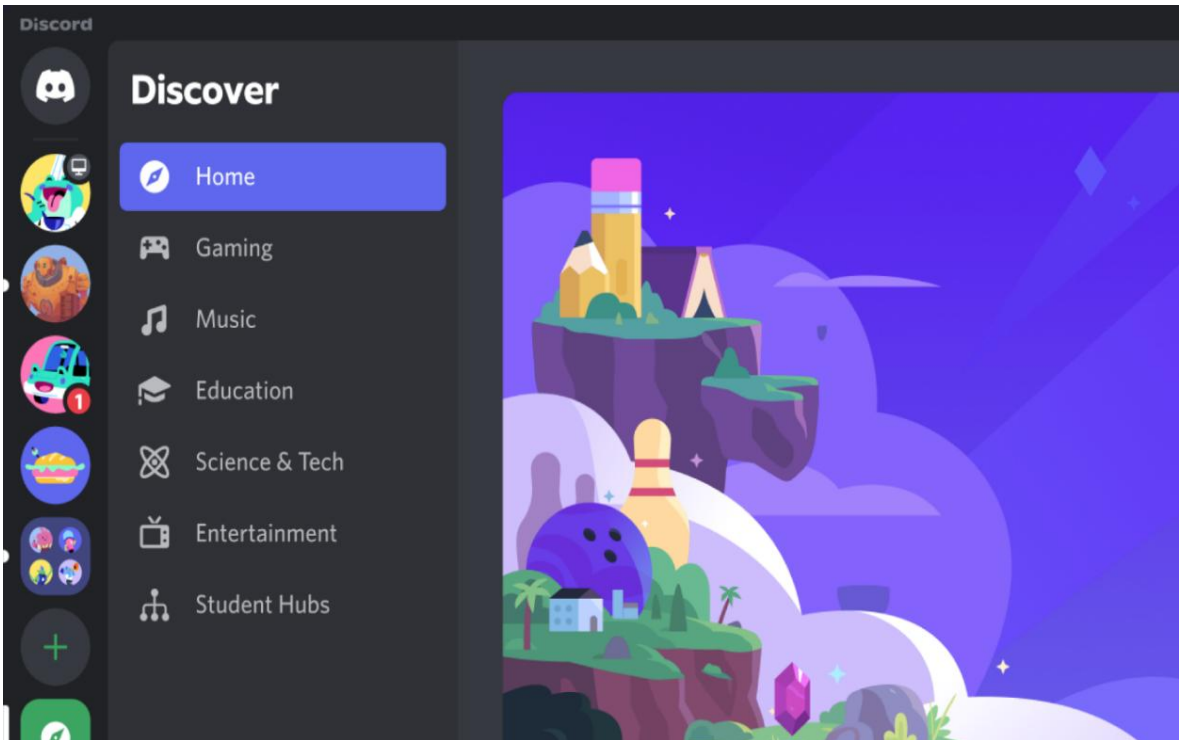
dashboards, and intelligent tutoring mechanisms that scaffold peer interaction and monitor group dynamics in real time (Sichterman et al., 2025; Zerkouk et al., 2025). These developments signal a shift from platform-based adoption to digitally integrated learning ecosystems where collaboration is continuously supported by data-informed facilitation.

At the core of OCL is the deliberate integration of technology and pedagogy to establish active and inclusive learning communities. By fostering social interaction and collaborative knowledge construction, OCL supports the development of essential 21st-century competencies such as problem-solving, adaptability, and effective communication (Kamal & Abdillah, 2024; Kumi-Yeboah et al., 2020). In pre-university contexts, these competencies increasingly include digital collaboration literacy, AI-aware critical evaluation skills, and responsible technology use (Oates & Johnson, 2025). Within the Malaysian higher education transformation agenda, recent policy discourse further emphasizes AI literacy, digital resilience, and collaborative problem-solving as key graduate attributes aligned with national digital education reforms (Ministry of Higher Education Malaysia, 2024; Selvanathan & Narayanan, 2024). These skills are particularly critical in pre-university education where students must navigate demanding academic schedules and examination pressures while developing both independent and collaborative learning capacities. Such competencies necessitate the purposeful selection of digital platforms that can operationalise collaborative pedagogy in authentic learning contexts.

Discord (Figure 1.1) is a platform originally developed for gaming communities that has increasingly gained recognition for its potential to support both synchronous and asynchronous OCL (Jannah et al., 2024; Oyarzun & Martin, 2023). Its features including voice channels, text-based communication, screen sharing, and file uploads can facilitate dynamic and flexible interactions. In contrast to conventional video conferencing platforms

such as Zoom or Microsoft Teams, Discord offers a gamified interaction design with real-time notifications, enhancing usability and engagement particularly among students (Ayob et al., 2022; Jannah et al., 2024). As a result, educators are beginning to adopt Discord as a tool to transform traditional coursework into more interactive and engaging learning experiences, encouraging active participation and sustained collaboration.

More recent investigations position Discord within broader digital learning infrastructures, emphasizing its role in sustaining informal-academic boundary crossing, persistent peer networks, and community-based knowledge construction in higher and pre-university education (Alghamdi, 2026; Crapciu & Blaga, 2025). In the Malaysian context, emerging studies have begun examining the use of Discord in higher and blended learning environments, reporting positive student acceptance and highlighting its potential to support flexible communication and collaborative engagement (Ismail et al., 2025; Mahdzir et al., 2023). Local investigations further indicate growing academic interest in Discord-mediated collaboration within Malaysian institutions, signalling its relevance beyond informal social use.

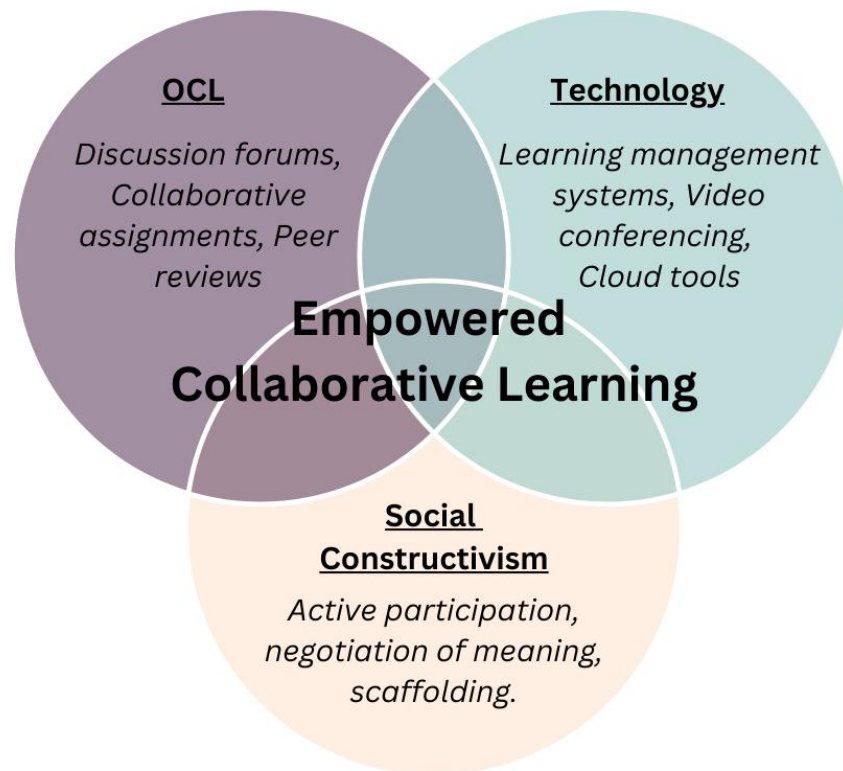


**Figure 1.1:** Discord Server Interface

At both global and national levels, education policies increasingly emphasize the integration of digital platforms as essential tools for fostering equitable and high-quality learning outcomes (Reyer Van der Vlies et al., 2020). Post-2022 reforms further emphasize digital resilience, blended learning sustainability, and AI integration in education systems worldwide (Xie & Zhang, 2025). In Malaysia, the *Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013–2025* highlights the pivotal role of Information and Communication Technology (ICT) in enhancing digital literacy, critical thinking, and problem-solving skills among students (Zainal & Zainuddin, 2020). Recent policy extensions and digital transformation agendas under the *Pelan Transformasi Digital Pendidikan (2023–2025)* further reinforce the strategic integration of emerging technologies, digital platforms, and data-informed pedagogy within pre-university education (Termizi et al., 2025).

Within this policy landscape, the Malaysian matriculation program serves as an accelerated pre-university pathway (Abdussuyukur et al., 2021; Beram et al., 2024), requiring students to rapidly develop proficiency in both independent and collaborative learning strategies to prepare for university-level coursework and high-stakes examinations. These essential competencies can be effectively nurtured through structured OCL frameworks supported by reliable digital tools. However, the integration of digital collaborative platforms occurs within a tightly structured, examination-driven environment in which centrally administered assessments, such as the *Peperiksaan Semester Program Matrikulasi* (PSPM), shape instructional pacing and student learning strategies. This creates a distinctive tension between innovation in digital collaboration and the imperatives of syllabus coverage and performance accountability.

Within the broader field of Computer-Supported Collaborative Learning (CSCL), social constructivist theories (see Figure 1.2) emphasize interaction, collaborative meaning-making, and scaffolding as foundations for meaningful learning (Poudel, 2021). Recent CSCL research further examines how digital ecosystems, AI-mediated scaffolding, and analytics-enhanced collaboration reshape peer interaction in online environments (Syafii et al., 2024; Wan et al., 2025). Vygotsky's (1978) Zone of Proximal Development (ZPD) explains how learners progress through guidance from more capable peers or mentors, while Harasim's (2012) OCL framework highlights the role of digital platforms in expanding collaborative opportunities. In this context, Discord's multi-channel features support both synchronous and asynchronous engagement, which is particularly valuable in the time-sensitive Malaysian matriculation environment.



**Figure 1.2:** OCL, Technology & Social Constructivism

Activity Theory (AT) offers a comprehensive analytical framework for examining how learners (subjects), digital platforms and tools (mediating artifacts), and institutional elements such as rules, community, and division of labour interact in the pursuit of shared academic objectives (Engeström, 2000). Guided by this framework, the present research explores how Discord functions as a mediating tool for collaborative learning tasks within the exam-oriented context of Malaysian matriculation Biology classes. Specifically, the research aims to identify both the challenges faced and the effective practices adopted in the implementation of OCL in this context.

## 1.2 The Malaysian Matriculation Program

The Malaysian matriculation program functions as a crucial pre-university pathway for students seeking an accelerated transition into tertiary education. Established in the late 1990s by the Ministry of Education (MoE), the program was originally designed to expand access to higher education particularly in the fields of Science, Technology, Engineering, and Mathematics (STEM) for high-achieving secondary school leavers aiming to enter local public universities. While initially targeted at Bumiputera students, the program has since evolved to accommodate a more diverse demographic, offering a fast-paced and cost-effective route to fulfilling pre-university requirements (Ministry of Education, 2013). Recent evaluations of matriculation reform emphasize digital transformation, blended instructional delivery, and the strengthening of collaborative competencies aligned with national higher education readiness goals (Abdullah et al., 2025).

The most widely implemented track is the *Program Satu Tahun* (PST), which compresses advanced secondary-level content into two semesters. PST students typically study five core subjects, namely Mathematics, Chemistry, Physics, Biology, and Computer Science, alongside compulsory courses such as English, General Studies, and Islamic or Moral Studies (refer Table 1.1) (Abdussyukur et al., 2021). This intensive structure demands a heavy workload of lectures, laboratory sessions, co-curricular activities, and continuous assessments. Alternative tracks, including the *Program Dua Tahun* (PDT) and specialized technical or accounting streams, accommodate diverse academic backgrounds. However, all pathways culminate in the centrally administered PSPM final examinations, which significantly determine students' CGPAs and strongly shape curriculum delivery and learning strategies.

**Table 1.1:** Streams in the Matriculation Program

<b>Stream</b>	<b>Core Subjects</b>	<b>Compulsory Subjects</b>
<b>Life Sciences</b>	Mathematics, Chemistry, Biology, Physics	Co-curricular, English, General Studies, Islamic/Moral Studies
<b>Physical Sciences</b>	Mathematics, Chemistry, Physics, Computer Science	Co-curricular, English, General Studies, Islamic/Moral Studies
<b>Computer Science</b>	Mathematics, Chemistry, Biology, Computer Science	Co-curricular, English, General Studies, Islamic/Moral Studies

While the Malaysian matriculation program offers affordable and accelerated access to tertiary education, it places 18 to 20 years old students in a high-pressure environment. These students arrive with varying digital competencies, often showing proficiency in social media but lacking experience in structured OCL. Inconsistent internet access across some colleges further hampers sustained digital integration (Zainal & Zainuddin, 2020; Abdussyukur et al., 2021). To address these challenges, the *PPPM 2013–2025* and the *Pelan Transformasi Program Matrikulasi (PTPM) 2021–2025* emphasize strengthening ICT infrastructure, lecturer training, and active learning. In response, educators have adopted tools such as Google Meet and Microsoft Teams especially during the COVID-19 pandemic.

Despite positive outcomes such as increased engagement and higher-order thinking, barriers including uneven digital readiness, infrastructural constraints, and exam-driven pressures continue to persist. Nonetheless, these reforms provide an opportunity to examine how platforms like Discord can support structured collaboration and inform effective OCL practices in pre-university settings.

### **1.3 Problem Statement**

OCL has gained increasing global recognition for its potential to support active learner-centered education through interactive dialogue, knowledge co-construction, and peer engagement. However, its practical implementation remains uneven particularly in specific national and institutional contexts such as Malaysia (Samri & Jumaat, 2024). While OCL principles align with modern pedagogical goals such as flexibility, student agency, and deep learning, real-world application often falls short due to challenges in instructional design, technological integration, and contextual adaptability (Oyarzun & Martin, 2023; Gao et al., 2024). Furthermore, existing studies on OCL frequently overlook the critical role of specific digital platforms in enabling or constraining collaboration, resulting in a limited understanding of how technologies can be purposefully and strategically embedded within structured learning environments (Mnkandla & Minnaar, 2017).

The Malaysian matriculation program represents a uniquely high-stakes academic context, designed to prepare pre-university students typically aged 18 to 20 for tertiary education within a highly compressed timeframe. In this research, OCL effectiveness is examined specifically in terms of student engagement, participation patterns, collaborative knowledge construction, and interaction quality within Discord-mediated Biology learning. These students are required to master advanced content across multiple disciplines while simultaneously preparing for cumulative high-impact examinations (Krishnan et al., 2019). In Biology specifically, students must grasp complex and abstract concepts within limited instructional time, often leading to surface-level revision strategies rather than sustained collaborative inquiry (Minwuyelet et al., 2024). Biology topics such as molecular genetics, cellular processes, and physiological mechanisms demand conceptual integration and higher-order reasoning, yet the accelerated structure of the matriculation program frequently

prioritizes examination preparation over dialogic knowledge construction. Although often referred to as “digital natives”, many learners of this age group possess limited experience with goal-oriented and academically structured collaboration. Their engagement with digital tools is frequently limited to informal communication or passive consumption rather than active knowledge construction or higher-order cognitive engagement (Smith et al., 2020). The urgency of this issue was highlighted during the COVID-19 pandemic which exposed inequalities in digital readiness, reduced opportunities for sustained peer interaction, and raised concerns about the effectiveness of collaborative learning in online environments (Kalmar et al., 2022).

Within this context, Discord has emerged as a digital platform with promising affordances for supporting OCL. Initially designed for gaming communities, Discord offers voice and text channels, screen sharing, file uploads, and persistent chat histories which enable both synchronous and asynchronous communication. Its customizable servers and sub-channels (Lauricella et al., 2024) provide an adaptable structure that aligns with the fast-paced and exam-driven nature of the Malaysian matriculation. Despite these strengths, research on the pedagogical application of Discord remains limited, particularly within formal pre-university settings in Malaysia. Most existing studies focus on higher education or informal learning in international contexts (Craig & Kay, 2023), leaving a significant gap in understanding how Discord’s features function as tools to support structured OCL among Biology matriculation students.

In addition to technological affordances, effective OCL depends on clearly established communication norms. Ambiguity in expectations regarding synchronous and asynchronous participation may result in delayed responses, fragmented dialogue, or uneven engagement (Mansour, 2024). Although OCL emphasizes structured knowledge-building

phases (Harasim, 2012), limited research has examined how rules governing communication shape OCL processes within Discord-mediated environments in high-pressure pre-university settings. Without explicit communication guidelines, collaborative processes may lack coherence and sustained academic focus. There remains insufficient empirical evidence explaining how structured communication rules influence participation patterns, interaction quality, and collaborative knowledge construction in accelerated examination contexts.

Another important yet underexplored issue concerns group size. Large online groups may contribute to uneven participation, diffusion of responsibility, or passive observation, whereas smaller groups may increase accountability but reduce diversity of perspectives (Li, 2025; Ozekes, 2025). Despite the practical importance of group configuration in collaborative task design, limited empirical research has investigated optimal group size within accelerated and examination-oriented pre-university programs such as the Malaysian matriculation system. In the absence of evidence-based guidance, lecturers may adopt arbitrary grouping strategies that inadvertently hinder balanced division of labour and sustained engagement. This gap restricts educators' ability to structure effective division of labour in online collaborative tasks.

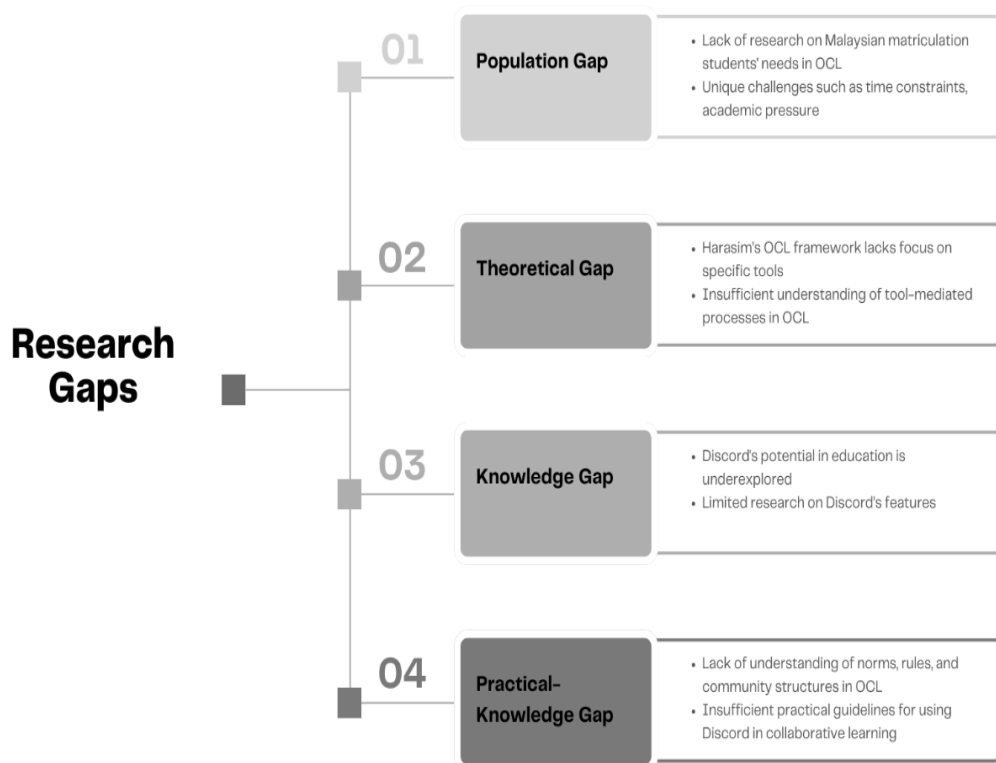
Furthermore, OCL effectiveness is shaped by the quality of lecturer–student and student–student interactions within the learning community. Instructor presence, facilitation strategies, and peer responsiveness are particularly critical in examination-oriented contexts where academic pressure may influence participation patterns. However, there is insufficient understanding of how lecturer–student and student–student interactions within a Discord community affect OCL processes in the Malaysian matriculation classrooms. Weak facilitation or unclear interactional roles may hinder meaningful knowledge co-construction despite the availability of digital tools (Knight & Knight, 2024).

While Harasim's (2012) OCL framework offers a conceptual foundation for understanding the phases of collaborative knowledge-building namely idea generation, idea organization, and intellectual convergence, it lacks explicit guidance on how to integrate platform-specific functionalities in real-world educational settings (Oyarzun & Martin, 2023). In contrast, AT offers a comprehensive analytical lens for examining how learners (subjects), digital tools (mediating artifacts), and institutional factors (rules, community norms, and division of labour) interact in complex ways to shape online learning experiences (Yusoff & Zin, 2012). By emphasizing on the sociocultural and tool-mediated dimensions of learning, AT facilitates a deeper investigation into how Discord may support or hinder OCL processes within the matriculation program.

This research addresses a critical gap in both literature and practice by examining how Discord-mediated OCL can be systematically structured within the accelerated, examination-driven Malaysian matriculation environment. These gaps inform five research questions focusing on Discord's features as tools, synchronous and asynchronous communication rules, group size, lecturer–student and student–student interactions, and design principles that enhance OCL effectiveness for Biology matriculation students. Through empirical investigation, the study seeks to advance understanding of tool-mediated collaborative learning while providing practical, evidence-based design guidance for educators and policymakers aiming to strengthen engagement, collaboration, and learning outcomes in Malaysia's pre-university context.

## 1.4 Research Gaps

Despite growing interest in OCL, four pressing gaps (Figure 1.3) highlight the need for deeper inquiry into how OCL can be effectively deployed in the Malaysian matriculation setting:



**Figure 1.3:** Research Gaps in OCL

### Population Gap

- Global OCL studies often focus on tertiary or general secondary contexts, leaving Malaysian matriculation students underexamined (Craig & Kay, 2023; Oyarzun & Martin, 2023). Despite being “digital natives,” these learners are not necessarily equipped to utilize technology for goal-oriented academic collaboration (Cherbonnier et al., 2024).

### **Theoretical Gap**

- While Harasim's (2012) OCL framework stresses knowledge-building, it gives limited guidance on specific technologies (Oyarzun & Martin, 2023). Sociocultural intersections in high-pressure settings also remain understudied (Grothaus, 2022). AT can address such gaps by examining how tools, norms, and roles interact (Yusoff & Zin, 2012), yet AT-based research in the Malaysian matriculation context is limited.

### **Knowledge Gap**

- Although Discord's educational use is gaining attention, existing research predominantly examines user satisfaction or general engagement rather than concrete learning outcomes (Kwiatkowska & Wiśniewska-Nogaj, 2022; Oyarzun & Martin, 2023; Bach & Thiel, 2024). Little is known about how to effectively incorporate Discord's synchronous features (voice chats, screen-sharing) and asynchronous features (text channels) into the high-intensity matriculation curriculum.

### **Practical-Knowledge Gap**

- Despite growing interest in digital tools, there is little actionable guidance for using platforms such as Discord in the accelerated programs. Studies highlight potential advantages but rarely address structuring tasks, coordinating interactions, or assessing outcomes in compressed timeframes (Robinson et al., 2017; Fernandez et al., 2022).

## 1.5 Research Objectives and Questions

Building on the gaps highlighted earlier, this research examines the adaptation of OCL to Malaysian matriculation settings with a particular focus on Discord as a collaborative platform. Informed by an AT perspective, the investigation centres on how specific AT components including Tools, Rules, Division of Labour, and Community shape students' collaborative experiences. The research objectives and questions are presented below:

### Research Objectives

- **RO1:** To explore how Discord's features function as mediating tools that support OCL among Biology matriculation students.
- **RO2:** To examine how synchronous and asynchronous communication rules influence OCL processes on Discord among Biology matriculation students.
- **RO3:** To analyze how group size (large vs. small) influences OCL among Biology matriculation students utilizing Discord.
- **RO4:** To investigate how lecturer–student and student–student interactions within Discord community affect OCL among Biology matriculation students.
- **RO5:** To identify key design principles that can enhance the effectiveness of OCL on Discord for Biology matriculation students.

## **Research Questions**

- **RQ1:** How do Discord's features function as a tool to support OCL among Biology matriculation students?
- **RQ2:** How do synchronous and asynchronous communication rules influence OCL processes on Discord among Biology matriculation students?
- **RQ3:** How does group size, whether large or small, affect the division of labour in OCL among Biology matriculation students who use Discord?
- **RQ4:** What roles do lecturer–student and student–student interactions within Discord community play in affecting OCL among Biology matriculation students?
- **RQ5:** Which design principles can strengthen the effectiveness of OCL on Discord for Biology matriculation students?

## **1.6 Research Motivation**

The researcher's twelve years of teaching experience within Malaysia's matriculation program have provided firsthand insight into the challenges and opportunities of integrating digital tools within a compressed and high-intensity curriculum. This experience highlights the need to understand how digital platforms can effectively support collaborative learning in the specific context of Malaysian matriculation. While tools such as Discord have gained popularity, existing literature seldom addresses the particular demands of accelerated educational environments, leaving educators without clear context-specific guidance. In addition, the researcher's longstanding interest in architecture developed in parallel with a professional background in biology has shaped the conceptual framework of this research. The metaphor of learning architecture offers a structured lens for examining how digital environments shape collaborative learning dynamics. This perspective enables an analysis of how technological resources, communication practices, and role assignments interact to influence student engagement and learning outcomes.

The COVID-19 pandemic further revealed inadequacies in digital integration including insufficient training, limited access to resources, and varying levels of student digital proficiency. The researcher has observed that these issues often led to student isolation, reduced motivation, and communication breakdowns, thereby hindering effective collaborative learning. In light of these complexities, this research aims to explore how Discord affects collaborative engagement and learning outcomes within the Malaysian matriculation context. By addressing both theoretical and practical gaps, this research seeks to provide educators and instructional designers with actionable insights for fostering effective and sustainable digital practices in accelerated academic programs.

## 1.7 Research Scope

This research focuses on a cohort of 30 Biology matriculation students at a matriculation college in Sarawak, observed over a 15-week intervention period. Discord is employed as the primary platform. Grounded in AT, this research explores four key dimensions of OCL:

1. **Tool-Mediated Interactions** examine how Discord features such as text chat, voice channels, screen sharing, and file uploads facilitate both real-time and flexible communication.
2. **Communication Rules** explore how students develop and follow norms for synchronous and asynchronous interactions including participation and coordination.
3. **Division of Labour** investigates how group size influences collaborative outcomes and how roles are distributed within group tasks.
4. **Community Dynamics** Considers how lecturer–student and student-student interactions evolve online and affect collaboration quality.

A purposive sample of 30 participants is selected to capture a diverse range of experiences while allowing sufficient depth for qualitative analysis. Data collection methods include focus group interviews, reflective journals, and online observations. Although the research is limited to a single institution and a specific Biology cohort, the findings may be applicable to other similarly intensive academic programs seeking to integrate digital platforms for enhanced collaborative learning.

## 1.8 Significance of Research

This research contributes meaningfully to four key areas: knowledge, theory, practice, and policy by investigating how OCL can be supported through Discord within the Malaysian matriculation context.

- **Contribution to Knowledge:** This research provides empirical evidence on the use of Discord in facilitating OCL among Biology matriculation students. It also broadens the academic discourse by demonstrating the feasibility of implementing OCL in high-intensity academic environments (Craig & Kay, 2023).
- **Theoretical Advancements:** Through the application of AT, this research examines the interplay of Tools, Rules, Division of Labour, and Community within OCL. It further clarifies the role of technology in supporting social constructivist learning principles (Jonassen & Rohrer-Murphy, 1999; Yusoff & Zin, 2012).
- **Practical Implications:** The findings provide evidence-based recommendations to support the integration of Discord's features into collaborative learning practices particularly for educators, instructional designers, and educational technologists involved in developing communication norms and coordination strategies suited to the demands of accelerated pre-university programs (Lauricella et al., 2024).
- **Policy Recommendations:** The research yields insights for policymakers in designing institutional strategies for curriculum development and technology integration with particular attention to equitable access and sustainable digital collaboration. It also informs decisions on resource allocation, professional development, and policy reforms aimed at strengthening 21st-century learning at both regional and national levels (Butler et al., 2024).

## 1.9 Thesis Organization

This thesis is organized into five chapters:

- **Chapter 1** introduces the background followed by the research problem and its significance. It also presents the research objectives, questions, scope, and motivation, situating the research within the evolving landscape of OCL in the Malaysian matriculation settings.
- **Chapter 2** offers a comprehensive literature review, examining foundational theories such as Harasim's OCL framework and AT. It provides an in-depth discussion of relevant empirical findings, clarifying how these theoretical perspectives and prior studies inform this research.
- **Chapter 3** details the methodology, describing the research design, participant selection, data collection instruments, and analytical procedures. It also addresses the ethical considerations and explains the measures taken to ensure trustworthiness and rigour.
- **Chapter 4** presents the results and analysis, linking the findings to the research objectives and questions. Qualitative data are examined, illustrating patterns, themes, and significant trends.
- **Chapter 5** synthesizes the key findings of the research, proposes design principles for implementing OCL via Discord in matriculation settings, and outlines the theoretical, practical, and policy contributions. It concludes with recommendations for future research to support continued exploration in accelerated pre-university contexts.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Chapter Overview**

This chapter addresses the research gaps identified in Chapter 1 by critically examining the interplay between OCL, AT, and digital learning tools such as Discord within the Malaysian matriculation context. This chapter examines the theoretical and empirical foundations of OCL within the Malaysian matriculation context. Section 2.2 positions OCL within the social constructivist paradigm, with emphasis on shared meaning-making, peer interaction, and scaffolded dialogue. Section 2.3 introduces AT as the primary analytical framework, tracing its development across three generations and demonstrating its relevance to mediated goal-directed learning. Section 2.4 explores four critical dimensions of OCL: technology platforms (Tools), communication modalities (Rules), group size (Division of Labour), and community dynamics (Community), in relation to AT's core constructs. These dimensions highlight the influence of institutional policies, infrastructure, cultural norms, and pedagogical design on collaborative processes. Section 2.5 examines Discord as a platform for OCL. Section 2.6 positions AT as the central theoretical lens for analyzing Discord-mediated collaboration in high-stakes examination conditions. Finally, Section 2.7 recommends a Design-Based Research (DBR) approach to guide the systematic implementation and evaluation of Discord-mediated OCL interventions. Accordingly, the chapter is organised to align the review with RO1–RO5 by examining Discord as a mediating tool (RO1), communication norms as rules (RO2), group size as division of labour (RO3), interaction patterns as community dynamics (RO4), and the AT–DBR logic that supports iterative refinement and design principles (RO5).

## **2.2 Online Collaborative Learning (OCL)**

OCL is broadly defined as a social constructivist approach in which learners co-construct knowledge through online interaction (Harasim, 2012). Dillenbourg (2007) characterizes collaborative learning as the active engagement of two or more individuals working together toward a learning objective, while Roschelle and Teasley (1995) emphasize the coordination required to solve problems collaboratively. Harasim's (2012) OCL model highlights the iterative process of idea generation, organization, and convergence, illustrating how group discourse can lead to the creation of meaningful knowledge artifacts. In this research, OCL is operationally defined as structured Discord-mediated collaborative learning activities in which matriculation Biology students engage in synchronous and asynchronous peer interaction to co-construct examination-oriented knowledge artifacts under lecturer-designed task conditions.

Recent Malaysian and ASEAN higher education research indicates that post-pandemic online collaboration in examination-oriented programmes continues to be shaped by assessment pressure, compressed academic calendars, and infrastructural variability (Abdullah et al., 2025; Hui et al., 2025; Samri & Jumaat, 2024). Studies conducted in Malaysian foundation and pre-university contexts further demonstrate that students benefit from persistent, platform-based discussion spaces that extend beyond scheduled class hours, particularly during preparation for high-stakes assessments (Abdussuykur et al., 2021; Beram et al., 2024). These findings highlight the contextual relevance of examining Discord-mediated OCL within the Malaysian matriculation system, where sustained peer consultation and timely clarification of complex concepts are critical under time-constrained academic conditions. Within this accelerated and examination-driven environment, OCL provides a structured mechanism for harnessing peer collaboration and scaffolding

understanding under pressure, consistent with social constructivist principles (Vygotsky, 1978). Recent Malaysian higher education studies further indicate that structured online collaboration supports examination-oriented learners in managing cognitive load while maintaining peer accountability (Hisham & Salim, 2023; Sari et al., 2024).

Although “cooperative” (Slavin, 2014; Gillies, 2016) and “collaborative” (Vygotsky, 1978; Roschelle & Teasley, 1995) are often used interchangeably in the literature, collaborative learning places greater emphasis on shared accountability, sustained dialogue, and iterative meaning-making (refer Table 2.1) (Ashcraft et al., 2008). In high-pressure academic contexts such as the Malaysian matriculation program, OCL can help ensure that students do not merely divide tasks but actively engage in collaborative knowledge construction. Through the integration of dialogic interaction and scaffolding strategies, educators can promote deeper engagement with content and foster a collaborative learning culture essential for success in accelerated pre-university settings. Recent digital pedagogy studies conducted across Southeast Asian higher education contexts similarly emphasize dialogic scaffolding and culturally responsive facilitation as critical success factors in structured online collaboration (Mariana & Nurjanah, 2023; Musliadi, 2024; Pawan et al., 2023).

**Table 2.1:** Key Differences Between Collaborative and Cooperative Learning

<b>Aspect</b>	<b>Collaborative Learning</b>	<b>Cooperative Learning</b>
<b><i>Structure</i></b>	Unstructured or loosely structured; student-directed	Highly structured; teacher-directed
<b><i>Role Assignment</i></b>	Roles emerge naturally among students	Roles are pre-assigned by the teacher
<b><i>Goal Orientation</i></b>	Focus on shared construction of knowledge	Emphasis on group goals with individual accountability
<b><i>Role of Teacher</i></b>	Facilitator or guide	Organizer and monitor

OCL is grounded in learning theories that view knowledge as socially constructed. Three prominent frameworks are commonly referenced:

- **Social Constructivism** (Vygotsky, 1978) emphasizes that learning occurs through social interaction where learners build on one another's ideas to develop new understandings.
- **Community of Inquiry (CoI) Model** (Garrison et al., 2000) highlights the roles of cognitive, social, and teaching presence in fostering meaningful online learning communities.
- **Connectivism** (Siemens et al., 2019; Peter & Ogunlade, 2024) views learning as an emergent process within dynamic digital networks where participants continuously navigate and contribute to evolving information flows.

While social constructivism provides a strong foundation for understanding learning as a socially mediated process (Vygotsky, 1978), it primarily emphasises interaction at the interpersonal level and offers limited analytical capacity for examining how institutional rules, technological tools, and role structures shape collaborative practices. AT extends this perspective by situating social interaction within a broader activity system, allowing learning to be analysed in relation to mediating artefacts, norms, and division of labour.

CoI model similarly contributes to OCL research by explaining how cognitive, social, and teaching presence support meaningful online learning experiences (Garrison, 2000). However, CoI focuses largely on experiential and instructional conditions rather than on the systemic tensions that arise between technology use, participant roles, and institutional expectations. In contrast, AT explicitly foregrounds contradictions within and

across activity system components, enabling deeper analysis of how such tensions influence collaborative learning processes over time.

Connectivism offers useful insights into learning within digitally networked environments by conceptualising knowledge as distributed across dynamic information networks (Siemens et al., 2019). Nevertheless, its emphasis on open connectivity and individual navigation provides limited guidance for analysing structured collaboration within formal educational settings. AT addresses this limitation by examining how digital platforms such as Discord mediate goal-oriented collective activity within bounded institutional contexts.

While these theories inform OCL design, AT provides a more comprehensive framework for this research by integrating mediation, structure, and contradiction within a single analytical lens. AT (Engeström, 1987) focuses on mediated activity, illustrating how tools like Discord shape collaboration among learners, instructors, and communities. By examining tensions among elements such as subjects, rules, and division of labour, AT reveals how digital platforms can enable or constrain collaborative learning. Its focus on mediation is especially relevant in the Malaysian matriculation context for understanding Discord's role in shaping collaborative outcomes. This makes AT particularly suited for examining and refining Discord-mediated collaborative learning in the Malaysian matriculation context.

Empirical research on OCL employs qualitative, quantitative, and mixed-methods designs in roughly equal measure (Oyarzun & Martin, 2023). Qualitative studies often use content analysis or interviews to examine how learners negotiate meaning and manage tasks, while quantitative approaches assess intervention outcomes through grades, test scores, or self-reported measures such as engagement and motivation. Mixed-methods designs

combine both to capture collaboration processes and learning outcomes. Recent studies commonly draw data from discussion boards, chat logs, wikis, and learning analytics, supplemented by interviews or surveys (Chatterjee & Correia, 2020). Systematic and meta-analytical reviews indicate a growing integration of learning analytics, AI-supported facilitation tools, and adaptive scaffolding mechanisms within collaborative learning research, particularly in technology-mediated environments (Maruf & Islam, 2025; Wang et al., 2024).

In Southeast Asian higher education contexts, including Malaysia, comparable methodological approaches have been adopted, with researchers utilizing platform-generated interaction logs, survey instruments, and reflective data to triangulate collaborative engagement and participation patterns (Loh, 2025; Roslan et al., 2026). This methodological integration enables a deeper understanding of not only what was learned, but how collaborative processes unfolded within specific learning contexts. Within design-oriented OCL research, particularly in DBR studies, iterative cycles of implementation and refinement are central to examining how collaborative interventions evolve over time. This approach supports collaborative intervention development and is well suited for investigating the evolving dynamics of online learning in authentic educational settings.

Digital platforms are central to OCL, but it is the pedagogical integration of technology that truly drives collaborative knowledge building (Oyarzun & Martin, 2023).

Commonly used categories include:

- **Learning Management Systems (LMS):** Moodle, Canvas, or Blackboard platforms offer structured environments for asynchronous forums, file sharing, and assessment tracking.
- **Collaborative Document Editing:** Google Docs or Microsoft 365 tools enable real-time co-authoring and brainstorming, supporting collaborative idea refinement.
- **Video Conferencing:** Zoom and Microsoft Teams applications allow synchronous group discussions, promoting immediate feedback and social presence.
- **Social Media and Cloud-based Tools:** WhatsApp, Padlet, or Jamboard often extend collaborative conversations beyond formal course spaces.

Originally developed for gaming communities, Discord has gained recognition as a flexible and accessible communication platform with growing relevance in educational contexts (Arifianto & Izzudin, 2021a; Dayana et al., 2021; Ayob et al., 2022). Recent Malaysian studies report increased adoption of Discord in blended and higher education settings to support peer mentoring, revision forums, and informal academic communities (Ismail et al., 2025; Mahdzir et al., 2023). It combines synchronous (voice channels, live chat) and asynchronous (text channels, pinned messages) features, providing informal yet rich interaction. Within the AT framework, Discord can serve as a mediating tool that shapes lecturer-student and student-student interactions. Its user-friendly interface, familiarity among younger student generations, and community-building functionalities offer compelling affordances. However, effective pedagogical design is crucial to optimize Discord's potential for Malaysian matriculation learners.

When thoughtfully implemented, OCL enhances learner engagement and social presence by fostering active participation, mutual support, and a sense of belonging, particularly valuable in matriculation program settings where peer interaction reduces isolation and sustains motivation (Ozkara & Cakir, 2020; Gaad, 2022). It facilitates collaborative knowledge-building through iterative discussions and co-construction of ideas, promoting deeper conceptual understanding and critical thinking (de Nooijer et al., 2021). Additionally, OCL supports peer assistance by enabling flexible, “anytime, anywhere” collaboration. Rooted in social constructivist theory, OCL draws upon collaborative intelligence, allowing students to combine their strengths and address complex academic challenges more effectively than when working individually.

Despite its advantages, OCL poses several challenges that can hinder its effectiveness. Technical and infrastructure limitations such as unstable internet connections and inadequate devices remain significant barriers in some Malaysian regions (Govindan & Hussin, 2024; Nohuddin et al., 2025). Effective OCL also requires consistent facilitation and instructor presence. Without timely support and feedback, learners may experience confusion, off-topic interactions, or unequal participation (Sharma et al., 2024). Furthermore, students in matriculation programs often face difficulty coordinating group work due to intense academic schedules and exam preparation pressures (Roychowdhury et al., 2020; Donelan & Kear, 2024). Lastly, gaps in digital literacy and cognitive overload which result from managing complex and text-heavy discussions across multiple digital tools can contribute to student disengagement and reduced motivation (Bayne & Inan, 2024).

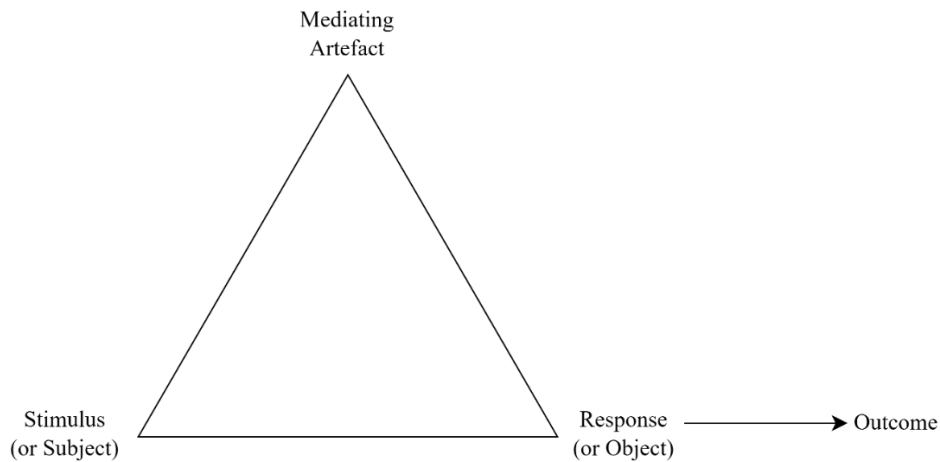
In this research, using AT as an analytical lens highlights how these issues can manifest as tensions among Subjects (students), Tools (Discord), Community (classmates and lecturers), and the broader Rules or institutional demands of the matriculation system. Recognizing and addressing these contradictions remains crucial for successful OCL implementation. Collectively, prior OCL scholarship establishes that collaborative learning quality depends less on “being online” and more on how interaction is structured, how participation is supported, and how tools and norms shape discourse in context. For Malaysian matriculation students operating within compressed semesters and exam-focused pressures, OCL must therefore be designed to sustain purposeful dialogue, shared accountability, and scaffolded knowledge construction. These insights directly inform RO1–RO4 by clarifying (i) what “effective collaboration” should look like in Discord-mediated activity (tool use, communication norms, group organisation, and community participation) and (ii) which constraints (time pressure, facilitation needs, and digital inequities) must be addressed through design decisions. They also establish the rationale for using AT as a systemic lens to examine how collaboration is enabled or constrained in the present setting.

### **2.3 Activity Theory (AT)**

AT serves as the primary theoretical lens for this research, offering a holistic framework to analyze how learners, tools, and institutional structures interact in goal-directed activities. Originating from Soviet psychology, AT has evolved through three generations that increasingly highlight the social and systemic nature of human cognition. In the Malaysian matriculation context where digital platforms such as Discord mediate collaborative learning, the emphasis within AT on contradictions and expansive learning offers valuable insights into understanding and addressing emerging tensions.

Recent Malaysian and Southeast Asian digital learning studies have increasingly drawn upon activity-system perspectives to analyse tensions between institutional LMS policies, informal communication platforms, assessment pressures, and learner participation norms (Diem et al., 2025; Mohamad et al., 2024). These studies demonstrate that AT is not only theoretically robust but also empirically applicable within post-pandemic regional higher education contexts, thereby strengthening its relevance for examining Discord-mediated OCL in the Malaysian matriculation programmes.

## First Generation: Vygotsky and Cultural Mediation



**Figure 2.1:** First Generation of AT

The first generation of AT traces back to Lev Vygotsky (1978), who argued that human cognition is fundamentally shaped by socio-cultural tools and signs. Rather than viewing learning as a direct response to external stimuli, Vygotsky emphasized cultural mediation as central to higher mental functions. Figure 2.1 typically depicts a triangular relationship among the Subject, Object, and Mediating Artifacts, illustrating how cultural tools including language mediate human activity. Within the present study, this mediational triangle provides the foundational logic for conceptualising Discord not merely as a communication platform but as a cultural tool that shapes how Biology matriculation students interpret examination tasks, construct shared meanings, and negotiate understanding under time-constrained academic conditions.

## Second Generation: Leontiev and Collective Activity

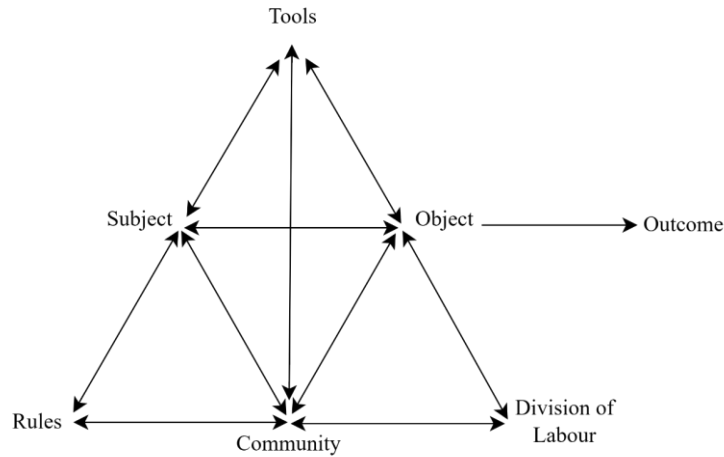
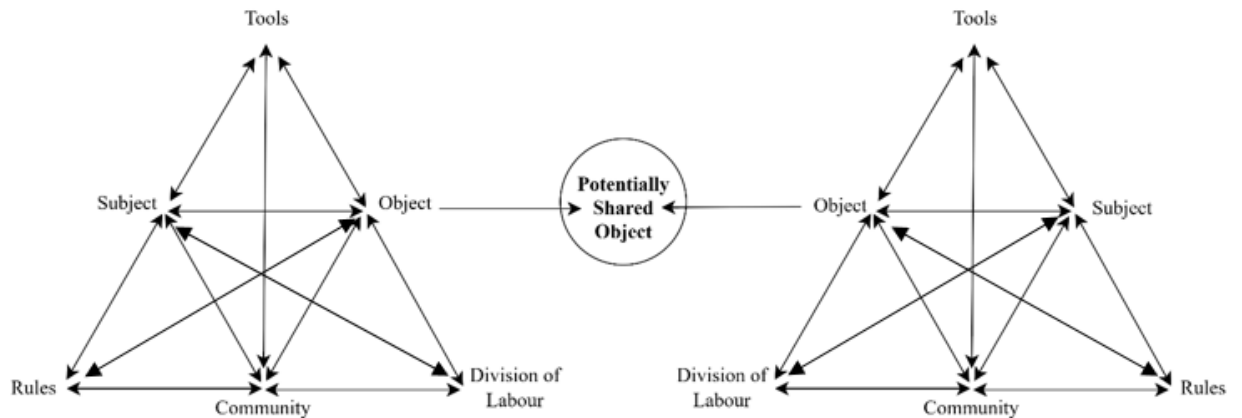


Figure 2.2 Second Generation of AT

Building on Vygotsky's ideas, Leontiev introduced a focus on collective and object-oriented activity (Cong-Lem, 2022). His hierarchical framework includes *activities* (driven by shared motives), *actions* (goal-directed tasks), and *operations* (routine behaviours shaped by context). Figure 2.2 expands the original triangle by incorporating Rules, Community, and Division of Labour, revealing how broader social structures shape and are shaped by individual and group actions. This expanded model is particularly relevant in the Malaysian matriculation setting, where institutional assessment rules, lecturer expectations, peer norms, and group task structures systematically influence how collaborative learning unfolds. By incorporating Rules, Community, and Division of Labour, second-generation AT allows the present study to examine how exam-oriented goals are collectively pursued within structured yet digitally mediated learning environments.

### Third Generation: Engeström and Systemic Contradictions



**Figure 2.3:** Third Generation of AT

Engeström (1987) extended AT by introducing third-generation AT to analyze multiple interacting activity systems (refer Table 2.2). As illustrated in Figure 2.3, this model emphasizes how two or more activity triangles can interact through partially shared objects, highlighting key concepts such as boundary crossing, networked learning, and inter-organizational activity systems (Engeström, 1987, 2001). A major aim of this development is to explain collective learning across systems including those in educational, health, or industrial contexts. Engeström also introduced the concept of contradictions which are historically accumulated tensions that can drive innovation or conflict. When participants confront these contradictions, they may engage in expansive learning and collaboratively generate new practices, tools, or understandings (Engeström, 2000). In educational settings, these insights are especially relevant for analyzing how digital platforms intersect with institutional norms and learner behaviours. In the Malaysian matriculation context, interacting activity systems may include (i) the formal institutional system governed by official LMS policies and assessment regulations, (ii) the lecturer-facilitated instructional system, (iii) the student peer-learning system mediated through Discord, and (iv) students'

home or socio-technical environments shaped by connectivity and device access. The interaction among these systems creates boundary tensions that can only be fully examined through a third-generation AT lens.

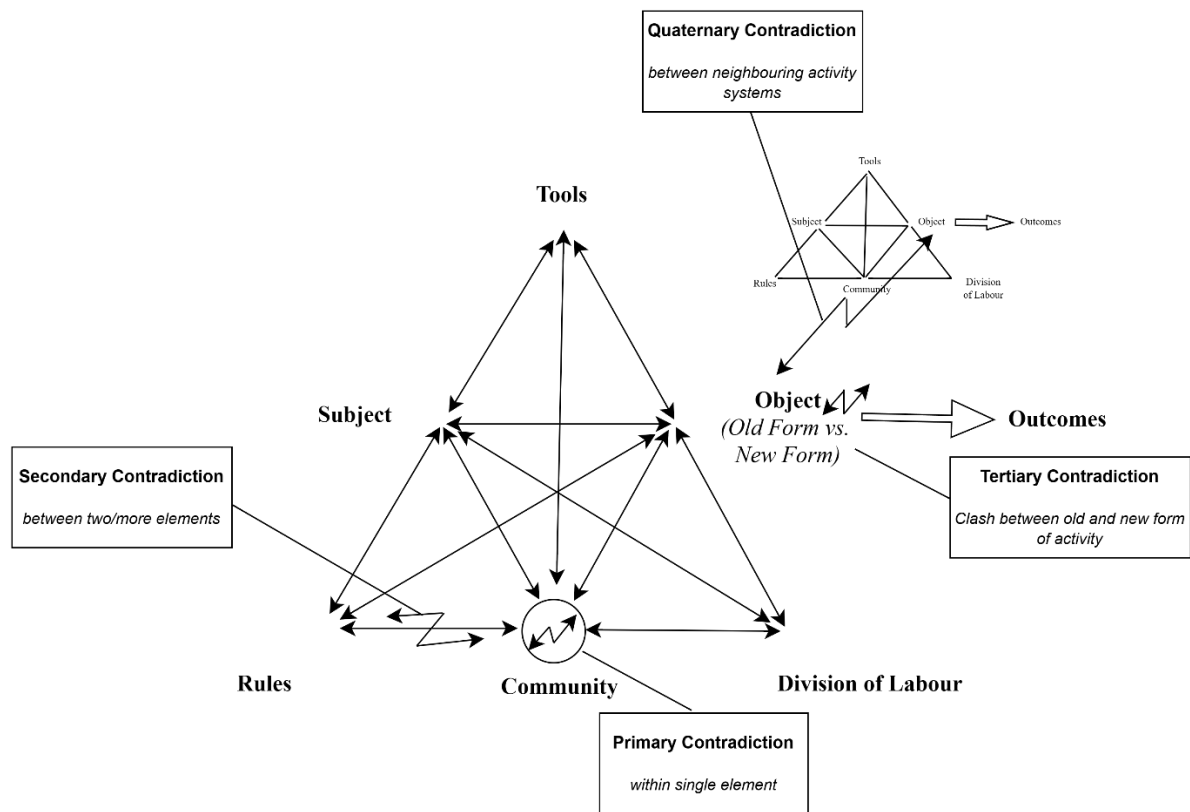
**Table 2.2:** Evolution of Engeström’s AT Framework

<b>Year</b>	<b>Contribution</b>	<b>Focus Area</b>	<b>Model Type</b>
<b>1987</b>	Introduced Expanded Activity Model	Theory building	First-generation (expanded Vygotsky)
<b>2000</b>	Applied theory to workplace innovation (DWR)	Applied methodology	Second-generation (with contradictions)
<b>2001</b>	Networked activity systems across boundaries	Multi-activity systems	Third-generation (co-configuration, interaction)

The foundational concepts and guiding principles of AT provide the analytical framework for this research. These principles offer a comprehensive lens through which to examine how human activity is mediated, object-oriented, and shaped by systemic tensions. Three key concepts: mediation, object oriented, and contradictions, underpin the application of AT in this research.

1. **Mediation:** Central to AT is the principle that human thought and behavior are mediated by cultural artifacts (Vygotsky, 1978). In this research, Discord functions as a mediating tool, structuring how students communicate, organize tasks, and interpret learning content. Features such as voice channels and text threads provide synchronous and asynchronous modes of interaction but also introduce constraints that can influence collaborative outcomes.

2. **Object-Oriented:** AT posits that human activity is organized around a shared object which represents the core problem or task that mobilizes collective effort (Engeström, 1987). In the Malaysian matriculation context, collaborative group projects often serve as the object, uniting learners around common goals. More specifically, in the present study the object is defined as the co-construction of examination-oriented knowledge artefacts such as structured revision summaries, clarified problem-solving procedures, and concept explanations aligned with high-stakes Biology assessments. Through Discord, these goals become focal points for coordinated efforts: students negotiate assignment requirements, share resources, and refine strategies, thus continuously shaping and reshaping the collective object.
3. **Contradictions and Expansive Learning:** Engeström (2000) conceptualizes contradictions as historically accumulated structural tensions that can disturb but also drive transformation within activity systems. He identifies four types of contradictions (see Figure 2.4) that help explain how systemic change may emerge: *Primary contradictions* occur within a single element of the activity system. *Secondary contradictions* arise between two or more elements within the same activity system. *Tertiary contradictions* emerge during the introduction of a more advanced form of activity into an existing system. *Quaternary contradictions* occur between neighbouring activity systems, revealing tensions at the interface of different institutional or social contexts.



**Figure 2.4:** Four types of Contradictions

Rather than viewing contradictions as problems to be eliminated, Engeström (2000) argues that they function as catalysts for expansive learning. This is a process in which participants collaboratively question existing practices, reconceptualize the object of activity, and design new models of work or learning. In the context of Malaysian matriculation program, addressing these contradictions may lead to pedagogical innovation, improved digital integration, and more responsive educational practices that align with both institutional goals and learner needs.

In the present research, potential contradictions anticipated within Discord-mediated OCL include: (i) tensions between Discord’s informal communication norms and the seriousness of exam-focused academic goals (primary contradiction within Tools), (ii) misalignment between institutional LMS policies and student preference for flexible

platforms (secondary contradiction between Tools and Rules), (iii) introduction of structured OCL practices into previously teacher-centred classroom cultures (tertiary contradiction), and (iv) tensions between students' home connectivity conditions and institutional expectations for synchronous participation (quaternary contradiction across interacting systems). These anticipated contradictions provide concrete analytic entry points for the empirical investigation.

A growing body of research applies AT to investigate OCL across diverse educational contexts, revealing how systematic analysis of components such as Tools, Rules, Community, and Division of Labour can illuminate both facilitators and barriers to collaboration. Studies indicate that merely providing digital platforms is insufficient for deep engagement. Instead, alignment between tools and clearly structured tasks is essential to achieving meaningful learning outcomes (Yusoff & Zin, 2012; Said et al., 2014). More recent regional studies similarly highlight that contradictions between institutional expectations and platform affordances frequently shape collaborative outcomes in Southeast Asian higher education settings (Diem et al., 2025; Mohamad et al., 2024). Clear role assignments foster balanced participation and strengthen community. Moreover, research shows that contradictions such as unequal digital skills among students or clashes between traditional teaching and online collaboration can block effective teamwork if not properly addressed (Pullenayegem et al., 2021). However, these tensions often serve as catalysts for innovation and prompting adaptive strategies in learning. Collectively, these findings highlight the analytical value of AT in examining the dynamic interplay between pedagogical objectives, technological affordances, and institutional constraints.

Within the context of Malaysian matriculation programs, AT offers a valuable lens for identifying and addressing persistent challenges such as examination-related stress, bandwidth limitations, and inflexible policy structures. By applying AT, educators can develop more effective and contextually responsive OCL practices through platforms such as Discord.

AT presents several strengths that establish it as a comprehensive analytical framework for examining OCL. It provides a holistic perspective that captures the dynamic interplay between individual cognition, social context, and cultural tools, making it particularly relevant in digital learning environments (Engeström, 2000). Its emphasis on context sensitivity allows researchers to analyse how historical, institutional, and cultural elements such as rules, language, and time constraints influence collaborative processes. A key contribution of AT lies in its focus on identifying contradictions within or between elements of the activity system. For example, misalignments between tools and objectives or imbalances in role distribution can reveal underlying tensions that affect the learning experience. Once surfaced, these contradictions often serve as catalysts for expansive learning and ongoing improvements in pedagogical practices and institutional arrangements.

However, third-generation AT has also drawn critique, particularly for its complexity in operationalising multiple interacting activity systems (Engeström, 2009; Foot, 2014). As the analytical scope broadens to include boundary crossing and multiple perspectives, scholars have noted that determining which systems or components to prioritise can present methodological challenges (Miettinen, 1999). In OCL contexts, AT may not fully capture the detailed ways in which institutional power dynamics, cultural diversity, and hierarchical roles shape participation, voice, and decision-making (Kaptelinin & Nardi, 2006; Fenwick, 2010). Although Engeström (1987) identifies contradictions as a key mechanism for

understanding systemic transformation, some argue that AT does not adequately address how power imbalances can prevent certain individuals from being heard or can maintain existing inequalities (Daniels, 2008).

Another limitation of third-generation AT lies in its focus on collective activity which may overlook individual agency, identity development, and varied motivations (Holland & Lave, 2019). This is particularly relevant in digital environments such as Discord where learners often navigate academic tasks, personal goals, and social interactions simultaneously. In such contexts, the collective orientation of AT may not adequately reflect how individual experiences intersect with or diverge from group objectives (Miettinen, 1999). For Malaysian matriculation students, the pressure to succeed in high-stakes examinations coexists with their engagement in digitally mediated learning communities. This duality may not be fully captured if the analysis is limited to shared tasks without attention to learners' personal trajectories and contextual constraints.

These critiques carry important implications for this research. Analysing Discord-mediated OCL through the lens of AT requires attention to the methodological challenges involved in representing multiple activity systems and amplifying individual voices. Power relations shaped by institutional hierarchies and lecturer-student dynamics may also be underrepresented in standard AT diagrams. In addition, the linguistic and cultural diversity among Malaysian matriculation students complicates the notion of multi-voicedness, making it difficult to fully trace how different perspectives influence collaborative interaction. While AT remains a valuable framework for identifying contradictions and opportunities for expansive learning, these limitations call for cautious interpretation. To address these concerns, the present study integrates multiple qualitative data sources within

a DBR framework to surface diverse perspectives and capture boundary tensions across interacting activity systems.

AT offers a strong lens for understanding how learners, educators, and digital tools shape collaborative learning processes. Its focus on systemic contradictions and mediating artefacts is well suited for investigating platforms such as Discord in high-pressure and exam-oriented educational contexts. However, it is important to remain critically aware of AT's complexity, its focus on collective activity over individual agency, and its limitations in addressing power relations. Despite these challenges, the strengths of AT make it a suitable framework for this research. Its capacity to illuminate the layered and evolving nature of collaborative learning environments supports an in-depth exploration of how digital tools mediate interaction, engagement, and group dynamics in the Malaysian matriculation setting. Addressing these limitations enhances the theoretical depth of the research and strengthens the credibility of its findings by enabling a more comprehensive and contextually sensitive interpretation of digital collaboration.

The reviewed AT literature supports an activity-system perspective for explaining how Discord-mediated collaboration emerges through the interaction of Tools, Rules, Community, and Division of Labour rather than individual learner factors alone. In this study, AT is used to identify contradictions in exam-driven matriculation learning and to analyse how these tensions shape adaptation and improvement over time. This framing informs RO1–RO4 by defining the analytical categories for examining tool use, communication norms, group structure, and interaction patterns, and informs RO5 by guiding the translation of contradiction-driven insights into context-responsive design principles.

## 2.4 Dimensions Influencing OCL

This section examines four key dimensions shaping OCL through the lens of AT: Technology Platforms (Tools), Communication Modalities (Rules), Group Size (Division of Labour), and Community Dynamics (Community), as shown in Table 2.3. Each dimension represents a significant strand of educational technology research and corresponds to specific AT components (Engeström, 2000). Beyond pedagogical effectiveness, these dimensions raise important issues of equity and digital inclusion. Differences in device access, internet stability, digital literacy, and home learning conditions influence how OCL is experienced, particularly in resource-variable contexts such as Malaysian matriculation colleges.

**Table 2.3:** Four Dimensions of OCL and AT Components

<b>Dimension</b>	<b>Description</b>	<b>Corresponding AT Component</b>
<b>Technology Platforms</b>	Digital tools supporting interaction and collaboration	Tools / Mediating Artifacts
<b>Communication Modalities</b>	Modalities of interaction (synchronous or asynchronous)	Rules
<b>Group Size</b>	Number of learners in each collaborative group	Division of Labour
<b>Community Dynamics</b>	Social roles, cohesion, and engagement within the group	Community

In the Malaysian matriculation context, these dimensions are particularly significant. A context-sensitive understanding of each is essential for designing and implementing a Discord-mediated OCL intervention that fosters meaningful collaboration and equitable participation. Recent Malaysian digital pedagogy research further underscores the importance of aligning platform selection, communication design, and facilitation strategies with exam-oriented curricular structures (Abdullah et al., 2025; Hui et al., 2025; Ramli et al., 2024).

### **2.4.1 Tool-related: Technology Platforms as Mediating Artifacts**

From an AT standpoint, Tools are the mediating artifacts that connect learners (subjects) to their shared goals or tasks (objects). In OCL contexts, these tools often take the form of technology platforms (e.g. LMSs, collaborative document editors, social platforms) that significantly influence how students interact, communicate, and construct knowledge (Engeström, 2000). Recent studies highlight that platforms such as Moodle or Blackboard remain foundational in many institutions due to their structured layouts and integrated assessment features (Oyarzun & Martin, 2023). However, a parallel trend highlights the rise of flexible and community-driven environments such as Discord or Microsoft Teams which integrate both synchronous and asynchronous affordances (Altowairiki, 2021; Hackett et al., 2024). Within Malaysian higher and pre-university contexts, recent studies report increased experimentation with blended platform ecosystems combining institutional LMS with informal communication tools to support revision, peer mentoring, and collaborative problem-solving (Ismail et al., 2025; Samri & Jumaat, 2024).

Research contrasting LMS with more social or open-ended platforms often reveals how different affordances align or clash with pedagogical goals (Gaad, 2022; Lauricella et al., 2024). LMS platforms typically provide comprehensive tracking and assessment tools but they may be less effective for real-time collaboration or informal peer support (Oyarzun & Martin, 2023). In contrast, Discord is designed to prioritise immediacy, facilitate community building, and support continuous interaction (Lauricella et al., 2024). While such openness can facilitate rich social constructivist activities, it may also create tensions when institutional requirements such as centralized grading or formal data archiving are not well supported by Discord's interface.

Tool choices in OCL are not merely about functionality but also about how platforms shape learning activities and reconfigure social relations. For instance, synchronous chat and voice channels can lower communication barriers and enhance student engagement. However, they also require stable internet connectivity (Gaad, 2022) which can cause problems in regions with poor network infrastructure such as parts of Malaysia. Empirical findings from Malaysian institutions indicate that connectivity variability across different regions continues to influence platform reliability and participation patterns (Abuhassna et al., 2023; Ahmed et al., 2025). Additionally, students who perceive Discord as “informal” may underutilize its academic affordances (Hackett et al., 2024). From AT perspective, these tensions highlight how tools can simultaneously facilitate and hinder learning activity, depending on broader institutional policies, learner expectations, and infrastructural conditions (Engeström, 2000).

From an equity perspective, access to technology platforms is unevenly distributed among learners. Students from rural areas or lower socioeconomic backgrounds may experience limited access to high-speed internet, shared devices, or suitable learning spaces, which can constrain their participation in technology-mediated collaboration (Buzy et al., 2024). Similar concerns have been documented in Malaysian digital inclusion studies, where disparities in bandwidth stability and device ownership continue to shape participation in synchronous online learning (Alias et al., 2024; Zainudin et al., 2025). Platforms such as Discord, which operate effectively on low bandwidth and mobile devices, may partially mitigate these disparities. However, reliance on third-party platforms without institutional support can also reproduce inequities if technical guidance, data subsidies, or accessibility features are insufficiently provided. Within AT, such disparities constitute structural

contradictions between Tools and Subjects, highlighting the need for institutional mediation to ensure inclusive participation (Engeström, 2000).

In the Malaysian matriculation contexts, platform selection is critical due to the exam-focused environment and compressed academic timelines (Said et al., 2014). Discord's customizable server setup and persistent text channels support efficient peer consultations and structured group discussions which are especially beneficial for intensive revision and project-based tasks. However, the use of third-party tools such as Discord may conflict with institutional requirements to rely on official LMS, leading to contradictions within the activity system (Engeström, 2000). To enhance Discord's mediating role, instructors and administrators should provide clear guidelines, technical support, and frame its relevance for exam preparation. This alignment can bridge the gap between students' collaborative learning needs and institutional requirements.

Prior research indicates that platform selection is pedagogically consequential because tools shape interaction patterns, visibility of contributions, and the flow of collaborative work. For this research, these findings justify examining Discord specifically as a mediating artifact that may enable sustained peer support and structured revision while also generating tensions (e.g., informality, notification reliability, and institutional platform expectations). This directly informs RO1 by guiding the analysis of how Discord's features function as a "Tool" to support (or constrain) collaborative learning, and it also frames equity-related constraints (device access and internet stability) as structural conditions that influence tool effectiveness in the Malaysian matriculation context.

## **2.4.2 Rules-related: Synchronous and Asynchronous Modes in OCL**

Within AT, Rules encompass the implicit and explicit norms governing how individuals participate in an activity system (Engeström, 2000). In OCL, these Rules often take the form of communication protocols which dictate the timing, structure, and expectations of learner interactions. The two dominant modalities in OCL, synchronous and asynchronous, each offer distinct advantages, limitations, and cultural implications (Mansour, 2024).

Real-time platforms including Zoom, Teams, or Discord's voice/video channels can foster immediacy and high social presence. Meta-analytic findings suggest that synchronous sessions often generate stronger engagement and quicker resolution of misunderstandings (Martin et al., 2021; Lukasje et al., 2024). However, the benefits of live interaction also depend on stable connectivity and the ability to coordinate synchronous scheduling. In exam-driven Malaysian contexts, this can lead to Rule-related contradictions such as rigid timetables might clash with students' home or work commitments, while weaker internet infrastructure can disrupt live collaboration (Buzy et al., 2024; Zainudin et al., 2025). Educators often respond by limiting synchronous interactions to essential milestones or by offering recorded sessions, thereby accommodating diverse student schedules and technical constraints (Lukasje et al., 2024).

Equity considerations are also embedded in communication rules governing synchronous and asynchronous participation. Students with unstable connectivity, caregiving responsibilities, or employment commitments may be disadvantaged by rigid expectations for real-time attendance. Asynchronous modalities can promote more inclusive participation by allowing learners to engage at flexible times and at their own pace, particularly for students from linguistically diverse or resource-limited backgrounds

(Mansour, 2024). From an AT perspective, inclusive rule design can reduce contradictions between institutional expectations and learners' lived conditions, thereby supporting more equitable engagement in OCL.

Asynchronous channels such as discussion forums, wikis, and text channels provide flexibility and encourage reflective depth in learner engagement (McCarron et al., 2021). Learners can revisit posts, reflect on peers' ideas, and compose thoughtful responses which is especially beneficial for second-language learners or those who require additional processing time (Mansour, 2024). In multilingual Malaysian classrooms, asynchronous text interaction has been shown to reduce participation anxiety and support more deliberate academic expression (Madzlan, 2023). Nonetheless, asynchronous communication can lead to fragmented discussions, delayed feedback, and reduced motivation if clear participation guidelines such as response timelines and post-length requirements are not established (Oyarzun & Martin, 2023). In the Malaysian matriculation context, unclear rules can disrupt collaborative knowledge building. Implementing structured discussion prompts, rotating moderators, and setting explicit deadlines can address these challenges while preserving the flexibility offered by asynchronous tools (Chowdhury, 2021).

Current scholarship increasingly supports blended strategies that combine synchronous "kick-off" sessions with asynchronous follow-ups to balance immediacy and reflection (Gogus, 2023; Mansour, 2024). Regional digital pedagogy research similarly highlights the importance of culturally responsive rule negotiation in Southeast Asian classrooms, where respect for hierarchy and face-saving norms influence turn-taking and critique patterns (Ishfaq et al., 2025). In culturally diverse contexts such as those common in Southeast Asia, clearly negotiated communication rules including turn-taking norms, respectful language, and camera preferences are crucial for maintaining group harmony

(Ong & Quek, 2023). When these cultural and institutional expectations are neglected, contradictions may emerge as traditional pedagogical norms come into conflict with new online practices (Engeström, 2000).

The reviewed evidence suggests that communication modality is not a neutral choice: synchronous interaction can enhance immediacy and social presence, while asynchronous interaction supports flexibility, reflection, and inclusion especially under uneven connectivity and competing commitments. In the present research, these insights shape the examination of how communication expectations are established, negotiated, and enacted within Discord, and how misalignments (e.g., required real-time participation vs. unstable internet or schedule constraints) generate rule-related contradictions. This directly informs RO2 by specifying what will be analysed about communication norms and participation expectations, and how these norms influence collaborative outcomes for matriculation learners.

### **2.4.3 Division of Labour-related: Large vs. Small Group Size**

Division of Labour in AT refers to how tasks, responsibilities, and decision-making are distributed among participants (Engeström, 2000). In OCL, a major determinant of effective division of labour is group size as it influences cognitive load, communication flow, and the range of expertise within the group (Kalaian et al., 2018; Saqr et al., 2019).

Larger groups can draw on diverse perspectives, enriching discussions, and fostering creativity (Mei et al., 2024). Research in higher education settings shows that diverse teams often produce stronger solutions as varied academic backgrounds promote collaboration and more comprehensive problem-solving (Al Mulhim & Eldokhny, 2020). However, as group size increases, coordination becomes more complex. Common issues include unequal participation, lack of accountability, and the exclusion of quieter members (Wang et al., 2023). In the Malaysian matriculation courses which are characterised by tight curricula and intensive assessments, large group tasks may intensify role confusion and uneven participation, leading to contradictions within the activity system (Engeström, 2000). These challenges can be addressed on Discord by assigning sub-channels for smaller task forces and clearly defining roles such as note-taker and discussion leader (Hackett et al., 2024).

Smaller groups typically consisting of three to six members tend to demonstrate stronger cohesion, clearer visibility of individual contributions, and more equitable workload distribution (Kalaian et al., 2018; Saqr et al., 2019). This structure often reduces social loafing and encourages closer interpersonal connections. However, limited group size can restrict the diversity of perspectives and excessive dependence on a single “expert” may weaken collective problem-solving (Al Mulhim & Eldokhny, 2020). Malaysian blended learning research further suggests that clearly defined shared group roles can improve participation equity commonly observed in collaborative classroom settings (Mukhtar et al.,

2025). A well-managed small group can respond swiftly to emerging needs such as clarifying complex content or facilitating peer tutoring. From an AT perspective, the key challenge is to maintain alignment with the learning objective such as exam readiness or conceptual mastery while ensuring tasks are distributed in a way that maximises each member's strengths without overloading any one individual (Engeström, 2000).

In Malaysian and broader Southeast Asian collaborative learning settings, group size interacts closely with culturally shaped participation norms. Empirical studies indicate that larger groups in authority-sensitive classrooms may intensify passive participation patterns, with students deferring to perceived high-achievers or waiting for lecturer validation before contributing (Gill et al., 2025; Kamarudin et al., 2023). Conversely, smaller groups with clearly rotated roles have been shown to increase accountability and reduce participation anxiety in Malaysian blended learning environments (Nazir et al., 2023). Within matriculation programmes characterised by high academic pressure, careful calibration of group size therefore becomes not only a logistical concern but a culturally responsive design decision that mitigates participation-related contradictions within the Division of Labour component.

Recent literature highlights hybrid group designs that combine the diverse perspectives of larger cohorts with the accountability and cohesion of smaller teams (Mei et al., 2024). For example, an entire class might begin by brainstorming in a shared Discord channel, followed by smaller sub-groups that refine or implement the proposed ideas. Rotating roles within these sub-groups can reduce hierarchical imbalances and address contradictions that arise when certain members dominate discussions (Wang et al., 2023). These designs align with AT's concept of expansive learning where group structures are

iteratively reconfigured to resolve tensions and support more effective collaboration (Engeström, 2000).

The literature demonstrates that group size affects coordination costs, accountability, and the likelihood of unequal participation, all of which become more pronounced in high-pressure academic contexts. For this research, these findings justify analysing group size as a practical lever that reshapes Division of Labour on Discord (role clarity, task allocation, leadership emergence, and participation balance). This directly informs RO3 by clarifying the indicators used to examine how large versus small group structures influence collaborative functioning and by framing participation imbalance as a systemic tension that can be addressed through design decisions.

#### **2.4.4 Community-related: Student and Lecturer Interactions**

The Community component in AT represents the broader social and cultural context in which learning occurs (Engeström, 2000). In OCL, interactions among students and between students and lecturers form the foundation of this community, shaping motivation, learner identity, and shared norms (Garrison et al., 2000; Miao & Ma, 2022). Effective peer collaboration can strengthen critical thinking, communication skills, and mutual support (Harasim, 2012). When students experience a high level of social presence reflected in timely feedback and genuine engagement, they are more likely to participate actively and stay engaged during challenges (Miao & Ma, 2022). However, when dominant voices or cultural norms discourage open disagreement, they can create a false sense of agreement, allowing underlying issues to remain unresolved (Han & Ellis, 2021). Recent Malaysian OCL studies indicate that structured facilitation and clear discussion guidelines are important for reducing passive participation often observed in teacher-centred classroom settings (Ishak et al., 2024; Yin et al., 2025). In Malaysian and other Southeast Asian contexts, face-saving practices and respect for authority can sometimes restrict open peer critique and limit the depth of discussion (Ong & Quek, 2023). Discord-based discussion channels can help overcome these limitations if they are deliberately structured to promote constructive dialogue such as by setting clear communication guidelines and rotating peer facilitators (Salehudin et al., 2023).

Lecturers play a vital role in guiding the online learning community by scaffolding discussions, providing formative feedback, and managing group dynamics (Garrison et al., 2000). Timely instructor interventions can prevent a lack of progress in asynchronous threads and reduce confusion during real-time voice interactions (Han & Ellis, 2021). In Malaysian pre-university contexts, lecturer clarification provided early on exam-related

content has been shown to significantly improve student confidence and continued participation (Tuan et al., 2023). In contrast, weak instructor presence may lead to disorganized discussions, loss of momentum, and increased dropout rates (Xie et al., 2022). On Discord, lecturer facilitation typically includes posting strategic prompts, summarizing key points, and addressing interpersonal issues. These actions reflect the mediator role in AT which involves resolving contradictions and maintaining learner focus on the intended learning goal (Engeström, 2000). For Malaysian matriculation students, prompt feedback on exam-related questions can be especially motivating, supporting both academic performance and socio-emotional engagement.

Cultural values such as a group-oriented culture and respect for hierarchy can influence how learners interact, affecting turn-taking in voice channels, the expression of disagreement, and help-seeking behaviours (Ong & Quek, 2023). For example, a contradiction may occur when instructors expect active debate but students remain silent out of respect for authority (Han & Ellis, 2021). Addressing such tensions often requires clear guidance on how to engage in respectful yet critical dialogue along with consistent modelling of open and inclusive interaction (Miao & Ma, 2022). These culturally embedded dynamics highlight that community in AT is not simply a background element. It actively shapes the exchange of information, the exercise of authority, and the development of norms in OCL.

Prior studies highlight that collaboration quality depends on community dynamics, including peer norms, psychological safety, and instructor presence. In culturally shaped contexts where learners may hesitate to disagree openly or challenge authority, community design and facilitation become essential. In the present research, these insights guide the analysis of how Discord supports (or limits) peer interaction and lecturer facilitation practices, and how culturally situated participation patterns influence collaborative depth.

This directly informs RO4 by defining what will be examined about student–student and lecturer–student interactions within the Discord community, including how community norms and facilitation practices shape engagement and collaborative outcomes.

These four dimensions include Technology Platforms (Tools), Communication Modalities (Rules), Group Size (Division of Labour), and Community Dynamics (Community). Together, they form a clear framework for designing and understanding OCL, especially in fast-paced academic settings like Malaysian matriculation. Guided by AT, this approach helps identify system-wide issues, cultural norms, and opportunities to improve learning by aligning technology, teaching methods, and institutional goals (Engeström, 2000). When used effectively, Discord’s mix of real-time and delayed communication, clear guidelines, structured groups, and efforts to build community can enhance learner interaction and shared knowledge-building (Vygotsky, 1978; Dillenbourg, 2007). This integrated approach shapes the current research and guides how Discord-based collaboration is studied and improved for the Malaysian matriculation setting.

The four dimensions reviewed in this section provide the organising framework for analysing Discord-mediated OCL in a way that is both conceptually coherent and context-sensitive. Specifically, they enable the present study to map empirical observations onto AT components (Tools, Rules, Division of Labour, Community) while remaining attentive to local constraints such as time pressure, infrastructure variation, and culturally shaped participation norms. As a result, Sections 2.4.1–2.4.4 collectively operationalise RO1–RO4 by defining what will be examined within each AT component and by clarifying how equity and inclusion concerns will be interpreted as systemic conditions influencing participation and outcomes.

## 2.5 Discord as OCL Platform

While several digital platforms such as Zoom, Microsoft Teams, and Google Classroom are widely adopted in formal educational settings, Discord was selected for this study due to its distinctive affordances for sustained OCL among student populations similar to Malaysian matriculation cohorts. Unlike Zoom and Teams which are primarily designed for scheduled instructor-led synchronous sessions, Discord supports a persistent learning space that integrates synchronous voice interaction with asynchronous text-based discussion within the same environment. This persistent structure allows collaborative activities to extend beyond fixed class times, supporting ongoing peer interaction, revision discussions, and informal academic support. In exam-oriented settings where continuous clarification and peer consultation are necessary, such persistence enables iterative knowledge construction rather than isolated session-based interaction.

In contrast to Google Classroom which is largely assignment- and lecturer-centred, Discord enables learner-driven communication through flexible channel organization, role-based participation, and real-time social presence. These features align closely with social constructivist and AT perspectives that emphasize interaction, mediation, and collective meaning-making. Furthermore, Discord's familiarity among younger learners particularly those accustomed to digital and gaming-related communication platforms reduces the entry barriers and promotes voluntary participation. Given the demographic profile of Malaysian matriculation students, Discord offers a contextually appropriate platform for examining how informal yet structured digital spaces can mediate OCL. Its channel-based architecture further allows instructors to structure discussion spaces according to task type (e.g., revision Q&A, concept clarification, project coordination), thereby supporting pedagogical intentionality rather than unregulated conversation.

Recent Malaysian digital pedagogy studies report increased experimentation with Discord and similar community-based platforms in foundation and pre-university settings, particularly for revision forums, peer mentoring, and examination preparation (Ismail et al., 2025; Mahdzir et al., 2023). These studies highlight that persistent channel structures support iterative clarification of complex concepts, while informal interaction norms may reduce participation barriers among younger learners familiar with social communication platforms. However, tensions also arise when institutional policies mandate the use of official LMS systems, creating tool–rule contradictions that require negotiated integration strategies within Malaysian higher education institutions. This contextual evidence strengthens the rationale for selecting Discord as the focal mediating artifact in the present study.

Discord, launched in 2015 as a lightweight voice-chat service for online gaming communities (Arifianto & Izzudin, 2021a; Chuang & Ratan, 2022) has rapidly developed into a versatile social platform supporting both synchronous and asynchronous communication for a wide range of user groups (Ghazali, 2024). As its user base expanded, developers rebranded Discord around 2020 with the tagline “Your Place to Talk”, signalling a strategic shift from purely gaming-related functions to broader applications including professional collaboration, fan-group engagement, and educational use which is the primary focus of this research (Ayob et al., 2022; Lauricella et al., 2024). In the context of OCL, Discord’s evolution illustrates how community-driven digital platforms can move beyond their original social or entertainment purposes to function as meaningful mediating artifacts (Engeström, 2000) in both formal and informal educational settings.

The effectiveness of Discord as a platform lies in the integration of synchronous voice and video with asynchronous text modalities within a unified and adaptable environment (Kristian et al., 2023; Lauricella et al., 2024). Channels dedicated to text-based

conversation enable learners to post, archive, and revisit discussion threads thereby supporting reflective engagement which is a key element of social constructivist learning (Vygotsky, 1978). Unlike traditional LMS such as Moodle or Blackboard where discussions are often strictly segmented and confined to specific threads or modules (Heinrich et al., 2022), Discord channels remain continuously active and foster a sense of real-time community similar to social media platforms (Craig & Kay, 2023). In parallel, the presence of permanent voice and video rooms offers functionality comparable to tools such as Zoom or Microsoft Teams. However, Discord's informal and always-open structure can lower the formal barriers that sometimes hinder spontaneous collaboration (Wiles & Simmons, 2022; Salehudin et al., 2023). For educators implementing a social constructivist or community of inquiry approach (Garrison et al., 2000; Harasim, 2012), these features position Discord as a compelling platform for promoting immediate feedback, social presence, and sustained peer interaction. Additional affordances such as pinned messages, threaded replies, and searchable archives further enhance organisational clarity, allowing key explanations and resources to remain visible and retrievable throughout intensive revision periods.

Recent empirical investigations highlight several pedagogical affordances that demonstrate Discord's potential as an effective platform for OCL. Researchers consistently report increased student engagement as the platform's immediacy and ease of access encourage learners to ask questions and share resources without significant delay (Arifianto & Izzudin, 2021b; Craig & Kay, 2023). The combination of synchronous chat and asynchronous text archives enables real-time collaboration. It also allows participants to revisit discussions at their convenience which is especially beneficial for students managing demanding coursework or family obligations (Dayana et al., 2021). By creating spaces where formal academic discourse and informal social interaction coexist, educators can strengthen

interpersonal relationships thereby enhancing group cohesion and a sense of community belonging (Salehudin et al., 2023). This stands in contrast to traditional video-conferencing tools where fixed meeting times and limited opportunities for casual interaction often hinder peer connection (Buzy et al., 2024). When deliberately structured, Discord can therefore function not merely as a communication tool, but as an integrated collaborative workspace supporting distributed cognition and collective problem-solving.

Nevertheless, certain challenges and contradictions arise when Discord transitions into a formal educational context. Students and instructors unfamiliar with Discord's gamer-oriented interface or advanced features such as roles, bots, and server permissions may find the learning curve steep (Wiles & Simmons, 2022; Kristian et al., 2023). Although the platform can operate under varying bandwidth conditions, real-time voice or video channels may create unequal learning experiences in areas where stable internet access is unreliable (Gaad, 2022). Notification overload, fragmented channel navigation, and multitasking across devices may also contribute to cognitive strain if discussion spaces are not carefully structured. From AT perspective, these limitations resonate with contradictions at the intersection of Subjects (students/instructors) and Tools (Discord features) elements, as well as between Community norms (gaming culture vs. formal academic standards) (Engeström, 2000). In the Malaysian matriculation programs, the tension between Discord's informal nature and institutional expectations for exam-focused learning becomes particularly evident. While the platform's user-friendly design can foster peer support and collaborative problem-solving, it may also conflict with official policies requiring the use of the institution's LMS, thus creating contradictions between established Rules and available Tools (Engeström, 2000; Salehudin et al., 2023).

The capacity for expansive learning is evident in the ways instructors and students adapt Discord to meet evolving pedagogical goals (Engeström, 2000). Studies show that educators who establish clearly defined channels for specific tasks such as revision Q&A, group project coordination, or peer tutoring can reduce confusion and maintain academic focus (Arifianto & Izzudin, 2021b; Farah & Eagle, 2021). Role assignments and the integration of bots further support the management of larger cohorts by distributing moderation duties, automating announcements, and conducting quick polls (Berrezueta-Guzman et al., 2024). These strategies represent an ongoing reconfiguration of the Division of Labour component within the activity system as instructors gradually decentralize authority and empower students to take leadership roles and sustain collaborative discourse (Hackett et al., 2024). When implemented effectively, such approaches can reduce cognitive overload, discourage free-riding, and promote learner autonomy. This adaptive use of platform features illustrates how pedagogical intentionality mediates technological affordances within the activity system.

However, institutional and cultural factors remain significant. In the Malaysian matriculation contexts, hierarchical relationships and respect for authority may discourage students from openly challenging peers or instructors (Ong & Quek, 2023). Discord's informal culture may facilitate more authentic interaction but it can also lead to discomfort if students associate the platform primarily with leisure activities. Contradictions may surface when the platform's openness conflicts with traditional instructor-centred values or when exploratory real-time interactions diverge from the structured demands of exam preparation. These tensions highlight the need for thoughtful moderation and scaffolding that consider local cultural norms, levels of digital literacy, and bandwidth limitations (Ayob et al., 2022; Kristian et al., 2023). The effectiveness of Discord-mediated OCL often depends

on active instructor facilitation. This includes clearly explaining online communication guidelines, ensuring academic integrity, providing technical support, and supporting students with varying language proficiencies to promote inclusive participation.

From AT perspective, the role of Discord as a mediating artifact can be seen as both enabling and constraining. It enriches the object of learning which is collaborative knowledge-building by providing versatile communication channels, a strong sense of social presence, and an intuitive interface. However, its informal design and status as an externally hosted platform may conflict with institutional regulations, raising concerns about data governance, privacy, and compliance with official LMS policies (Vladoiu & Constantinescu, 2020; Berrezueta-Guzman et al., 2024). For Malaysian matriculation students, the pressure to succeed in standardised exams may encourage the use of Discord for immediate peer support. However, institutional restrictions may limit its integration into formal academic settings. Resolving such contradictions involves what Engeström (2000) describes as expansive learning where stakeholders such as students, instructors, and administrators work together to revise norms, policies, or practices to better align with shared educational objectives.

In sum, Discord offers a powerful yet complex platform for OCL. Empirical research highlights increased student engagement, sustained peer communities, and flexible communication as key benefits (Craig & Kay, 2023; Salehudin et al., 2023; Lauricella et al., 2024). At the same time, its gaming origins, technical requirements, and potential misalignment with institutional expectations reveal underlying tensions in using an informal tool within structured exam-focused learning environments. In the Malaysian matriculation program, these contradictions reflect the dynamic interplay among Subjects such as biology students, Tools such as Discord features, Community including teachers, peer networks, and

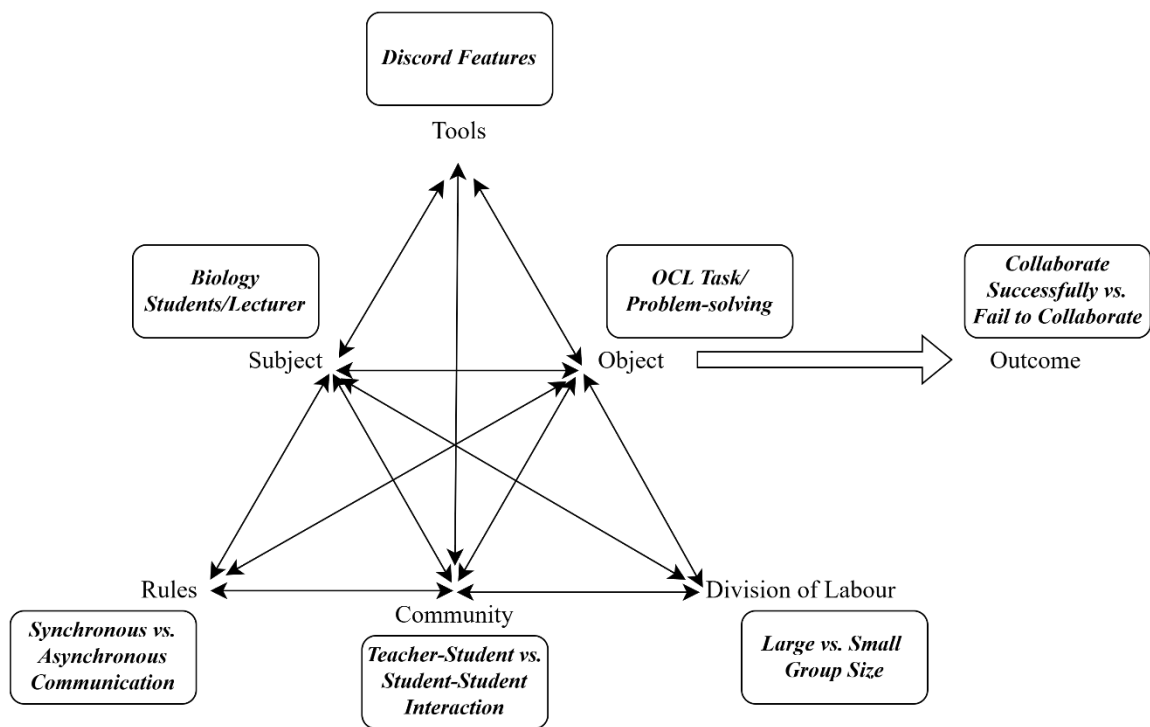
institutional culture, Rules such as communication modalities and exam requirements, and Division of Labour which defines how responsibilities are distributed among group members. All of these elements are guided by the Object of developing successful OCL participants. By identifying and addressing these contradictions through the lens of AT, educators and administrators can effectively utilize Discord's flexibility to support expansive learning, thereby enhancing collaborative and student-centred pedagogical practices.

The reviewed Discord literature suggests that its distinctive value lies in combining persistent text-based collaboration with optional synchronous interaction within a community-oriented space. However, it also introduces context-specific tensions when used for formal learning (e.g., interface complexity, gaming-associated norms, institutional compliance, and data governance). In this research, these affordances and tensions justify Discord as an analytically rich site for examining mediated collaboration under exam-focused constraints. This directly supports RO1–RO4 by framing Discord as the primary mediating tool through which rules, group organisation, and community participation are enacted, and it supports RO5 by motivating design refinements that translate empirical tensions into practical guidance for implementation in the Malaysian matriculation settings.

## 2.6 Activity Theory (AT) as Theoretical Framework

This section establishes AT as the primary theoretical lens for investigating how Discord-mediated OCL unfolds in the exam-focused setting of Malaysian matriculation. By foregrounding the emphasis of AT on mediated activity, contradictions, and expansive learning, this research addresses the complexity of integrating Discord social communication platform into an accelerated pre-university program. Moreover, the iterative orientation of DBR aligns with AT's core premise that learning environments evolve through ongoing negotiations among Subjects, Tools, Community, Rules, Division of Labour, and Object (Engeström, 2000). The following discussion establishes the relevance of AT for capturing the sociocultural complexities of OCL within matriculation contexts. It further outlines how AT informs the formulation of research questions, the development of design objectives, and the structuring of the DBR cycles undertaken in this research.

As established in Section 2.3, AT provides a multi-generational framework for analysing mediated, object-oriented activity and the contradictions that emerge within and across activity systems. Building on that foundation, this section focuses on how AT operationalises the DBR cycles in the present study by specifying what will be examined, how contradictions will be identified, and how those insights will guide iterative redesign. In this research, the AT framework (refer Figure 2.5) is employed to analyze how Discord mediates OCL among Malaysian matriculation students within an accelerated academic context. Each AT component corresponds to a key element in the learning environment, providing a structured lens for analysis:



**Figure 2.5:** Conceptual Activity System Model for Discord-Mediated OCL

- **Subject:** Primarily Biology matriculation students who engage in collaborative tasks using Discord, alongside instructors who facilitate and guide the learning activities.
- **Tools (Mediating Artifacts):** Discord’s voice channels, text-based threads, and file-sharing functionalities serve as the principal mediating tools.
- **Object:** Collaborative problem-solving in Biology through structured OCL tasks, aimed at mastering content and exam preparation, while fostering peer support and shared understanding.
- **Rules:** Communication modalities (synchronous vs. asynchronous), Institutional guidelines (e.g. mandatory use of official LMS)
- **Community:** The community includes lecturer–student interactions (instructional scaffolding) and student–student interactions (peer collaboration).

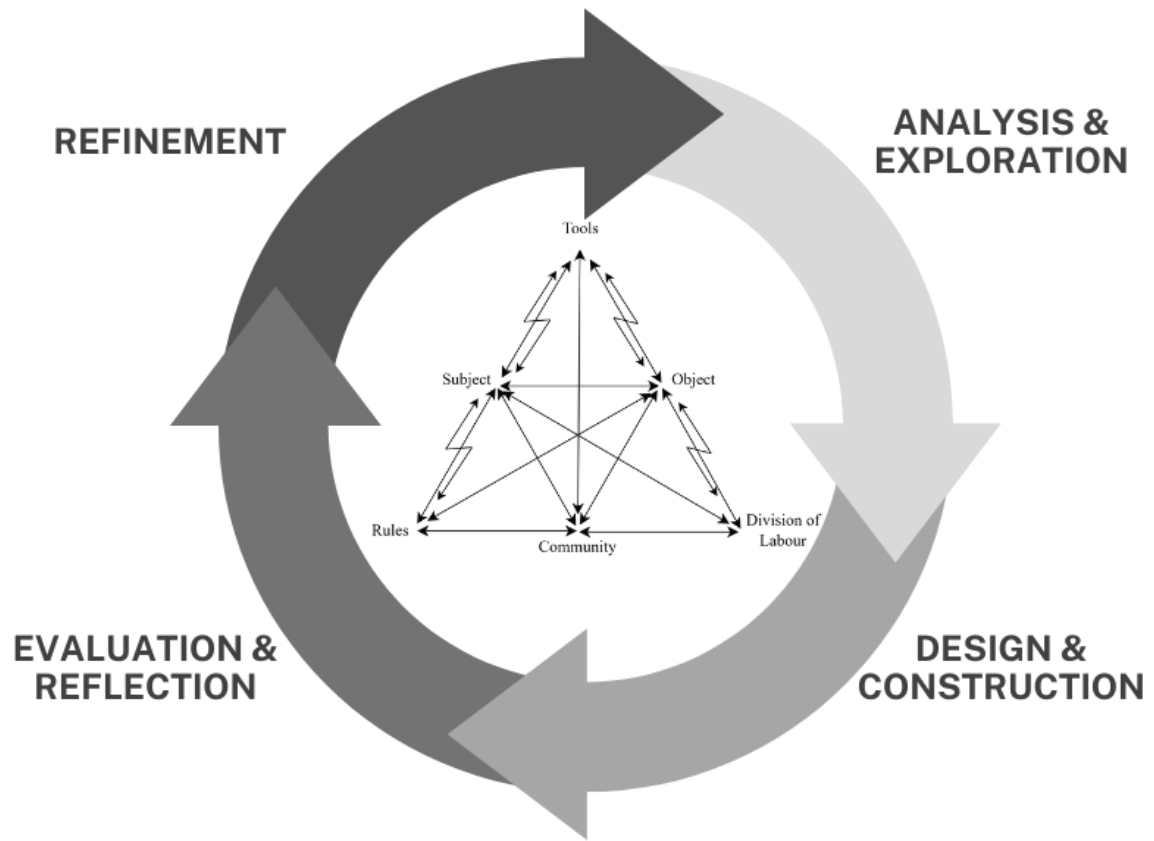
- ***Division of Labour***: Group size shapes how tasks are distributed and accountability maintained.
- ***Contradictions***: Systemic tensions or misalignments between components of the activity system. According to Engeström (2000), identifying and working through these contradictions enables expansive learning and drives transformation within the activity.

While frameworks such as Harasim's OCL model (2012) emphasise group discourse processes and the CoI framework (Garrison et al., 2000) focuses on teaching, social, and cognitive presence, AT offers a more comprehensive lens. It captures the interaction between social, cultural, and institutional forces and specific digital tools (Yusoff & Zin, 2012). This level of depth is particularly relevant to the Malaysian matriculation context where several challenges are present:

1. **Time Constraints**: Short semesters and high-stakes examinations define the learning environment. The systemic perspective of AT helps reveal how such pressures influence the configuration of rules, tools, and community interactions.
2. **Institutional Policies**: Policies often mandate the use of institutional LMS which may conflict with students' preference for more accessible platforms. AT conceptualises these misalignments as contradictions, highlighting opportunities for pedagogical innovation.

3. **Sociocultural Norms:** Students may be reluctant to express disagreement or challenge authority. AT frames these tendencies as contradictions within the community component, indicating a need for interventions such as structured scaffolding or rotating peer roles.
4. **Multiple Stakeholders:** The effective integration of Discord requires coordination among students, lecturers, and administrators. AT's emphasis on interacting activity systems that incorporate multiple perspectives is particularly suited to analysing how such collaborations evolve and how informal digital platforms can be aligned with formal academic objectives.

The DBR methodology complements AT by providing a cyclical and context-sensitive approach to educational intervention. DBR progresses through iterative phases: *Analysis & Exploration*, *Design & Construction*, *Evaluation & Reflection*, and *Refinement*, all informed by sustained collaboration with participants. Figure 2.6 illustrates how these DBR iterations align with Engeström's Activity System model. Each cycle responds to newly identified contradictions, leading to modifications and refinements in the use of Discord. This process reflects AT's principle of expansive learning (Engeström, 2000) wherein contradictions within an activity system serve as catalysts for reflection and the reconfiguration of tools, rules, or the division of labour to better achieve the intended object.



**Figure 2.6:** AT aligned with DBR Phases

In this study, AT explicitly informs each phase of the DBR process. During the analysis phase, the AT framework is used to identify the key components of the activity system (Subject, Tools, Rules, Community, Division of Labour, and Object) and to surface contradictions shaping Discord-mediated OCL in the matriculation context. In the design phase, these identified contradictions guide the development of pedagogical tasks, communication structures, and role arrangements intended to realign activity system components. During the implementation phase, AT informs the examination of how the tool and instructional strategies mediate student activity in practice. Finally, in the reflection phase, AT is used to interpret whether identified contradictions are mitigated, transformed, or reproduced, thereby informing subsequent refinements and iterative redesign.

Accordingly, AT functions as the analytic mechanism that links diagnosis to redesign across DBR cycles, ensuring that refinements are grounded in observed tensions within Tools, Rules, Community, and Division of Labour rather than in isolated impressions of platform effectiveness. Integrating AT within a DBR framework allows this research to systematically document how each phase of a Discord-mediated intervention responds to and resolves emerging tensions. Across cycles, both technological components and pedagogical practices are refined, ensuring that the learning environment remains responsive to student needs while adhering to institutional expectations. The alignment between the iterative and practice-oriented nature of DBR and AT's focus on transformation provides a strong foundation for continuous educational improvement and theoretical advancement.

AT stands at the forefront of this research because it offers a comprehensive and context-sensitive framework for examining the dynamic interplay among Discord (as a mediating artifact), Malaysian matriculation students (as subjects), institutional and cultural norms (as rules and community), the distribution of responsibilities among participants (as the division of labour) and OCL objectives (as the object). By focusing on contradictions that arise within and across these components, AT not only explains how tensions emerge but also guides expansive learning processes that can lead to lasting educational innovation. Coupled with the iterative approach of DBR, AT enables this research to systematically investigate and refine Discord-mediated OCL, ensuring that findings reflect both empirical evidence and real-world usability. In the following chapters, the methodological design and analysis plan are explicitly grounded in the structures of AT, reinforcing its central role in shaping the conceptual framework, research protocols, and interpretation of findings.

Positioning AT as the overarching theoretical framework establishes a clear logic for connecting empirical observations to the research objectives. Discord use will be analysed

through interacting activity-system components, with particular attention to contradictions that emerge during implementation. This framing strengthens the conceptual model by specifying how Tools, Rules, Community, and Division of Labour will be examined in relation to the Object of exam-oriented OCL. It also clarifies how the research moves from explanation to improvement where contradictions identified through AT analysis are treated as actionable signals that guide iterative refinement within the DBR cycles. Accordingly, this section explicitly anchors RO1–RO4 as the analytic focus (component-based investigation) and RO5 as the design outcome (context-responsive refinements and design principles).

## 2.7 Chapter Summary

This chapter places OCL within a social constructivist pedagogical framework, highlighting social interaction and dialogic processes as essential to collaborative knowledge construction. Previous research demonstrates that structured learning tasks, strong facilitation strategies, and thoughtfully chosen technologies can effectively foster collaboration in online environments. Nevertheless, challenges such as digital inequalities, cognitive overload, and inadequate instructor presence point to the need for better alignment between pedagogical design, technological affordances, and contextual realities. AT, traced through its three generational stages, offers a holistic lens for examining the interplay among learners, tasks, tools, rules, community, and division of labour. It treats contradictions within these systems not as mere problems but as drivers of “expansive learning,” prompting ongoing pedagogical innovation. This chapter also identifies four key dimensions of OCL: technology platforms, communication modes, group size, and community dynamics, and explicitly links them to the relevant AT elements. Discord is then introduced as a flexible mediating tool that accommodates both synchronous and asynchronous modes of interaction. Empirical findings highlight its interactive, informal features as conducive to high levels of student engagement and community cohesion. However, concerns about user-friendliness, alignment with institutional policies, and equitable access remain significant. Through an AT perspective, these issues become focal points for iterative refinement in integrating Discord into formal teaching contexts, particularly in the Malaysian matriculation. The theoretical and empirical foundations outlined in this chapter inform the methodological framework presented in Chapter 3 which guides the design, implementation, and analysis of Discord-mediated OCL in the Malaysian matriculation context.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Chapter Overview**

This chapter describes and justifies the research design and methodology used to explore how Discord mediates OCL among Biology matriculation students in a Malaysian setting. Building on the previously discussed constructivist foundations, this research adopts a DBR framework combined with an interpretive case study approach. In this research, DBR functions as the overarching methodological framework structuring the iterative design, implementation, and refinement of the intervention, while AT operates as the theoretical and analytical lens used to interpret interactions, contradictions, and transformations within the activity system. This combination therefore enables iterative intervention design and detailed contextual analysis. This methodological approach addresses the challenges presented by matriculation academic programs that place strict time constraints on both students and lecturers. The chapter is organized as follows: Section 3.2 reaffirms the social constructivist worldview that underpins the qualitative inquiry, while Sections 3.3 and 3.4 explain the synergistic application of DBR and the case study strategy. Section 3.5 outlines the data collection process which includes focus group interviews, reflective journals, and online observations followed by Section 3.6 which discusses thematic analysis and measures taken to ensure analytical rigour. Section 3.7 addresses research trustworthiness through methods such as triangulation and member-checking, and Section 3.8 identifies the ethical considerations including data protection, institutional permissions, and participant consent. The chapter concludes by showing how these integrated methods illuminate the processes and outcomes of Discord-mediated OCL.

### 3.2 Research Paradigm: Social Constructivist

In this research, the adoption of a social constructivist paradigm reflects the belief that knowledge does not exist in a vacuum but rather emerges through the interplay of socio-cultural contexts, interpersonal interactions, and individual meaning-making processes (Vygotsky, 1978). According to Creswell and Poth (2018), this stance diverges from positivist or post-positivist approaches which often assume an external objective reality that can be quantified and measured (refer Table 3.1). Social constructivism highlights that individuals interpret and collaboratively construct their understanding of reality through dialogue, negotiation, and reflective practice, a consideration particularly relevant to OCL contexts.

**Table 3.1:** Comparison of Research Paradigms

<b>Aspect</b>	<b>Social Constructivism</b>	<b>Postpositivism</b>	<b>Transformative</b>	<b>Pragmatism</b>
<b>Ontology</b> <i>(nature of reality)</i>	Multiple realities, socially constructed	Critical realism (single reality, imperfectly known)	Multiple realities shaped by power and oppression	Multiple realities, practical and dynamic
<b>Epistemology</b> <i>(how we know)</i>	Subjectivist, researcher interacts with participants	Objectivist, researcher is distant	Subjectivist and collaborative	Practical, focus on what works
<b>Axiology</b> <i>(role of values)</i>	Value-laden, acknowledges participant values	Value-free, researcher neutrality	Strongly value-oriented, aims for social justice	Values inform inquiry, but focus on usefulness
<b>Methodology</b>	Qualitative, emergent, inductive	Quantitative, hypothesis-driven, experimental	Participatory, critical, action-oriented	Mixed methods or methods that best answer questions

### ***Ontological Assumptions***

Ontology concerns the nature of reality. From a social constructivist perspective, reality is not a single fixed entity but is socially constructed through participants' experiences, socio-cultural backgrounds, and institutional contexts (Crotty, 1998; Creswell & Poth, 2018). Multiple realities therefore coexist, shaped through interaction and meaning-making. In OCL, learners experience engagement differently, and these realities overlap within shared digital spaces such as Discord. As students participate in collaborative tasks and discussions, their understandings evolve through ongoing dialogue and reflection, continually reshaping how they interpret learning and participation.

### ***Epistemological Foundations***

Epistemology refers to the nature and scope of knowledge and the processes through which it is acquired (Creswell & Poth, 2018). Within a social constructivist paradigm, knowledge is not viewed as an objective entity to be transmitted from lecturer to learner. Instead, it is co-constructed through active participation, dialogic interaction, and reflective practice (Guba & Lincoln, 1994). Online learning platforms such as Discord enable co-creation of knowledge where both instructors and learners collaboratively engage in group discussions, iterative feedback, and shared inquiry. In this process, intersubjective meaning-making becomes central, as individuals bring their diverse cultural backgrounds, prior knowledge, and academic beliefs into the learning discourse. These multiple perspectives interact and blend through conversation, negotiation, and feedback, generating collaborative understanding.

### ***Axiological Commitments***

Axiology deals with the role of values and ethics in research (Creswell & Poth, 2018). A social constructivist paradigm holds that values are inseparable from the research process, emphasizing ethical engagement, reflexivity, and participant agency (Lincoln & Guba, 1985). Researchers operating from this perspective are committed to participant-centered practices that treat individuals not as passive subjects but as active contributors to knowledge construction. Ethical considerations such as safeguarding confidentiality and obtaining informed consent are particularly important in digital research environments. Within online platforms including Discord, these responsibilities include respecting participants' digital footprints and ensuring they understand how their contributions will be used. Additionally, the researcher is expected to reflect continuously on their own biases, assumptions, and positionality, acknowledging their role as a co-constructor of meaning rather than a neutral observer.

### ***Methodological Implications***

Social constructivism supports qualitative approaches that explore the complexity of human experience in interactive learning contexts (Creswell & Poth, 2018). In this research, DBR and a case study design are used to examine student engagement with Discord-mediated OCL. DBR enables iterative design and refinement in response to ongoing evaluation and real-world constraints, while the case study approach provides contextualised insight into participants' behaviours, interactions, and perceptions within a defined cohort. Multiple data sources, including interviews, observations, focus groups, and chat logs, are employed to capture how learners collaboratively construct and apply knowledge (Creswell & Poth, 2018).

Thus, embracing a social constructivist paradigm situates the researcher and participants as co-constructors of knowledge particularly within Discord-mediated collaborative learning environment. This philosophical perspective highlights the importance of dialogue, interaction, and reflexivity in shaping *what learners come to know, how they know it, and why it matters*. By acknowledging the multiple evolving realities of participants, respecting the axiology of inclusive and ethical research, and employing qualitative methods that capture the lived experiences of learners, this research aims to provide a detailed understanding of how Discord facilitates OCL in a Malaysian matriculation setting.

Guided by a social constructivist paradigm, this research adopts an interpretivist stance in which the researcher seeks to understand participants' meanings, experiences, and actions as they are situated within a specific socio-cultural and institutional context. Rather than assuming neutrality or detachment, the researcher acknowledges their role as an active interpreter and co-constructor of meaning throughout the research process. As a Biology lecturer within the Malaysian matriculation system, the researcher brings contextual knowledge of curriculum demands, student learning practices, and institutional norms which informs the interpretation of interactions and contradictions observed in Discord-mediated OCL. Reflexivity is therefore central to this stance with continuous critical reflection employed to recognise how the researcher's assumptions, experiences, and decisions shape data generation, analysis, and interpretation. This interpretive positioning supports a context-sensitive understanding of how participants make sense of collaborative learning practices within a digitally mediated environment.

### **3.3 Research Approach**

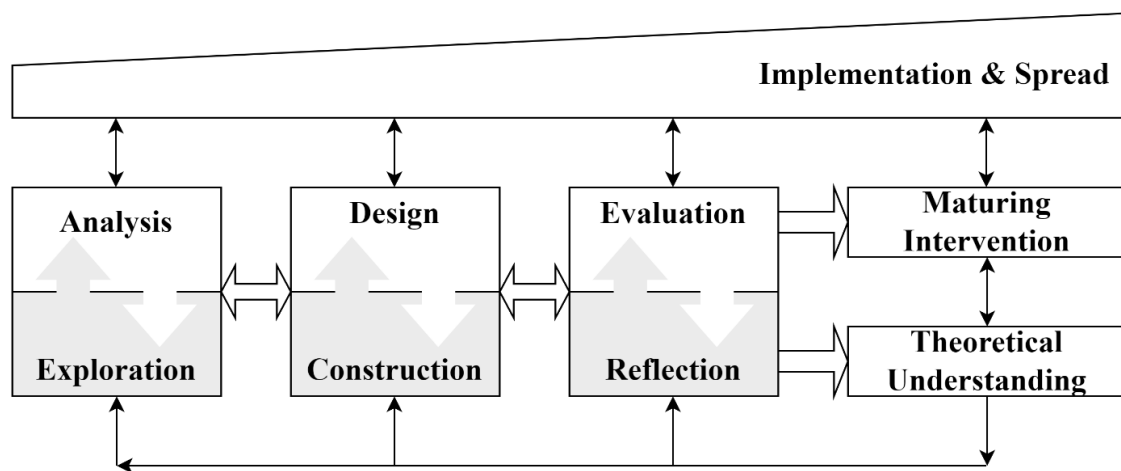
This research adopts a DBR strategy aligned with McKenney and Reeves's (2018) three-phase model set within a single-case study framework. This combination offers a structured yet flexible route for investigating how Biology matriculation students engage in OCL using Discord in real-world settings. By integrating the principles of DBR with a context-sensitive case study, the research maintains an iterative cycle of design, implementation, and refinement, ensuring both theoretical rigour and practical relevance. Within this structure, DBR governs the cyclical development of the intervention, whereas AT is employed during analysis to examine how tools, rules, division of labour, and community interact within each cycle.

#### **3.3.1 Design-Based Research (DBR)**

DBR is recognized for bridging the gap between educational theory and classroom practice (The Design-Based Research Collective, 2003; Barab & Squire, 2004). Unlike conventional experimental or quasi-experimental methods that often isolate variables, DBR acknowledges that learning environments are complex evolving systems (Ozverir et al., 2021). Rapid changes in technology, institutional policies, and learner dynamics can shift the conditions under which educational interventions occur. DBR embraces these realities by using iterative design cycles to refine interventions in collaboration with stakeholders such as lecturers, administrators, and students.

As illustrated in Figure 3.1, McKenney and Reeves (2018) have articulated a widely adopted DBR model comprising three interrelated phases: (1) Analysis & Exploration, (2) Design & Construction, and (3) Evaluation & Reflection. Each phase builds on the others in a cyclical manner that continues until the intervention is suitably adapted to local conditions

and validated in terms of both theory and classroom effectiveness. This iterative stance not only fosters practical relevance but also contributes novel insights to the research literature. In the present study, DBR structures the development of the Discord server prototype and the refinement of collaborative tasks across cycles, while AT informs the interpretation of how contradictions emerging during implementation shape subsequent redesign decisions.



**Figure 3.1:** Generic model for conducting DBR

### a) Phase 1: Analysis and Exploration

This initial phase involves a systematic investigation of the educational context, specific needs, and relevant theoretical frameworks. Typical activities include conducting literature reviews, performing needs assessments, and engaging in preliminary discussions with stakeholders (e.g., lecturers, students). Findings from this phase help refine research questions, highlight design challenges, and establish initial objectives for the intervention.

## **b) Phase 2: Design and Construction**

Drawing on insights from Phase 1, a prototype or strategy is developed to address the identified needs. This step is both collaborative and iterative, incorporating feedback from educators, students, and other stakeholders. Design elements such as specific tasks, software features, or pedagogical approaches are tested and refined in rapid cycles, ensuring alignment with local constraints.

## **Phase 3: Evaluation and Reflection**

During and after each design cycle, qualitative and/or quantitative data are gathered to assess the extent to which the intervention meets its intended learning objectives. This process may include collecting student and lecturer feedback, reviewing performance metrics or participation, and identifying contradictions or newly surfaced challenges. Reflections on these findings inform theoretical and practical insights, guiding next design iterations. Over time, these iterative refinements yield empirically grounded design principles adapted to the local context. In this research, these outputs are presented as analytically generalisable design principles that offer transferable guidance grounded in theory and iterative empirical refinement, rather than statistically generalisable claims. While DBR determines when and how refinements are implemented, AT provides the conceptual framework for analysing why specific tensions emerge and how they signal opportunities for expansive learning within the activity system (Engeström, 2001).

The iterative and context-sensitive nature of DBR makes it particularly well-suited to technology-enhanced collaborative learning environments where user engagement, platform affordances, and institutional requirements can change rapidly (Ozverir et al., 2021; Wang & Hannafin, 2005). In the context of the present research, DBR allows for meaningful accommodation of real-world constraints faced by Malaysian matriculation students who must navigate a highly exam-oriented curriculum within a limited timeframe. The methodology supports the development of DBR intervention in Section 3.5 that evolves in alignment with these institutional priorities. Through iterative cycles of design, implementation, and evaluation, the research not only refines a practical intervention for OCL in Biology but also contributes theoretical insights into how digital tools can effectively support collaboration in time-constrained academic environments.

It is important to clarify that DBR and AT serve distinct but complementary roles in this study. DBR functions as the methodological strategy that organises the iterative intervention process, whereas AT operates as the theoretical lens used to analyse systemic interactions and contradictions within each iteration. DBR answers the question of how the intervention evolves across cycles, while AT explains how and why transformations occur within the mediated learning activity. This distinction ensures methodological coherence while preserving theoretical depth.

### 3.3.2 Case Study

Although the McKenney and Reeves model provides the core DBR framework, this research is further situated within a case study to enable an in-depth and contextual analysis. Case study research is a qualitative approach that examines a bounded system such as an individual, group, organization, or phenomenon within its authentic context (Stake, 1995; Yin, 2018). Instead of manipulating or isolating variables under controlled conditions, case studies offer a holistic understanding of how participants, technology, and institutional structures intersect in complex ways. This perspective is especially valuable in educational and OCL settings where institutional policies, cultural norms, technological access, and group dynamics collectively shape learning experiences, often beyond the reach of quantitative methods alone. Accordingly, this research adopts an instrumental case study approach (Merriam & Tisdell, 2016), focusing on one Biology class using Discord to generate broader insights that may inform the design of similar OCL interventions in exam-driven contexts.

Several considerations underpinned the choice of a single-case study over a multiple-case design for this research. First, prioritizing depth of analysis over breadth facilitates a closer examination of students' interactions, challenges, and evolving experiences with Discord. Second, practical constraints within Matriculation program such as heavy workloads and rigorous curricular demands limit the feasibility of multiple-case research. Third, the alignment with DBR ensures that each iterative cycle informs and refines the ongoing intervention, enhancing the immediate instructional relevance of the findings. Finally, situating this single case in a Malaysian Matriculation context allows for culturally and institutionally grounded insights that can extend to other exam-oriented systems seeking to implement OCL. While the single-case design enables rich and context-sensitive analysis,

the findings are not intended for statistical generalization. Instead, they offer analytical and theoretical insights that may be transferable to comparable exam-oriented and time-constrained educational contexts subject to careful consideration of local conditions.

Building on the DBR framework outlined in Section 3.3.1, this research embeds its iterative design cycles in a single-case study to achieve deep and context-specific analysis of Discord-mediated OCL. The case comprises a Biology class of 30 students and a lecturer in a Malaysian Matriculation college. By examining one bounded system, the research captures the detailed interplay of exam-oriented and time-constrained conditions that characterize Matriculation programs. The boundaries of the case are as follows:

- **Temporal Boundary:** The 15-week frames of the intervention duration, spanning Discord server launch, iterative design cycles, and final reflections.
- **Spatial Boundary:** The research is confined to one Malaysian Matriculation college in Sarawak, shaped by local policies, resources, and socio-cultural factors.
- **Participant Boundary:** Data collection involves 30 Biology students (aged 18–20) and one Biology lecturer.
- **Technological Boundary:** Discord serves as the primary platform, highlighting its affordances and constraints for OCL.

Focusing on a single case prioritises depth over generalisation. Using focus groups, reflective journals, and online observations, the research triangulates data to provide a comprehensive account of Discord-mediated collaborative Biology learning. Although situated in one institution, the rich contextual detail supports transferability to similar exam-oriented programmes.

### 3.4 Participants Selection and Sampling

A purposive sampling strategy (Patton, 2015) guided the selection of 30 students (labelled as S1–S30) enrolled in a Malaysian Matriculation college Biology class under the M-001 Life Sciences stream. All 30 students had completed the Sijil Pelajaran Malaysia (SPM) examination and were between 18 and 20 years old. 40% of participants (n=12) were male and 60% (n=18) were female. Ethnic distribution included Malay (20%), Chinese (40%), and Dayak (40%). Although all students were enrolled in the same Biology class, they brought diverse perspectives that could influence collaborative dynamics. Table 3.2 presents the demographic breakdown of the sample.

**Table 3.2:** Demographic Background of Participants

<i>Characteristics</i>	<i>Components</i>	<i>N</i>	<i>%</i>
<b>Program of Study</b>	Life Sciences M-001 (Subjects: <i>Biology, Physics, Chemistry, Mathematics</i> )	30	100
<b>Gender</b>	Male	12	40
	Female	18	60
<b>Ethnicity</b>	Malay	6	20
	Chinese	12	40
	Dayak	12	40
<b>Age</b>	18-20	30	100
<b>Education Level</b>	SPM Graduates	30	100

The selection criteria were:

- 1) enrolment in the Life Sciences (M-001) Biology course at a Malaysian Matriculation college
- 2) prior exposure to online learning during secondary or matriculation studies
- 3) active use of at least one digital learning or communication platform (e.g., Google Applications, Telegram, Microsoft Teams, or Discord)

- 4) basic digital competency (defined as the ability to access online platforms, participate in discussions, share digital resources, and collaborate using technology-mediated tools)

These criteria ensured that all participants possessed a functional level of digital literacy required for participation in Discord-mediated online collaborative learning, while allowing for variation in familiarity and proficiency across platforms.

All participants had prior exposure to online learning during their secondary education or current matriculation studies. Participants’ digital competency was operationalised in terms of their prior experience with online learning platforms and collaborative communication tools rather than through formal proficiency testing. This approach aligns with the exploratory and design-based nature of the study, which focuses on how students with varying degrees of digital familiarity adapt to and engage with Discord as a collaborative learning platform Table 3.3 summarizes their experiences with online courses and collaborative technology tools.

**Table 3.3:** Participant Inclusion Criteria

<i>Characteristics</i>	<i>Components</i>	<i>N</i>	<i>%</i>
<b>Online Learning Course Past Experience</b>	Yes	30	100
<b>Current Active Accounts</b>	Yes	30	100
<b>Use of Collaborative Technology Tools</b>	Google Applications	30	100
	Telegram	16	53.33
	Microsoft Teams	4	13.33
	Discord	3	10

All participants reported being active users of at least one online learning platform. They unanimously cited Google Applications (Meet, Classroom, Docs) as a primary tool for coursework. Sixteen participants mentioned Telegram for course-related communication and four used Microsoft Teams (notably S1, S5, S13, and S23, who had attended Maktab Rendah Sains MARA schools). Three had tried Discord (S5, S6, S20) although two of them primarily used it for gaming. These varied experiences show the students' familiarity with multiple platforms, a trend that became widespread during the Covid-19 pandemic. Overall, the participants demonstrated adaptability and willingness to engage in digital learning environments, making them suitable as participants for this research on Discord-mediated OCL.

### 3.5 DBR Intervention

#### 3.5.1 Phase 1: Analysis & Exploration

The researcher began with preliminary brief interviews involving the Biology lecturer (L1) and a group of students to explore contextual constraints and inform the initial design of the intervention. These discussions revealed several key challenges including time constraints, exam-oriented instructional focus, and limited opportunities for sustained collaborative work due to the compressed syllabus. As L1 noted: *“Because the Biology syllabus is so compressed, we rarely have enough time for group work... It is quite hard to carry out collaborative activities.”* Student interviews further highlighted variations in digital readiness and familiarity with educational technology. While many reported daily use of social media, concerns emerged around inconsistent internet connectivity and unfamiliarity with structured platforms such as Discord. One student (S22) noted *“Sometimes my connection just drops in the middle of an online session. I usually rely more on text messaging”*. Another student (S1) expressed hesitation: *“I have never done group work online except for simple WhatsApp chats. Discord is new for me”*.

Additionally, the researcher administered a digital learning open survey across the college for both students and lecturer (refer **Appendix A**). The findings revealed important patterns for initial design of the intervention:

- 94.2% of student respondents owned personal digital devices, predominantly smartphones (94.4%) and laptops (72.2%).
- 50% rated their internet speed as moderate, and only 41.7% expressed satisfaction with their internet service.
- These infrastructural limitations posed a significant barrier to synchronous and sustained online collaboration.

On the lecturer side, the survey showed a generally high level of digital readiness:

- All lecturers used laptops (100%) for online teaching with substantial use of smartphones (88.2%) and PCs (76.5%).
- 70.6% of lecturers identified as digitally proficient or very proficient, and all expressed willingness to further improve their digital literacy.
- 88.2% had adopted Google Classroom as their primary online teaching platform, supported by additional tools such as YouTube, Google Meet, Kahoot, and Zoom. None had previously used Discord.
- Most lecturers reported high confidence in using digital tools and used them frequently for teaching purposes.

Nonetheless, the challenges persisted at the institutional level:

- Although 76.4% of lecturers rated on-campus internet facilities as good or very good, only 41.2% found the internet speed satisfactory.
- Several lecturers cited issues with unstable connectivity and noted the impact on real-time teaching effectiveness.
- The available equipment in the recording studio and the aging state of student-loan laptops further limited the institution's digital teaching capacity.

Thus, these preliminary insights directly shaped the initial design objectives for Discord-mediated OCL environment:

- **Design Objective 1:** Ensure tool usability with intuitive navigation and clear communication norms tailored to students' digital familiarity.
- **Design Objective 2:** Structure collaborative tasks to accommodate diverse access conditions and student autonomy within tight instructional schedules.
- **Design Objective 3:** Integrate scaffolding strategies that enable lecturers to guide student-led engagement even in time-constrained settings.
- **Design Objective 4:** Address equity of access by accounting for infrastructural differences in internet connectivity and device availability.

Data collected during the analysis phase directly informed the initial redesign decisions for the first DBR cycle. Interview findings regarding limited time for collaborative work led to the alignment of Discord tasks with specific syllabus topics and structured time allocations. Survey results indicating unstable internet connectivity informed the prioritisation of text-based channels and asynchronous options alongside synchronous interaction. Lecturer feedback highlighting students' unfamiliarity with Discord guided the implementation of simplified server navigation and explicit onboarding instructions. These data-driven adjustments ensured that the intervention design responded directly to contextual and infrastructural constraints identified during Phase 1.

### 3.5.2 Phase 2: Design & Construction

Drawing on initial design objectives, a Discord server prototype (Figure 3.2) was developed and iteratively refined to address time constraints, connectivity challenges, and the need for structured online collaboration. The design process involved:

#### a) Discord Server Layout

- **Lobby Channel:** A general text channel for announcements, informal discussions, and general inquiries. The purpose of this space was to foster community building and helped students transition to more focused academic conversations.
- **Topic-Specific Channels (Figure 3.3):** Dedicated channels for subject-related discussions, sharing of lecture slides, recommended readings, and YouTube videos. These channels helped students engage in in-depth, topic-centered interactions without distractions

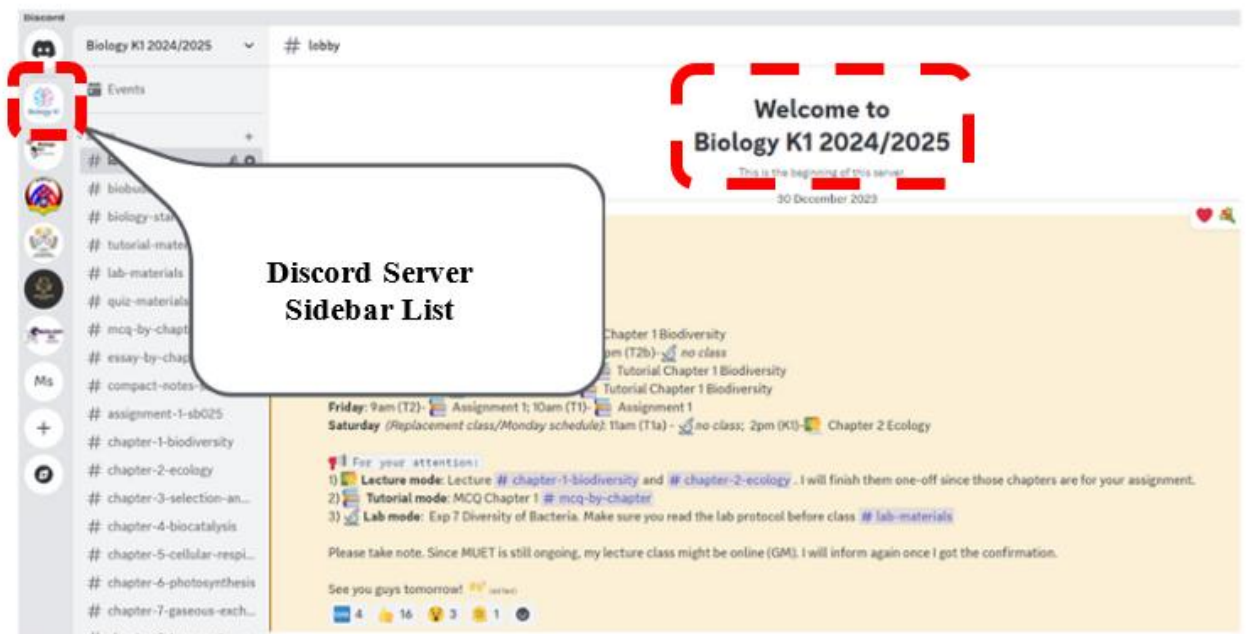
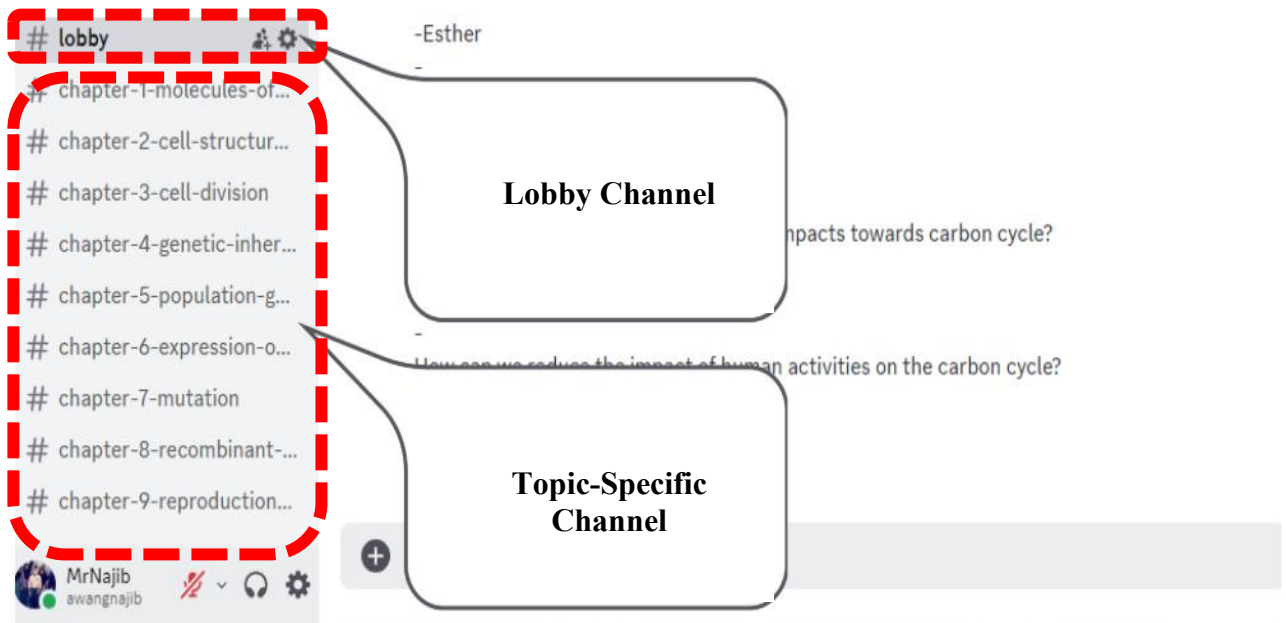
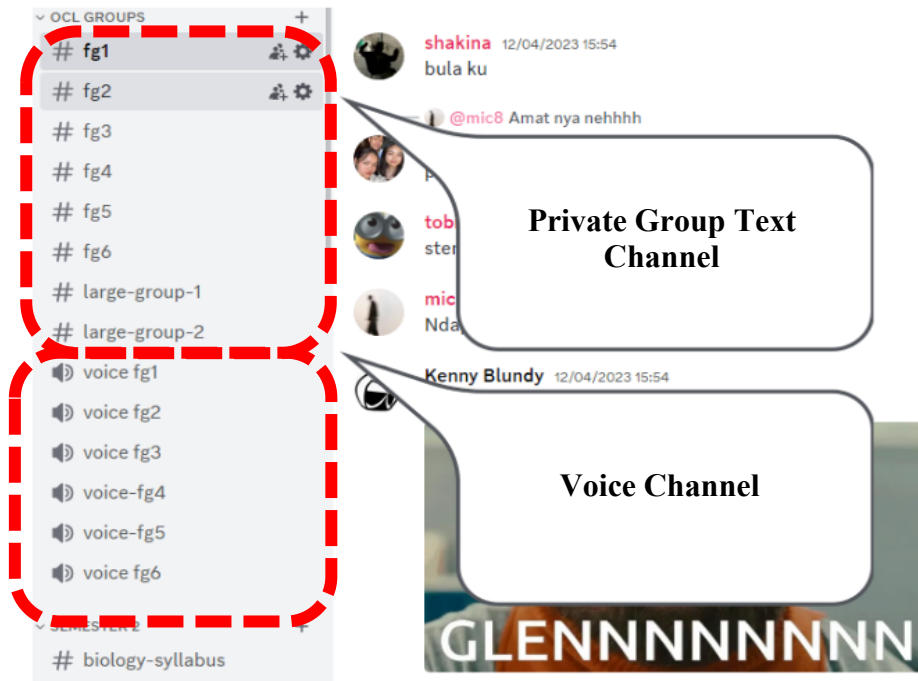


Figure 3.2: Discord Server Prototype



**Figure 3.3:** Lobby and Topic-Specific Text Channel

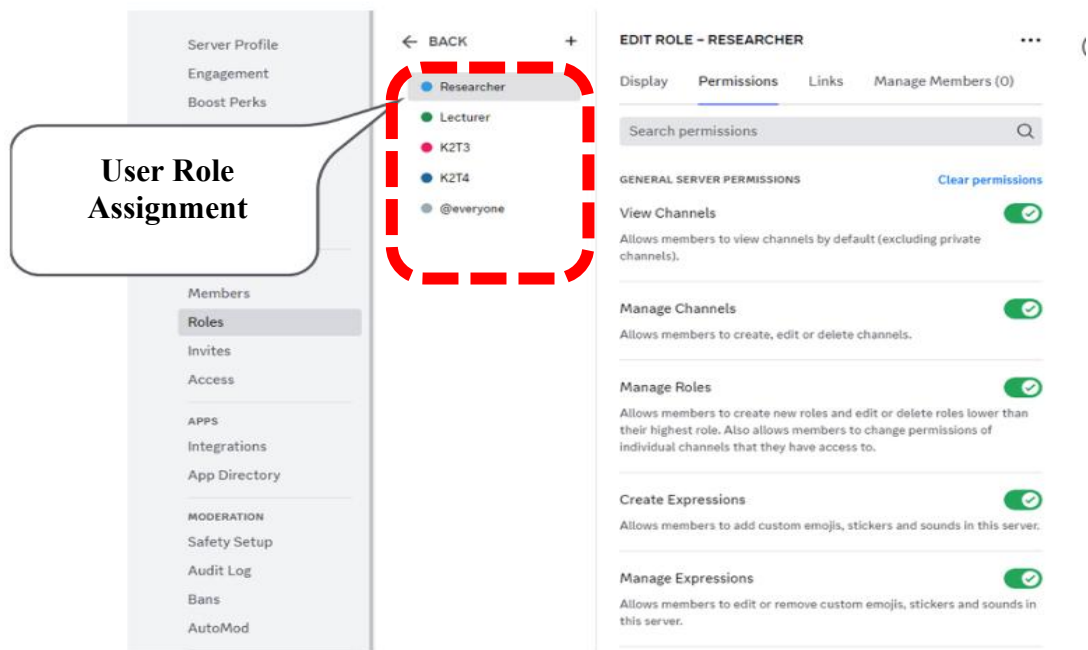
- **Private Group Project Text Channels (Figure 3.4):** Workspaces for both large teams and smaller subgroups, allowing students to collaborate on project-based tasks. Each group could brainstorm ideas, share drafts, and track progress in a contained environment that minimised clutter
- **Voice Channels with Video and Screen-Sharing:** Real-time collaboration spaces for synchronous discussions, mini-lectures, consultation, and immediate feedback to simulate the interactive elements of a physical classroom.



**Figure 3.4:** Private Group Text and Voice Channel

**b) User Role Assignments (Figure 3.5)**

- **Researcher:** Act as primary moderator and has observational rights, allowing for naturalistic data collection (e.g. participation patterns) without altering the flow of student interaction.
- **Lecturer:** Granted moderator privileges to pin important messages, manage respectful discourse, and provide academic materials.
- **Student:** Standard permissions to participate in discussions, share materials, and collaborate. Students were grouped in small teams (6 groups of 5 members each) for targeted tasks and large teams (2 groups of 15) for broader discussions.



**Figure 3.5:** Role Assignments Features

Discord prototype was reviewed by a matriculation lead trainer for digital classrooms (refer **Appendix B**; *Expert 1*). Expert feedback from his review helped refine channel layouts, role assignments, and real-time collaboration features to align with best practices in digital pedagogy.

### **c) Participant Group Configurations**

Participants were assigned to different group arrangements according to each DBR cycle's design requirements. Table 3.4 summarizes the distribution of student groups across the seven iterative designs. For tasks involving the same group size (e.g., five-member teams or larger 15-member teams), the same core membership was preserved to maintain consistency in data collection and facilitate longitudinal comparisons.

**Table 3.4:** Overview of Participant Groups in Iterative Designs

Task	Total No. of Groups	No. of Members per Group	Group Members
<b>Task 1: Discord as OCL Tool</b>	6	5	• Group 1: S1–S5
<b>Task 2: Synchronous Activity</b>			• Group 2: S6–S10
<b>Task 3: Asynchronous Activity</b>			• Group 3: S11–S15
			• Group 4: S16–S20
			• Group 5: S21–S25
			• Group 6: S26–S30
<b>Task 4: Large Group Activity</b>	2	15	• Group 1: S1–S15
			• Group 2: S16–S30
<b>Task 5: Small Group Activity</b>	6	5	• Group 1: S1–S5
<b>Task 6: Lecturer-Student Interaction</b>			• Group 2: S6–S10
<b>Task 7: Student-Student Interaction</b>			• Group 3: S11–S15
			• Group 4: S16–S20
			• Group 5: S21–S25
			• Group 6: S26–S30

**d) Iterative Tasks & Cycles**

As shown in Table 3.5, the intervention was structured into seven iterative tasks conducted over a period of 15 weeks of Semester 1 Session 2024/2025. Each task was designed to address a specific research question (RQ) and an accompanying AT component within the OCL environment (refer **Appendix C** for full instruction details of each task). The sequence of tasks allowed for progressive refinement across iterations. Each cycle concluded with data collection through focus groups, reflective journals, and online observations, followed by adjustments to tool design, rules, group structures, and facilitation strategies. By the final cycle, these iterative refinements yielded a cohesive Discord-mediated OCL model tailored to the exam-driven Biology context.

**Table 3.5:** Intervention Iterative Tasks & Cycles

Task	Week	Design Objective	Biology Topic	AT Element	Data Collection & Instruments
1	1-2	To familiarize students with Discord’s features and establish basic norms for online collaboration.	Molecules of Life	Tools (RQ1)	1. Lecturer’s reflective journal 2. Focus Group Interview (end of Week 2)
2	3-5	To investigate how synchronous interaction affects student collaboration	Cell Division	Rules (RQ2)	1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 5)
3	6-8	To examine how asynchronous discussions influence student collaboration	Genetic Inheritance		1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 8)
4	9-10	To explore the dynamics and division of labour in large groups for OCL	Expression of Biological Information	Division of Labour (RQ3)	1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 10)
5	11-12	To explore the dynamics and division of labour in small groups for OCL	Mutation		1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 12)
6	13-14	To evaluate how lecturer facilitation shapes community dynamics for OCL	Recombinant DNA Technology	Community (RQ4)	1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 14)
7	15	To evaluate how peer-collaboration shapes community dynamics for OCL	Reproduction and Development		1. Lecturer’s reflective journal 2. Online Observation 3. Focus Group Interview (end of Week 15)

Following each DBR iteration, data from online observations, focus group interviews and the lecturer’s reflective journal were systematically analysed to inform subsequent redesign decisions. For example, observational data from early synchronous sessions revealed uneven participation and connectivity disruptions which led to the redesign of later

tasks to incorporate smaller group discussions and increased reliance on asynchronous follow-up activities. Entries in the lecturer’s reflective journal noting reduced engagement during extended voice sessions informed the introduction of clearer time structures and scaffolded prompts in subsequent cycles. Focus group feedback indicating confusion in large-group coordination resulted in clearer role assignments and the use of moderator-supported sub-channels in later iterations. Each modification was therefore grounded in empirical evidence from the preceding cycle, ensuring that redesign decisions were systematically informed by collected data. Table 3.6 summarises how the seven tasks were organised into four structured iterative DBR cycles, indicating the number of cycles undertaken and the corresponding levels of refinement across the intervention:

**Table 3.6: DBR Cycles and Refinement Levels**

<b>DBR Cycle</b>	<b>Tasks</b>	<b>AT Focus</b>	<b>Primary Refinement Level</b>
Cycle 1	1	Tools (RQ1)	Foundational usability adjustments
Cycle 2	2-3	Rules (RQ2)	Communication structure refinement
Cycle 3	4-5	Division of Labour (RQ3)	Group configuration restructuring
Cycle 4	6-7	Community (RQ4)	Facilitation and interaction enhancement

Furthermore, to demonstrate how each AT element explicitly guided the DBR phases of design, implementation, evaluation, and redesign, Table 3.7 presents the alignment between AT components and the DBR process:

**Table 3.7:** Alignment of AT Elements with DBR Phases

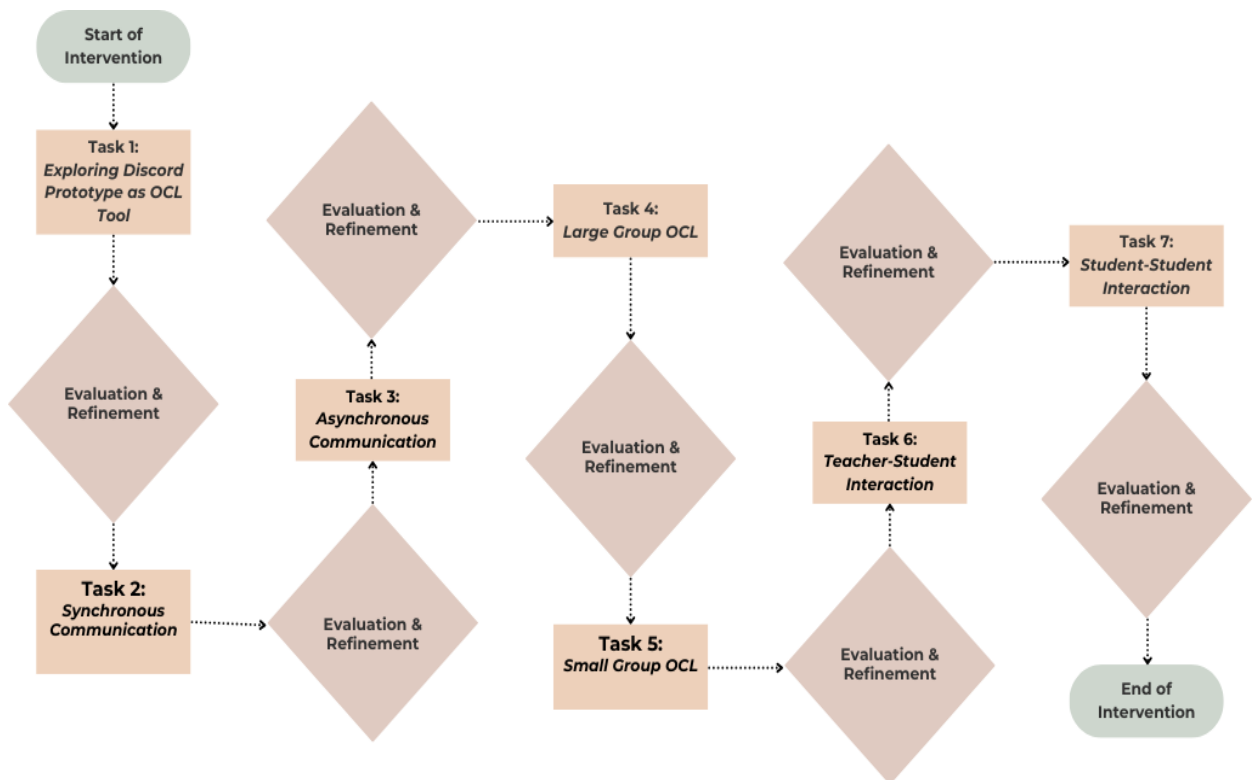
AT Element	Design Consideration	Implementation Focus	Evaluation Lens	Nature of Redesign
Tools	Platform structure and usability	Server layout and onboarding	Mediating artefact effectiveness	Interface simplification
Rules	Communication protocols	Sync/async task design	Norm alignment and participation balance	Modality adjustment
Division of Labour	Group size and role allocation	Collaborative task structuring	Participation equity and coordination	Role clarification
Community	Facilitation strategy	Lecturer–student and peer interaction	Social presence and engagement	Moderation refinement

All Biology topics across the seven tasks underwent review by an experienced subject-matter expert (refer **Appendix B**; *Expert 2*) to ensure content accuracy and alignment with learning objectives. Additionally, based on the findings of the preliminary interview, several strategies were incorporated to ensure inclusive engagement, recognising that participants had varying levels of internet connectivity. These strategies aimed to minimise technical barriers and create a more accessible OCL environment:

- **Strategy 1:** Participants with reliable broadband connections were encouraged to join live voice calls, while those with weaker internet access could opt for text-based discussions.
- **Strategy 2:** Asynchronous scaffolds (e.g. written task guides and pre-recorded instructions) and extended deadlines were implemented to support students who needed to log in during off-peak hours or conserve data.
- **Strategy 3:** Essential slides and reading assignments were compressed into smaller file sizes, ensuring that students with limited connectivity could still access important content.

### 3.5.3 Phase 3: Evaluation & Reflection

Once Discord server was fully operational and initial tasks were implemented, the evaluation and reflection phase was initiated following each major task in iterative cycles as illustrated in Figure 3.6. Data were collected through focus group interviews, online observations, and reflective journaling to investigate participants' interactions within Discord, identify factors that facilitated or hindered collaboration, and assess the extent to which the tasks fostered deeper engagement with Biology content.



**Figure 3.6:** Iterative Task Cycles Flowchart

After each cycle, the researcher identified emerging contradictions or tensions that constrained effective OCL. These qualitative insights informed iterative design revisions including adjustments to the server's structure and the implementation of more flexible scheduling for OCL discussions. Each modification was tested in next cycles, forming a

continuous improvement loop. Through ongoing evaluation, redesign, and iteration, the intervention progressively evolved into a cohesive framework. This process led to the development of a comprehensive set of design principles (**RQ5**) for effectively embedding OCL within an exam-oriented Biology learning context.

### **3.6 Data Collection Methods**

Data collection used qualitative methods aligned with the iterative cycles of DBR and the contextual depth of the case study approach. Students' focus group interviews, lecturer reflective journals, and online observations provided comprehensive insights into student engagement, collaborative dynamics, and the interaction between technology and pedagogical practices. This triangulation approach (Creswell & Poth, 2018) strengthened the credibility of the research by enabling cross-verification of student accounts, lecturer reflections, and researcher observations. All instruments and interview questions were reviewed by two UNIMAS experts (refer to **Appendix B; Expert 1 and 2**) to ensure their validity and alignment with best practices in educational research. Revisions were made based on expert feedback.

#### **3.6.1 Students' Focus Group Interviews**

Focus group interviews were conducted at the end of each task to gather collective insights into participants' perceptions and experiences throughout each DBR iteration (Task 1-7). Across the seven DBR tasks, a total of seven focus group sessions were conducted (one session per task). All 30 students participated in each session, resulting in seven full-cohort focus group discussions over the 15-week intervention. Engaging students in semi-structured group discussions allowed deeper exploration into the effectiveness or challenges of Discord-mediated collaborative tasks (Morgan, 1997). The group setting aligns with Vygotsky's (1978) principles that knowledge is socially co-constructed, revealing complex group dynamics and shared cultural understandings that individual interviews might overlook (Krueger & Casey, 2015; CohenMiller & Izenkova, 2022). Furthermore, group interactions prompted spontaneous reflections among students, enriching data on their

interpretations of collaborative activities and related contextual influences (Schilling et al., 2024). Focus groups were strategically scheduled immediately after each task iteration from Week 1–15, ensuring timely and contextually relevant feedback (Barab & Squire, 2004). Conducting sessions soon after task completion helped reduce memory lapses and allowed participants to readily discuss their fresh experiences (Nobrega et al., 2021).

Since most discussions occurred in Discord text channels, students benefitted from the platform's familiarity and experienced fewer inhibitions compared to face-to-face settings (Hinkes, 2021). Text-based focus groups also promoted candid expression by reducing social pressure and enabling participation across time and space. Member checking was employed for clarification when necessary, ensuring accurate interpretation of participant responses. This approach supported the multi-voiced nature of collaborative learning environments (Engeström, 2001), fostering collective shaping of insights through iterative dialogue (Daniels et al., 2019; Schilling et al., 2024).

A semi-structured interview protocol (refer **Appendix D**) with open-ended questions guided discussions, addressing topics such as Discord usage, group norms, lecturer influence, and learning outcomes. Each session lasted approximately 30–45 minutes, balancing comprehensive data collection with consideration for students' academic workloads (Adler et al., 2019). Data transcripts (see sample in **Appendix D**) were systematically exported, anonymized using pseudonyms (S1–S30), and securely stored on password-protected devices. These transcripts provided critical qualitative data for thematic analysis (Section 3.7), capturing evolving student perspectives on collaborative interactions mediated by Discord.

### 3.6.2 Lecturer's Reflective Journal

The lecturer's reflective journal served as a critical qualitative data source, systematically documenting evolving instructional perspectives, pedagogical strategies, and experiential insights throughout the OCL intervention (Task 1-7). Reflective journals are widely acknowledged in educational research as effective tools for capturing detailed accounts of instructional practice, particularly in digital and blended learning contexts (Putri, 2020; Taşdemir & Gümüşok, 2023). Recent studies further validate the methodological value of instructor journals in tracking pedagogical reasoning, professional growth, and adaptation to online platforms (Perrotta & Bohan, 2020; Babinská & Pleschová, 2024).

These journals encompass various forms of reflection including event-oriented entries that describe immediate instructional actions (Nalani et al., 2021), meditative entries that foster introspection and self-awareness (Park et al., 2020), critical entries that support problem-solving and integration of theoretical knowledge (Barham, 2023), and conferencing journals that promote reflective dialogue through interactive written exchanges (Maneepakathorn, 2023). Each instructional task cycle was accompanied by guided open-ended prompts (refer **Appendix E**) which encouraged the lecturer to document real-time teaching experiences, identify barriers to collaboration or conceptual understanding, and propose responsive refinements. This process enabled the capture of authentic instructional insights grounded in day-to-day classroom realities and digital interactions, particularly those mediated via Discord.

All journal entries (see transcripts in **Appendix E**) were confidentially recorded within a private lecturer-only text channel on the course Discord server. This design choice promoted privacy, psychological safety, and genuine self-reflection (Perrotta & Bohan, 2020; Putri, 2020). The lecturer was clearly informed that reflections were not evaluated for correctness but instead valued as iterative contributions to improving the instructional design and alignment of the OCL framework with students' evolving learning needs. This reflective practice is aligned with constructivist pedagogical principles where continuous situated reflection informs the refinement of teaching approaches within technology-enhanced learning environments (Barham, 2023). The journal played a formative role in shaping the DBR cycles, offering rich and contextual insights into lecturer decision-making and instructional responsiveness in OCL.

### **3.6.3 Online Observations**

Online observations were systematically employed to document real-time collaborative interactions within Discord channels (Tasks 2–7 only). A total of six structured online observation sessions were conducted, corresponding to Tasks 2 through 7. Each observation session lasted approximately 60–90 minutes, depending on the duration of synchronous discussions and the activity level within asynchronous text channels during the designated task period. These observations provided critical insights into students' authentic behaviours, extending beyond their self-reported perceptions (Yin, 2018). By closely monitoring asynchronous text-based discussions and live synchronous voice interactions (no recordings were made in accordance with conditional ethical approval in Section 3.9), the researcher examined student engagement, group cohesion, conversational flow, and evolving collaboration patterns across the DBR cycles (refer **Appendix F** for observation

logs and notes). This method ensured a grounded interpretation of interactional dynamics that aligned with or diverged from participants' reflections (González & Ponce, 2024). To safeguard participant privacy, data collection was limited to public Discord channels explicitly designated for group work with private or direct messages intentionally excluded in accordance with ethical research standards (Müller, 2023).

Data were collected using a structured observational checklist designed to assess four key dimensions of collaborative learning: Participation Level, Reciprocity, Social Engagement, and Cognitive Depth. Each dimension was evaluated through observable behaviours classified as either “*High*” or “*Low*”, supporting clear, consistent, and replicable interpretation of student interactions (Horvitz et al., 2024). The researcher remained critically aware of the potential for interpretive bias in qualitative coding, applying the checklist systematically to enhance reliability (Burke et al., 2024). The following are the criteria used to qualitatively assess each dimension:

#### **a) Participation Level**

This dimension captured the consistency and initiative of student contributions including the frequency of posts, responsiveness, and the extent to which learners initiated or sustained discussion threads. This aligns with prior research emphasizing the importance of regular presence and initiative in digital collaboration (González & Ponce, 2024):

- ***High Participation*** involved frequent and proactive engagement including initiation of new discussions and timely meaningful contributions across tasks.
- ***Low Participation*** reflected sporadic engagement, limited initiative, and posting primarily in response to prompts.

## **b) Reciprocity Level**

Reciprocity examined the depth and mutuality of exchanges, focusing on how effectively learners responded to, built upon, or extended peers' ideas. These behaviours are indicative of collaborative knowledge construction as observed in asynchronous online forums (Almodiel, 2022).

- **High Reciprocity** featured multi-turn dialogues, collaborative idea-building, clarifying questions, and mutual acknowledgment.
- **Low Reciprocity** interactions were brief, isolated, and lacked interdependence in the conversation flow.

## **c) Social Engagement**

Social engagement assessed the emotional and interpersonal tone of discourse including expressions of support, humour, empathy, and non-verbal cues like emojis. Such markers are essential for understanding interpersonal rapport in online learning communities (Müller, 2023).

- **High Social Engagement** was evident through warm, expressive, and community-oriented interactions that fostered group cohesion.
- **Low Social Engagement** consisted of transactional and task-oriented communication with minimal affective expression.

#### **d) Cognitive Depth**

This dimension reflected the intellectual complexity of student discussions. It included evidence of analytical questioning, reflective thinking, conceptual application, and collaborative problem-solving. This categorization aligns with the ICAP (Interactive–Constructive–Active–Passive) framework used to evaluate student engagement in digital forums (Burke et al., 2024).

- *High Cognitive Depth* involved extended reasoning, integration of biological concepts, and thoughtful application of knowledge to task demands.
- *Low Cognitive Depth* was marked by surface-level exchanges focused primarily on task management or factual clarification.

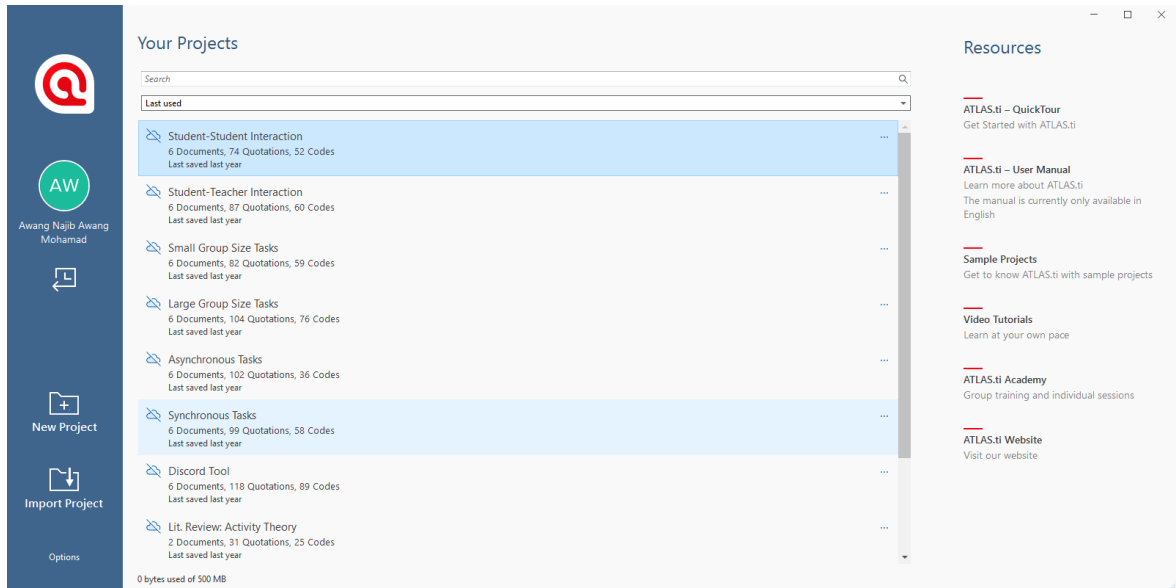
All individual contributions were analyzed per task with data synthesised into group-level profiles capturing emergent collaborative patterns across the four dimensions. These summaries were narratively presented to depict evolving interactional dynamics within each group and across DBR iterations, thereby offering a comprehensive qualitative understanding of how students engaged with Discord-mediated collaborative learning environment (Horvitz et al., 2024).

### **3.7 Thematic Analysis**

A thematic analysis was conducted on the qualitative data obtained from focus group interview transcripts, reflective journal entries, and online observation notes. The analysis drew on the six-phase framework proposed by Braun and Clarke (2006) with Atlas.ti 2024 as the primary software for organizing, coding, and synthesizing data (see Figure 3.7). The purpose of employing thematic analysis was to systematically identify patterns that directly addressed RQ1–RQ4 and to map these patterns onto the relevant AT components (Tool, Rules, Division of Labour, and Community), thereby ensuring analytical alignment between data interpretation and the study’s conceptual framework.

#### **a) Phase 1: Familiarization**

The researcher commenced by conducting multiple thorough readings of all qualitative data sources. This immersive reading process aimed primarily to develop a comprehensive understanding of the collected data. At this preliminary stage, no formal coding or categorization was undertaken. Instead, the researcher engaged in reflective analysis to identify initial themes, recurrent issues, or noteworthy patterns. Particular attention was given to capturing the holistic essence of participants’ perceptions of OCL while noting emerging concerns and contextual complexities. During this phase, preliminary observations were tentatively linked to the research questions to guide subsequent coding toward issues relevant to Discord’s mediating role (RQ1), communication norms (RQ2), group configurations (RQ3), and interactional dynamics (RQ4).



**Figure 3.7:** Screenshot of ATLAS.ti project interface

## b) Phase 2: Generating Initial Codes

Relevant codes were systematically labelled from the data using Atlas.ti 2024 upon completion of the familiarization stage (Figure 3.8). Open coding was employed to assign descriptive codes both *inductively* based on emergent perspectives from participant responses and *deductively* guided by existing literature and theoretical frameworks.

The screenshot shows the 'Document Manager' view in ATLAS.ti. At the top, there are 'Group' and 'View' buttons. Below is a search bar labeled 'Search Documents'. The main content is a table with the following columns: ID, Name, Media Type, Location, Groups, Quotations, and Created by. The table lists seven documents (D1 to D7) with their respective details. Document D5 is highlighted in blue.

ID	Name	Media Type	Location	Groups	Quotations	Created by
D 1	FG1_DiscordTool	Text	Library		15	Awang Najib Awang Mohamad
D 2	FG2_DiscordTool	Text	Library		19	Awang Najib Awang Mohamad
D 3	FG3_DiscordTool	Text	Library		15	Awang Najib Awang Mohamad
D 4	FG4_DiscordTool	Text	Library		25	Awang Najib Awang Mohamad
D 5	FG5_DiscordTool	Text	Library		27	Awang Najib Awang Mohamad
D 6	FG6_DiscordTool	Text	Library		17	Awang Najib Awang Mohamad
D 7	Journal Transcr...	Text	Library		11	Awang Najib Awang Mohamad

**Figure 3.8:** Document Manager view in ATLAS.ti

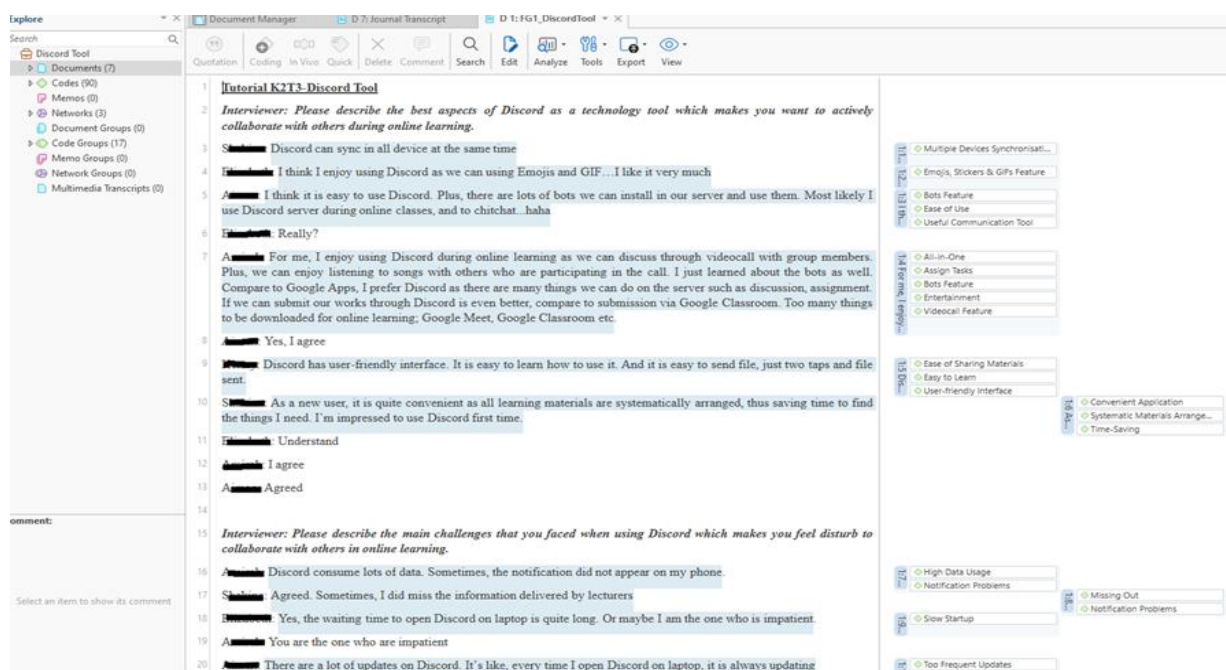
For example, statements such as “*Discord consume lots of data*” were coded as *High Data Usage*, while remarks like “*I prefer synchronous because we can finish the task immediately*” were labelled *Time Saving*. Similarly, a comment such as “*When we get fast reply from the lecturer, we feel more confident to continue the discussion*” was coded as *Immediate Support*, whereas the statement “*Sometimes only two or three people talk, others just remain silent*” was coded as *Uneven Participation*. The initial coding approach was deliberately inclusive to ensure that a comprehensive range of insights was captured and could be further explored in the next stages of analysis. Each code was subsequently examined in relation to the relevant research question and AT component to ensure that the analytic process remained conceptually anchored rather than purely descriptive.

To enhance analytic credibility and reduce potential researcher bias, a secondary coder from the researcher’s academic circle was appointed to review a subset of the coded transcripts (approximately 20% of the dataset). The secondary coder examined the alignment between selected data excerpts and their assigned codes and provided feedback on coding consistency and conceptual clarity. Any discrepancies in interpretation were discussed and resolved collaboratively, leading to refinement of selected code labels and consolidation of overlapping categories. This process strengthened coding reliability and supported the trustworthiness of the thematic analysis.

### **c) Phase 3: Searching for Themes**

Following the initial coding, related codes were clustered into preliminary themes. Codes reflecting similar concepts were systematically grouped to examine conceptual relationships (Figure 3.9). For instance, codes such as *High Data Usage*, *Slow Startup*, *Small File Upload Size*, and *Notification Problems* were combined into a candidate theme titled

"**Technical Issues**". Similarly, codes representing constructive group interactions including *Prompt Feedback* and *Group Support* formed the basis of a potential theme labelled "**Effective Communication**". For example, the student statement "*Sometimes when we discuss in voice channel, I cannot follow because the internet lag and people talk too fast*" was initially coded as *Unstable Internet Connection* and *Difficulty Following Discussion*. These codes were subsequently clustered with related codes such as *High Data Usage* and *Internet Connection Dependent* and later refined under the broader theme **Connectivity Issues**. Likewise, coded excerpts such as *Immediate Lecturer Support* and *Prompt Feedback* were grouped under the developing theme **Lecturer Presence** which was later positioned within the broader AT component of Community.



**Figure 3.9:** Coded transcript in ATLAS.ti

Throughout this iterative process, the researcher continuously referred back to underlying data excerpts (quotations) to ensure that the identified clusters authentically captured participants' experiences. Atlas.ti facilitated this verification by enabling quick retrieval and review of all data segments associated with specific codes, thereby supporting rigorous and comprehensive theme development. At this stage, emerging themes were explicitly cross-checked against the research questions to ensure that each theme contributed directly to answering at least one RQ rather than remaining as an isolated descriptive category.

#### **d) Phase 4: Reviewing Themes**

Next, each candidate theme was carefully assessed for internal coherence and alignment with the underlying data. This involved verifying that all quotations linked to each theme consistently reflected its central concept (Figure 3.10). When thematic overlaps were identified, themes were either merged or reorganized to enhance clarity and coherence. For example, the code *High Data Usage* was integrated with *Internet Connection Dependent* into the broader theme **Connectivity Issues**.

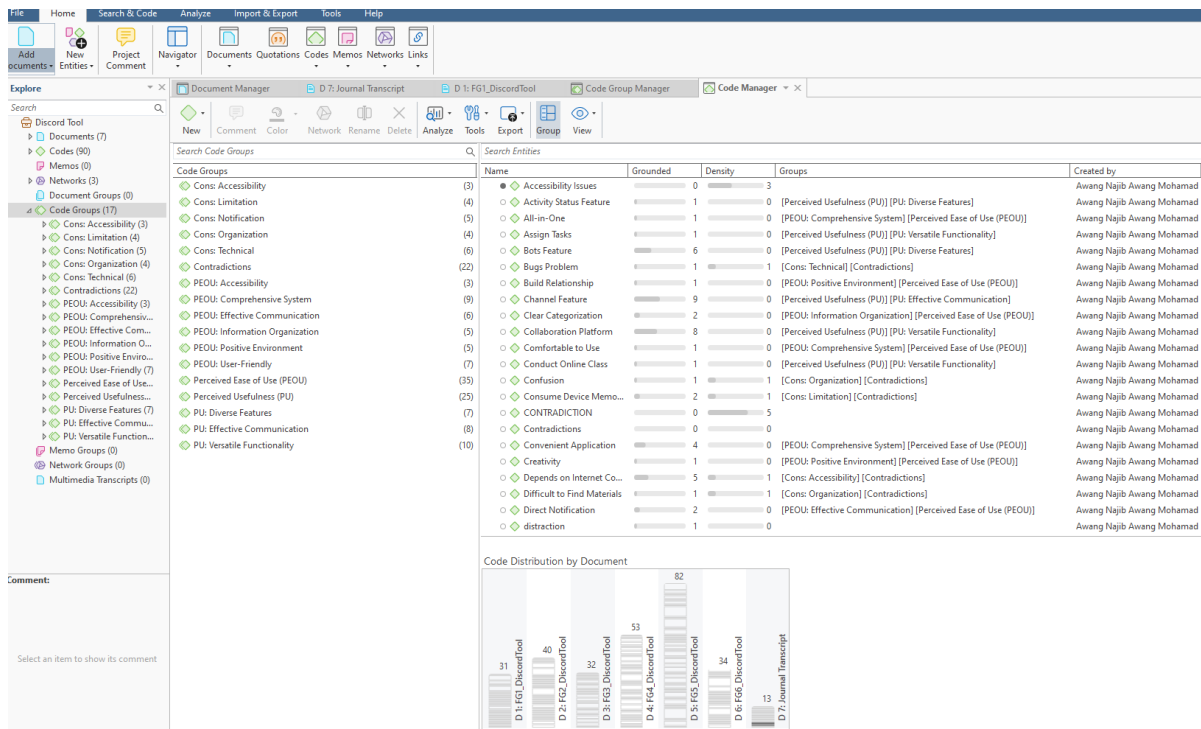


Figure 3.10: Code Group Manager in ATLAS.ti

Similarly, *Effective Communication* was subdivided into *Instant Feedback* and *Active Engagement*, emphasizing the distinction between immediate support and sustained interaction. Additionally, potential overlaps or closely related codes such as *Low Participation* frequently co-occurring with *Connectivity Issues* were identified for further analysis. Codes were retained within a theme only if they demonstrated strong conceptual alignment with the central meaning of the theme and were supported by multiple data excerpts across at least two data sources (e.g., focus group and observation, or journal and focus group). Codes that appeared in isolated instances, lacked sufficient supporting quotations, or showed weak alignment with the developing thematic structure were not immediately incorporated into the main thematic framework. Instead, these codes were re-examined through triangulation with other data sources to determine whether they represented emerging patterns or context-specific anomalies. Codes that continued to lack conceptual coherence after cross-source comparison were deferred from final theme

construction, and their exclusion was documented in analytic memos to maintain an audit trail of decision-making. This review phase ensured that only analytically meaningful themes capable of illuminating Discord's mediating functions and interactional dynamics in relation to the RQs were retained for final interpretation.

#### **e) Phase 5: Defining and Naming Themes**

After refinement, each theme was meticulously defined to clearly articulate its conceptual scope within the context of OCL. Themes were refined and named to accurately reflect their central ideas such as “**Privacy and Anonymity Settings**” which captured participants' appreciation for Discord's controls over personal information disclosure and “**Scheduling Conflicts in Synchronous OCL**” which described the logistical challenges participants faced when coordinating synchronous activities. Additionally, sub-themes were established where needed to highlight specific dimensions within broader thematic categories. Throughout this process, the researcher continuously drew upon participant quotations, observational data, and reflective journal entries to ensure that theme definitions and labels authentically represented participants' experiences and the contextual complexities associated with OCL. Each finalised theme was explicitly positioned within the relevant AT element and linked to the corresponding research question to preserve theoretical coherence and analytical precision.

#### **f) Phase 6: Final Interpretation**

Finally, the researcher integrated the identified themes into a structured interpretation aligned with the research questions and theoretical framework using a Thematic Analysis Matrix (refer **Appendix J**). Key themes were illustrated using representative data extracts, clearly conveying each theme's significance and practical implications. For example, the

theme “**Boosting Productivity in Lecturer-Student OCL Community**” was supported by participant quotes such as: “*We can finish our task faster when the lecturer is present because we get immediate clarification*” (S3). Reflexivity was maintained throughout the interpretive phase by revisiting reflective memos to ensure interpretations were grounded in the data. The thematic findings were then connected to the broader DBR context, showing how the analysis informed iterative improvements to Discord-based tools and guided pedagogical strategies for effective OCL. By explicitly aligning each interpretive insight with the relevant RQ and AT construct, the final analysis demonstrates how thematic patterns move beyond description to provide theoretically grounded explanations of how Discord mediates OCL within the matriculation context.

### 3.8 Trustworthiness & Rigour

This research followed Lincoln and Guba (1985) framework to ensure credibility, transferability, dependability, and confirmability of its qualitative findings. These criteria are foundational for establishing trustworthiness in qualitative research:

- **Credibility:** The research intervention spanned 15 weeks, allowing sufficient time to observe changes in students' use of Discord across iterative cycles. Prolonged engagement and persistent observation support the authenticity of qualitative data (Lincoln & Guba, 1985). Preliminary focus group findings were shared with participants as a form of member checking, which is a recommended strategy to confirm that recorded responses accurately reflect participants' experiences (Birt et al., 2016). Member checking was conducted after each focus group through a brief summary posted in the designated Discord channel. Participants were invited to confirm accuracy or clarify meaning within a 3–5 day response window. Where ambiguities arose, follow-up prompts were issued and summaries revised accordingly. Minor factual corrections were amended immediately, while interpretive clarifications were documented in analytic memos and incorporated into subsequent coding. This process preserved participants' intended meanings while maintaining an auditable record of revisions. Additionally, data triangulation across multiple sources including focus groups, lecturer's reflective journal, and online observations was employed to verify the consistency of emerging patterns (Yin, 2018).
- **Transferability:** The research provides thick and detailed descriptions of the research context including the structure of Malaysian matriculation system, cultural

expectations, and the implementation of Discord. Such rich contextual information enables readers to assess whether findings are applicable to other similar educational environments (Merriam & Tisdell, 2016). Emphasis on institutional constraints and the exam-driven culture further supports readers in making informed transferability judgments (Tracy, 2010).

- **Dependability:** A detailed audit trail was maintained through researcher memos which systematically documented design decisions, contradictions, and iterative modifications across each DBR cycle as further elaborated in Chapter 4. These memos served not only as a methodological record but also as a practical tool for informing ongoing refinements to the instructional design. By tracing how emerging insights from participant feedback, observations, and reflections were translated into specific pedagogical and technical adjustments, the memos supported a transparent and coherent design process (Carcary, 2021). In addition, peer debriefing sessions were conducted with *Expert 1* and *Expert 2* after each cycle to obtain external feedback and critique, enhancing logical consistency and ensuring alignment between the research data and evolving intervention design (Spall, 1998).
- **Confirmability:** The researcher engaged in regular reflexivity by recording personal assumptions and potential biases after each coding session. This helped reduce the risk of subjective interpretation influencing the findings (Olmos-Vega et al., 2023). A secondary coder from the researcher's circle was appointed to assist with the coding process. This individual reviewed a subset of the focus group transcripts, and any differences in coding were resolved collaboratively, thereby enhancing the consistency and reliability of the thematic analysis (O'Connor & Joffe, 2020).

### 3.9 Ethical Considerations

The following were the ethics considerations of this research:

- **Ethical Approvals:** Formal approval was obtained from the following bodies: Malaysian Ministry of Education (MoE) via the Educational Research Application System (eRAS 2.0) [*Ref. No: KPM.600-3/2/3-eras (18676)*]; Matriculation Division; UNIMAS Human Research Ethics Committee [*Ref. No: UNIMAS/TNC(PI)/09 – 65/02 (80)*], and Director of the participating matriculation college (refer **Appendix G**).
- **Participant Briefing and Consent:** All relevant personnel were approached in person. The researcher clearly explained the aims of the study and assured participants of confidentiality. Written informed consent was obtained (refer **Appendix H**) and participants were informed of their right to withdraw at any time without penalty.
- **Anonymity and Confidentiality:** The anonymity of participants and the participating institution was strictly maintained. No identifying information was included in any publications, presentations, or report.
- **Data Protection and Storage:** All digital data were encrypted and stored on password-protected drives. Data access was restricted to the researcher alone.
- **Dissemination of Findings and Publication Approval:** The final findings were formally presented to the MoE (Matriculation Division) and the participating matriculation college in both hardcopy and softcopy formats. Any publications derived from this research were submitted only after securing permission from the Malaysian MoE.

### **3.10 Chapter Summary**

This chapter has presented the methodological framework for investigating Discord-mediated OCL in a Malaysian Biology matriculation setting. Guided by the social constructivist worldview, the research adopts DBR approach within a single-case study design to generate iterative and in-depth insights into collaborative learning under time-constraint conditions. AT serves as the guiding lens, ensuring that each design cycle addresses the roles of Tools (RQ1), Rules (RQ2), Division of Labour (RQ3), and Community (RQ4) in shaping the OCL environment. The data collection strategy which includes focus group interviews, lecturer's reflective journal, and online observations ensures methodological triangulation and supports an in-depth exploration of participant engagement. Detailed procedures for thematic analysis, reflexivity, and iterative feedback loops have been described along with considerations of ethical considerations and trustworthiness. The next chapter will present the empirical findings, illustrating how participants navigated and adapted to Discord's features and limitations throughout the iterative development of the intervention.

## **CHAPTER 4**

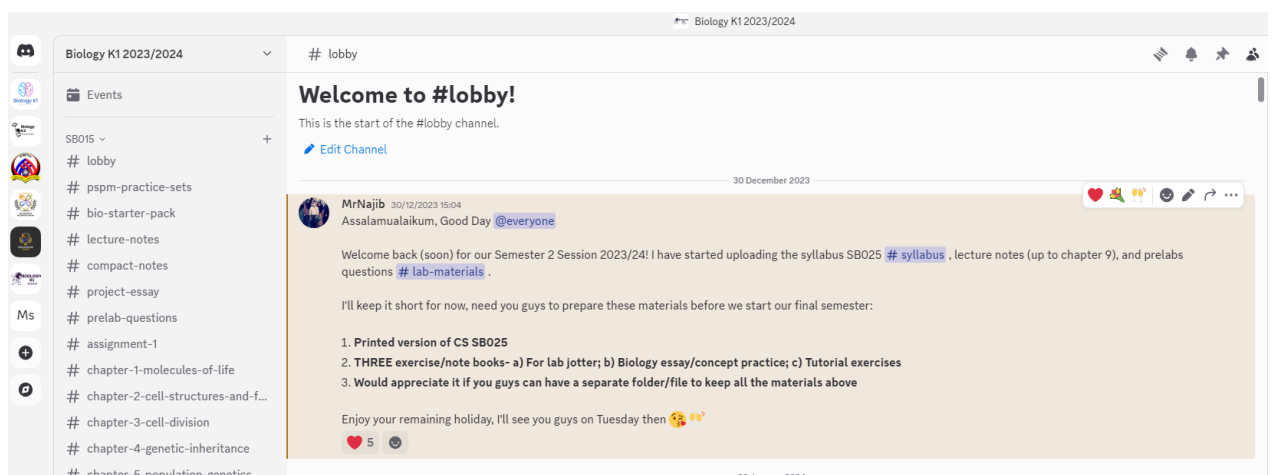
### **RESULTS & DISCUSSION**

#### **4.1 Chapter Overview**

This chapter presents the findings and analysis from seven tasks that explored the use of Discord in facilitating OCL among Biology matriculation students. Section 4.2 examines how the features of Discord served as mediating tools that influenced student interaction and academic engagement (RQ1). Section 4.3 addresses the role of communication rules, both synchronous and asynchronous, and their impact on collaborative outcomes (RQ2). Section 4.4 investigates the effects of group size and division of labour on task execution, comparing the advantages and disadvantages of large groups (15 members) and small groups (5 members) (RQ3). Section 4.5 focuses on community dynamics, specifically lecturer–student and student–student interactions, and discusses how these relationships either supported or hindered meaningful online collaboration (RQ4). Each section applies AT to identify contradictions, tensions, and potential improvements for OCL design in Biology matriculation settings.

## 4.2 Discord as Mediating Tool in OCL

At the beginning of the semester (Week 1–2), a dedicated Discord server comprising 20 text and voice channels was established to mediate OCL in Biology (Figure 4.1). The channels were organized to support various collaborative needs such as announcements (#lobby), Q&A per chapter (e.g. #chapter-1, #chapter-2), group tasks (#group-t3), and resource sharing (#biology-syllabus, #compact-notes, #practicum). All participants were assigned the “*Student*” role, while the lecturer and researcher held moderator privileges to manage channel access and coordination.



**Figure 4.1:** Screenshot of Discord Server Prototype

Since participants were unfamiliar with Discord for academic collaboration, Task 1 (refer **Appendix C** for instruction details) aimed to introduce the platform through a face-to-face orientation, complemented by a pinned instructional YouTube video (“How to Use Discord 2024”) in the #lobby channel. Synchronous and asynchronous activities were implemented to help students explore Discord features and establish initial norms of collaboration. This task was aligned with the Tools element of AT (RQ1) and focused on the Biology topic “Molecules of Life”.

Students were grouped and assigned to select one subtopic (water, carbohydrates, lipids, proteins, or nucleic acids), discuss its structural components and biological roles, and co-create an infographic using collaborative features on Discord. The infographic was evaluated based on content accuracy, visual design, creativity, and key concepts (refer **Appendix I** for student work sample). Data were collected through the lecturer's reflective journal and a focus group interview conducted at the end of Week 2 (no online observation was conducted for this introductory stage).

#### 4.2.1 Results

### *Positive Themes*

#### **Theme 1: Intuitive Interface and Design**

Focus group participants consistently praised Discord for its intuitive and user-friendly interface, often drawing favourable comparisons with other platforms. For example, S1 (FG1) remarked, “*Discord has a user-friendly interface. It is easy to learn how to use it. And it is easy to send file, just two taps and file sent*” [Code: Easy to Learn]. Similarly, S22 (FG5) highlighted the platform’s organizational benefits over WhatsApp, stating, “*Discord interface is more user-friendly... not crowded by the group chats like in WhatsApp.*” [Code: Organized Layout]. Participants S14 (FG3) and S2 (FG1) likewise described how Discord’s intuitive layout encouraged them to share materials more confidently right from their first encounter with the platform [Code: Confident Engagement].

The lecturer’s reflective journal supported these sentiments, observing that minimal time was needed for students to master basic features such as text channels and file sharing [Code: Easy to Learn]. According to the journal, this ease of adoption allowed participants to focus on critical discourse rather than struggling with technical barriers [Code: Easy to Learn]. The lecturer also noted that the presence of informal elements such as emojis contributed to an atmosphere of relaxed but productive engagement, thus lowering communication hesitations for new users [Code: Confident Engagement].

In summary, the convergence of focus group responses and lecturer reflections indicates that Discord’s intuitive interface reduced technological barriers, enhanced early user confidence, and enabled students to prioritise academic engagement over platform navigation. The theme therefore underscores how interface design functioned as a

foundational enabler of effective OCL within the matriculation context. These findings directly address RQ1 by demonstrating how Discord’s interface design functioned as a mediating Tool that reduced technological friction and supported early collaborative engagement in Biology OCL tasks.

**Table 4.1:** Summary of Theme: Intuitive Interface and Design

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Easy to Learn</b>	“Discord has a user-friendly interface. It is easy to learn how to use it... just two taps and file sent.” – S1 (FG1)	Lecturer observed students quickly mastered basic features such as channels and file sharing.
<b>Organized Layout</b>	“Discord interface is more user-friendly... not crowded by the group chats like in WhatsApp.” – S22 (FG5)	Journal noted the clean layout helped reduce confusion compared to messaging apps.
<b>Confident Engagement</b>	“We were more confident to share materials from the start.” – S14/S2 (FG3/FG1, paraphrased)	Journal reported that emojis and informal tools encouraged early, relaxed participation.

**Theme 2: Effective Channel Organization**

Many participants found Discord’s channel-based structure crucial for keeping discussions clear and on-topic. S4 (FG1) remarked, “*I prefer to use Discord. It is much organized... for online learning.*” [Code: Organized for Learning]. S21 (FG5) underlined, “*We can divide the topics into smaller specific divisions.*” [Code: Topic-Specific Channels] instead of mixing everything in a single chat thread. Participant S10 (FG2) also appreciated how quick it was to locate the correct channel, noting, “*You don’t need to search for it... you can see the class on the sidebar.*” [Code: Easy Navigation].

The lecturer’s journal reinforced this praise, indicating that students were significantly more efficient when referencing prior threads and materials thanks to Discord’s clearly labelled channels [Code: Organized for Learning]. The journal provided details on the creation of dedicated channels, including #tutorial-book and #practicum channels, which helped reduce confusion about where to post or locate information [Code: Topic-Specific Channels]. Although participants called for archiving old channels to avoid clutter, the

journal highlighted that Discord’s organizational strengths provided students with a clear advantage over messaging-only apps [Code: Easy Navigation].

In summary, the structured channel organization of Discord enhanced clarity, reduced informational overload, and supported efficient retrieval of academic content. By segmenting discussions into topic-specific spaces, the platform strengthened procedural order and minimized confusion, thereby facilitating more focused and productive OCL engagement within the matriculation setting. This theme addresses RQ1 by illustrating how Discord’s channel architecture structured knowledge flow and interaction patterns, thereby shaping the quality and efficiency of collaborative learning processes.

**Table 4.2:** Summary of Theme: Effective Channel Organization

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Organized for Learning</b>	“I prefer to use Discord. It is much organized... for online learning.” – S4 (FG1)	Lecturer noted that clearly labelled channels helped students locate materials efficiently.
<b>Topic-Specific Channels</b>	“We can divide the topics into smaller specific divisions.” – S21 (FG5)	Journal mentioned channels like <i>#tutorial-book</i> and <i>#practicum</i> reduced confusion.
<b>Easy Navigation</b>	“You don’t need to search for it... you can see the class on the sidebar.” – S10 (FG2)	Lecturer observed that students accessed correct threads quickly without needing reminders.

**Theme 3: Accessible File Sharing and Multi-Device Sync**

Participants lauded Discord’s simplicity in file exchange and its seamless experience across different devices. S30 (FG6) acknowledged, “*Discord makes it easier for us to send and receive learning materials quickly*” [Code: Easy File Sharing], while S18 (FG4) added, “*We can discuss and share task information and also ask task-related questions.*” [Code: Integrated Collaboration] all in one integrated space. Reflecting on the archival aspect, S11 (FG3) stated, “*In Discord, we can find older materials easily because everything is clearly arranged by topic.*” [Code: Archival Accessibility], highlighting the platform’s longevity for shared files in separate topical channels (e.g. *#chapter-3-cell-division*).

The lecturer observed in reflective journal entries that continuous multi-device syncing enabled students to switch between phones, tablets, and laptops without losing conversation threads or file access [Code: Multi-Device Synchronization]. S2 (FG1) specifically praised this feature, saying, “*Discord can sync on all devices at the same time.*” [Code: Multi-Device Synchronization]. However, the journal noted that while multi-device capabilities facilitated flexibility, certain students experienced lag or forced logouts when simultaneously logged in on multiple devices [Code: Multi-Device Synchronization]. Despite these minor setbacks, the key advantage of on-demand material sharing greatly supported real-time collaboration and resource retrieval [Code: Easy File Sharing].

In summary, Discord’s accessible file-sharing functions and multi-device synchronization enhanced continuity, flexibility, and resource accessibility within OCL. The ability to retrieve archived materials, share documents instantly, and transition seamlessly across devices strengthened collaborative efficiency, although minor technical interruptions occasionally moderated this advantage. These findings further respond to RQ1 by showing how file accessibility and cross-device synchronization mediated sustained participation and resource continuity in time-sensitive Biology learning contexts.

**Table 4.3:** Summary of Theme: Accessible File Sharing and Multi-Device Sync

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Easy File Sharing</b>	“Discord makes it easier for us to send and receive learning materials quickly.” – S30 (FG6)	Lecturer noted students frequently shared resources with minimal technical barriers
<b>Integrated Collaboration</b>	“We can discuss and share task information... all in one integrated space.” – S18 (FG4)	Journal highlighted Discord’s structure supported both conversation and file access.
<b>Archival Accessibility</b>	“We can find older materials easily because everything is clearly arranged by topic.” – S11 (FG3)	Topic-specific channels helped students revisit materials from previous discussions.
<b>Multi-Device Synchronization</b>	“Discord can sync on all devices at the same time.” – S2 (FG1)	Journal observed smooth device switching, though some users faced logout issues.

#### **Theme 4: Versatile Collaboration Features**

Focus group discussions revealed appreciation for Discord's range of communication tools, including text, voice, video, and interactive elements such as stickers and emojis. S10 (FG2) described how directly tagging lecturers facilitated academic inquiries, stating, "*You get the response directly.*" [Code: Direct Communication]. Similarly, S16 (FG4) remarked "*Yes, I prefer Discord because it is fun to use, it has lots of cute stickers and emojis... suitable for collaborative discussion.*" [Code: Engaging Environment], highlighting the contribution of informal features to a more comfortable and engaging learning environment. S6 (FG2) further emphasized that the use of voice channels supported group discussions for homework, thereby reducing instances of miscommunication [Code: Voice Channel Support].

According to the lecturer's reflective journal, these diverse platform features fostered an inclusive environment in which students felt more at ease expressing themselves, whether through text or voice communication [Code: Voice Channel Support]. Additional elements such as music bots and quick GIF responses were noted to enhance group cohesion, with the journal documenting instances where playful exchanges led to increased trust among participants [Code: Engaging Environment]. However, the lecturer also cautioned that in the absence of clear guidelines, these same features could become sources of distraction [Code: Feature Richness vs. Distraction]. Thus, maintaining a balance between social interaction and academic focus was deemed essential to fully leveraging Discord's collaborative potential in support of meaningful learning outcomes [Code: Feature Richness vs. Distraction].

In summary, Discord's versatile communication features enriched OCL by enabling immediate lecturer access, multimodal interaction, and a socially engaging atmosphere that

strengthened group cohesion. Nevertheless, the same feature richness required structured facilitation to prevent distraction, underscoring the need for balanced integration of social and academic functions within collaborative learning environments. This theme addresses RQ1 by demonstrating how multimodal affordances both enhanced and constrained collaborative engagement, depending on the clarity of facilitative guidelines.

**Table 4.4:** Summary of Theme: Versatile Collaboration Features

Code (Atlas.ti)	Focus Group Quote	Journal Insight
<b>Direct Communication</b>	“You get the response directly.” – S10 (FG2)	Lecturer observed that tagging and direct messaging improved immediacy of clarification.
<b>Engaging Environment</b>	“It is fun to use, got lots of cute stickers and emojis... suitable for collaborative discussion.” – S16 (FG4)	Informal tools like emojis and GIFs were noted to enhance group cohesion.
<b>Voice Channel Support</b>	“Voice channels supported group discussions for homework.” – S6 (FG2)	Journal highlighted that voice interactions reduced miscommunication in group work.
<b>Feature Richness vs. Distraction</b>	-	Lecturer cautioned that without clear rules, interactive features could distract learners from the task focus.

**Theme 5: Privacy and Anonymity Settings**

Several participants expressed appreciation for Discord’s privacy features, noting that the ability to conceal phone numbers and other personal information encouraged more open and confident communication. As S16 (FG4) stated, “*We can hide our phone numbers from others... I feel that Discord is suitable for an important and serious discussion.*” [Code: Concealed Contact Info]. Similarly, S22 (FG5) endorsed the platform’s data protection, commenting, “*From my perspective, Discord... gives us more privacy by not exposing our personal data.*” [Code: Data Protection Confidence]. These responses suggest that minimizing personal data exposure can facilitate online collaboration, particularly in settings involving participants from diverse backgrounds.

In the lecturer’s reflective journal, privacy settings were identified as a key factor in enhancing student confidence. The journal recorded instances where typically reserved

students began contributing more actively once reassured that their private details were protected [Code: Concealed Contact Info]. Furthermore, these privacy features were noted to help preserve a professional boundary between students and lecturers, thereby promoting a respectful academic environment [Code: Data Protection Confidence]. The journal recommended aligning institutional policies, such as avoiding the requirement for phone numbers during account creation, with Discord’s privacy features to further support students’ willingness to engage in collaborative learning [Code: Encouraged Engagement].

In summary, Discord’s privacy and anonymity settings strengthened student confidence, safeguarded professional boundaries, and encouraged broader participation in OCL. By reducing concerns about personal data exposure, these features created a psychologically safe environment that supported more open and sustained academic engagement. These findings contribute to RQ1 by highlighting how privacy affordances functioned as a mediating Tool that shaped students’ willingness to participate actively in collaborative discussions.

**Table 4.5:** Summary of Theme: Privacy and Anonymity Settings

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Concealed Contact Info</b>	“We can hide our phone numbers from others... suitable for an important and serious discussion.” – S16 (FG4)	Journal noted increased participation from reserved students after learning about privacy settings.
<b>Data Protection Confidence</b>	“Discord... gives us more privacy by not exposing our personal data.” – S22 (FG5)	Lecturer observed that privacy tools fostered a more professional and respectful atmosphere.
<b>Encouraged Engagement</b>	-	Journal recommended aligning platform use with institutional policies to support privacy and engagement.

## *Negative Themes*

### **Theme 6: Notification Frustrations**

While many participants viewed Discord positively overall, its unreliable notification system frequently led to missed updates. S4 (FG1) remarked, “*Sometimes, the notification did not appear on my phone.*” [Code: Missed Notifications], and S11 (FG3) described instances of being redirected incorrectly when tapping on a notification [Code: Navigation Issues via Alerts]. S21 (FG5) reflected a common concern: “*If that group of students are not tagged, no notification will be received.*” [Code: Tagging Limitations]. This inconsistency compelled students to manually check the app, contributing to anxiety over potentially overlooked announcements.

The lecturer’s reflective journal documented several cases in which participants missed time-sensitive instructions or assignment details due to notification failures [Code: Missed Notifications]. Although tagging individuals was used as a partial workaround, the journal also noted that excessive tagging could become disruptive [Code: Tagging Limitations]. The lecturer recommended providing students with systematic guidance on customizing their notification settings and suggested platform-level improvements such as the introduction of an “auto-alert” feature for class announcements to ensure consistent communication and support collaborative learning [Code: Navigation Issues via Alerts].

These findings suggest that notification unreliability can weaken perceived instructor presence and disrupt continuity of communication, both of which are critical determinants of sustained engagement and accountability in OCL environments. In time-sensitive academic contexts such as the matriculation programme, consistent notification systems are

therefore not merely technical conveniences but pedagogical necessities that shape students’ sense of inclusion, responsiveness, and task alignment.

In summary, notification limitations constrained the effectiveness of Discord as a mediating Tool by interrupting information flow and increasing student uncertainty. Reliable alert systems are essential to maintaining continuity, instructor visibility, and coordinated participation within exam-oriented OCL settings. This theme addresses RQ1 by demonstrating that technological instability within the Tool component directly influenced perceived instructor presence and collaborative responsiveness.

**Table 4.6:** Summary of Theme: Notification Frustrations

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Missed Notifications</b>	“Sometimes, the notification did not appear on my phone.” – S4 (FG1)	Lecturer noted students missed key instructions due to inconsistent notification delivery.
<b>Tagging Limitations</b>	“If that group of students are not tagged, no notification will be received.” – S21 (FG5)	Journal observed that tagging helped but led to overuse, creating disruption and message overload.
<b>Navigation Issues via Alerts</b>	“I saw a notification and clicked it, but it did not direct me to that message.” – S11 (FG3)	Lecturer recommended structured training on notification settings and proposed a class-level auto-alert feature.

**Theme 7: Technical Issues**

Participants consistently reported technical difficulties, including slow application startups, frequent forced updates, and glitches affecting voice or chat functionality. S3 (FG1) noted, “*Yes, the waiting time to open Discord on a laptop is quite long.*” [Code: Slow Startup], while S5 (FG1) described encountering updates “*every time I open Discord.*” [Code: Forced Updates], which often caused abrupt interruptions during sessions. S9 (FG2) added that microphone or voice channel malfunctions were “*embarrassing*” [Code: Voice/Chat Glitches], illustrating how such issues diminished user confidence and hindered effective real-time collaboration.

Entries in the lecturer’s reflective journal supported the disruptive nature of these technical challenges. The journal described instances where mid-lesson voice chat failures necessitated sudden transitions to alternative platforms [Code: Voice/Chat Glitches]. Although some problems were eventually addressed by the developer, the continual release of updates frequently introduced new bugs, thus compounding user frustration [Code: Forced Updates]. The lecturer concluded that while regular updates can enhance security and functionality, excessive or poorly timed changes may compromise session continuity. A more stable update cycle, along with accessible troubleshooting resources was recommended to support a smoother user experience [Code: Stability Recommendation].

In summary, recurring technical disruptions weakened the stability of Discord as a mediating Tool by interrupting synchronous flow, reducing user confidence, and increasing cognitive load. Platform reliability and structured technical support are therefore essential conditions for sustaining effective OCL in high-stakes, time-sensitive academic contexts. These findings address RQ1 by evidencing how technical reliability shaped the extent to which Discord could function effectively as a mediating Tool in structured collaborative learning.

**Table 4.7:** Summary of Theme: Technical Issues

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>Slow Startup</b>	“The waiting time to open Discord on laptop is quite long.” – S3 (FG1)	Lecturer observed delays at the start of sessions due to slow app loading, affecting punctuality.
<b>Forced Updates</b>	“Every time I open Discord, it’s updating.” – S5 (FG1)	Journal noted that frequent updates disrupted lesson flow and introduced new bugs.
<b>Voice/Chat Glitches</b>	“Mic or voice chat always have bugs... it’s embarrassing.” – S9 (FG2)	Lecturer reported mid-lesson technical failures requiring sudden platform switches.
<b>Stability Recommendation</b>	-	Journal recommended a more stable update cycle and better user guidance for troubleshooting issues.

### **Theme 8: Connectivity Dependence and Data Usage**

A major challenge identified by participants was Discord's high data consumption and reliance on stable internet connectivity. S20 (FG4) stated, "*Discord needs a large amount of internet data for it to function normally.*" [Code: High Data Consumption]. S23 (FG5) similarly commented on its "*large amount of data*" requirements [Code: High Data Consumption]. Participants such as S16 (FG4) found the need for frequent refreshes difficult in areas with unreliable service [Code: Unstable Connectivity Impact], while S6 (FG2) highlighted the absence of offline access options, noting, "*They [other platforms] provide functionality to save all files offline. Using Discord, I need to have a strong internet connection.*" [Code: Lack of Offline Access].

From the lecturer's perspective, participants located in areas around the college with slow internet connectivity or no Wi-Fi availability were the most severely impacted by these limitations. They often missed live voice discussions due to unstable connections and faced difficulties downloading large files essential for their coursework [Code: Unstable Connectivity Impact]. This situation placed them at a disadvantage compared to peers with more reliable internet access. The journal highlighted a key challenge: while Discord's advanced features such as voice channels, screen sharing, and bots improved collaborative learning, they also created problems for students with limited internet access [Code: High Data Consumption]. The lecturer suggested that more work is needed to find inclusive solutions or to use hybrid learning approaches that can support students with varying internet conditions [Code: Lack of Offline Access].

In summary, heavy data usage and connectivity dependence functioned as structural constraints that shaped unequal participation in OCL. While Discord's rich features enhanced collaboration for well-connected students, they simultaneously risked

marginalising learners with limited bandwidth, underscoring the need for adaptive, bandwidth-sensitive, and hybrid implementation strategies in exam-oriented contexts. This theme addresses RQ1 by revealing how infrastructural conditions mediated the effectiveness of Discord’s affordances, thereby influencing equitable participation in collaborative Biology tasks.

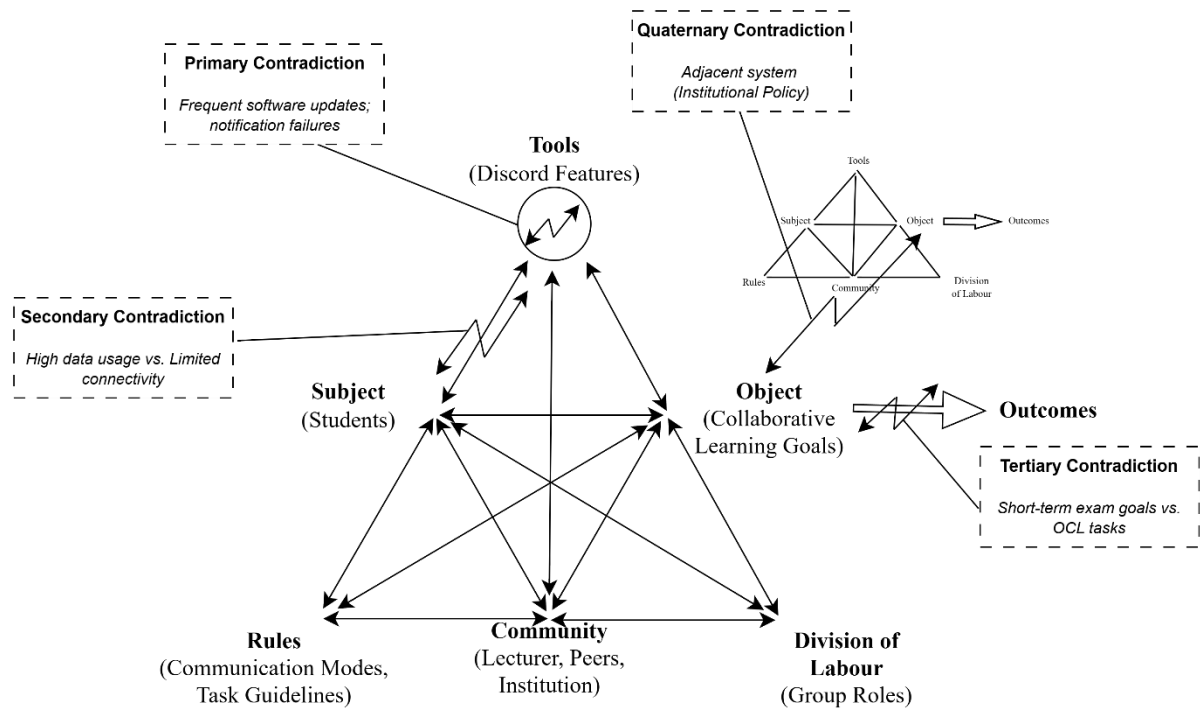
**Table 4.8:** Summary of Theme: Connectivity Dependence and Data Usage

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>
<b>High Data Consumption</b>	“Discord needs a large amount of internet data for it to function normally.” – S20 (FG4)	Lecturer noted that students with limited data struggled to access voice channels and download materials.
<b>Unstable Connectivity Impact</b>	“Frequent refreshes are difficult in areas with bad service.” – paraphrased from S16 (FG4)	Journal highlighted that students from low-bandwidth areas missed real-time discussions.
<b>Lack of Offline Access</b>	“Other platforms provide offline access... but Discord needs strong internet.” – S6 (FG2)	Lecturer emphasized the need for hybrid approaches to support students with poor or inconsistent access.

#### 4.2.2 Discussion

***RQ1: How do Discord features function as a tool to support OCL among Biology matriculation students?***

Within the specific context of this Malaysian matriculation Biology cohort, the results demonstrate how Discord's channel-based structure, file-sharing features, and varied communication modalities functioned as mediating artifacts that facilitated collaboration (Engeström, 2000). Consistent with existing OCL studies (Butarbutar et al., 2023; Lauricella et al., 2024), the platform's intuitive interface and organizational structures enabled learners to share resources, pose questions, and engage in real-time or asynchronous exchanges. These findings highlight the importance of aligning technology as a Tool with the Object of OCL, especially in an exam-driven context where time efficiency and clarity of communication are critical. In direct response to RQ1, these findings suggest that in this context, Discord functioned not merely as a communication platform but as a mediating Tool that structured how knowledge was accessed, exchanged, and refined within collaborative Biology tasks within this specific matriculation context. Yet, the results also highlight several contradictions that emerged when Discord was integrated into a matriculation environment. Within AT, contradictions are not merely problems but catalysts for expansive learning (Engeström, 2001). Figure 4.2 maps these tensions onto the activity system components. In line with Engeström's (2001) expansive learning cycle, the identification of these contradictions marks the initial phase of questioning and analysis, prompting participants and the researcher to critically examine existing practices and consider potential transformations within the activity system.



**Figure 4.2:** Contradictions in a Discord-Mediated Activity System

### **Primary Contradictions** (Within the Tool Element)

A key contradiction appeared within the Tool component when participants encountered frequent software updates, inconsistent notifications, and periodic voice-channel malfunctions. Empirical data from focus groups and reflective journal entries consistently documented frustration with sudden updates and unexpected disconnections during synchronous discussions. For example, several participant quotations explicitly reflected frustration with platform instability. S12 (FG3) noted that updates sometimes occurred “*suddenly before discussion,*” disrupting continuity, while observational notes recorded instances where students re-entered voice channels after unexpected disconnections. These data extracts demonstrate how technical instability was experienced directly as a barrier to collaborative continuity rather than merely a minor inconvenience. Although regular updates can enhance platform security and functionality, the researcher found that the updates occasionally disrupted ongoing sessions. This tension led some

students to lose confidence in Discord's reliability. This finding partially refines earlier optimism regarding Discord's user-friendly nature (Craig & Kay, 2023). From an AT perspective, this tension reflects a primary contradiction within the Tool component, where technological enhancement simultaneously introduced instability. While prior research has noted technical hiccups (Wiles & Simmons, 2022), the time-sensitive demands of matriculation academic program schedule heightened the negative impact here, highlighting the unique pressures faced by exam-driven programs. Within the expansive learning framework, this disruption represents the "analysis" stage, where participants began recognising structural tensions in the Tool component and reconsidering assumptions about technological reliability in supporting collaborative continuity. Thus, in relation to RQ1, Discord's effectiveness as a Tool in this study was conditional upon infrastructural stability; its mediating function strengthened collaboration only when technical reliability was sustained within this specific academic setting.

### **Secondary Contradictions** (Between Tools and Subject)

Several tensions emerged between Tools and Subjects. High data consumption and the need for stable internet (Tool) meant that students with limited connectivity (Subject) struggled to access synchronous sessions and large file uploads. Participant quotations further substantiated this tension. S22 (FG2) reported that unstable internet caused missed explanations during live discussions, while S1 (FG1) stated that downloading large files was "difficult with limited data." These statements illustrate how infrastructural limitations shaped differential participation and reinforced inequities within synchronous engagement. From an AT perspective, this pattern represents a secondary contradiction between the mediating Tool (Discord's technical affordances) and the Subject (students' material and

infrastructural conditions). This misalignment between Discord's features and the socioeconomic or infrastructural realities of certain learners affirms earlier cautions about digital inequities in OCL (Gaad, 2022). However, this issue was especially problematic in the exam-oriented environment where quick access to announcements and immediate downloading of revision materials were essential. This challenge extends prior studies (Altowairiki, 2021; Hackett et al., 2024) by illustrating that even when a platform supports deep collaboration, constraints such as bandwidth or data limitations can hinder participation, thereby necessitating adaptive or hybrid strategies (e.g. offline access, institutional Wi-Fi support). This recognition of inequitable participation reflects the modelling phase of expansive learning, as the activity system was reconceptualised to accommodate infrastructural diversity through adaptive communication strategies. Accordingly, RQ1 is further clarified by demonstrating that Discord's features functioned effectively as a Tool when aligned with the material conditions of learners in this cohort; otherwise, the same features risked reproducing participation inequalities within this context.

### **Tertiary Contradictions** (Old vs. New Forms of Activity)

A tertiary contradiction emerged indirectly from their focus on short-term exam-oriented tasks (Old Form) in contrast to deeper collaborative engagement (New Form). Discord's design fosters exploratory discussion, creative idea-sharing, and iterative feedback, all of which are hallmarks of constructivist learning (Harasim, 2012). However, the matriculation program emphasizes rapid coverage of material and high-stakes examinations. This clash between a conventional exam-driven activity and the more dialogic collaborative approach made possible by Discord mirrors Engeström's (1987) description of new tools entering traditional practice. Some students used Discord merely for quick

clarifications or “test tips” rather than sustained knowledge-building. Focus group data extracts showed that several students prioritised efficiency over dialogic exploration. This pattern was observed across four of the six focus groups, where participants consistently referenced time pressure and examination priorities as reasons for limiting extended discussions. For instance, S3 (FG4) commented that Discord was mainly useful for “quick clarification before exam,” and S18 (FG6) explained that extended discussions were avoided due to time pressure. These participant quotations indicate that the platform’s collaborative affordances were filtered through an exam-oriented mindset. This partial application contrasts with typical learning contexts that are not driven by examinations (Kristian et al., 2023) where Discord’s features have been used more extensively for project-based inquiry or community-building. Here, time pressure and curricular priorities moderated the degree to which the platform’s collaborative affordances were fully realized. Such tension illustrates the expansive learning movement from questioning established exam-oriented norms toward envisioning alternative collaborative practices that better align the Tool with deeper constructivist objectives. In relation to RQ1, this suggests that while Discord’s features offer affordances for deeper OCL, their actual function in this study was mediated by prevailing academic norms and assessment pressures within the matriculation programme.

### **Quaternary Contradictions** (Misalignment with Other Activity Systems)

Although institutional policies (Other Activity System) did not explicitly prohibit third-party platforms, the lecturer’s reflective journal suggested occasional tension between the official LMS (Moodle) and Discord usage. Reflective journal entries further revealed that some announcements had to be duplicated on Moodle to ensure compliance with institutional reporting norms. In one entry, the lecturer noted that certain students still relied

on Moodle notifications despite active Discord participation. These data extracts highlight the coexistence of parallel activity systems and the practical negotiation required between them. This tension is a quaternary contradiction wherein Discord-mediated learning activity system intersects with institutional norms and the default reliance on an official LMS. Similar to findings in Yusoff and Zin (2012) and Hackett et al. (2024), participants appreciated user-friendly platforms yet concerns regarding interoperability, record-keeping, or policy alignment could reduce institutional support. In exam-driven contexts, educators may prioritize platforms that offer formal tracking mechanisms or institutional approval, thereby limiting the use of Discord for academic activities. At this stage of the expansive learning cycle, the activity system entered a phase of negotiation and realignment, seeking compatibility between emerging Discord-mediated practices and existing institutional structures. This clarifies RQ1 further by showing that Discord's function as a Tool in this case was shaped not only by user interaction but also by its compatibility with institutional systems and assessment policies.

Collectively, these primary, secondary, tertiary, and quaternary contradictions illustrate the iterative movement described in Engeström's (2001) expansive learning cycle. The activity system progressed from initial questioning of technological reliability to analysis of infrastructural misalignments, modelling of adaptive hybrid strategies, and negotiation with institutional systems. This progression demonstrates how tensions within Discord-mediated OCL served not merely as obstacles but as catalysts for pedagogical refinement within the matriculation context.

These findings largely align with research praising Discord's capacity for fostering immediacy, inclusivity, and community-building (Arifianto & Izzudin, 2021a; Vladoiu & Constantinescu, 2020). However, the results also refine this literature by illuminating the

heightened impact of technical and logistical challenges in time-pressured environments. While prior studies have noted moderate technical challenges, the high-stakes nature of the matriculation context in which missing an online update regarding learning activities can adversely affect exam performance, intensified both the benefits and limitations of using Discord. In effect, the platform's collaborative affordances are highly beneficial when stable connectivity, predictable updates, and well-structured tasks are ensured. However, these same features become liabilities under conditions of limited bandwidth or sudden software changes.

Notably, the findings also challenge the assumption that Discord's "friendly" and "informal" atmosphere automatically translates into sustained knowledge-building. Although emojis, stickers, and real-time conversation did reduce communication barriers (Salehudin et al., 2023), without clear instructional guidelines, students risked straying off-topic or underutilizing asynchronous channels for deeper reflection. These observations mirror the caution in Martin and Bolliger (2018) regarding the necessity of explicit facilitation. In academic settings that prioritize open-ended exploration and student-driven learning, the flexibility to engage in exploratory or creative discussions can support collective meaning-making (Hackett et al., 2024). By contrast, matriculation participants operating under strict deadlines tended to use Discord mainly for brief clarifications and updates, thereby limiting its potential for deeper collaborative engagement.

Although the data support the conclusion that Discord's features can facilitate collaborative learning, several alternative interpretations merit consideration. For example, during focus group interviews, a few students who were already familiar with other platforms such as WhatsApp or Telegram downplayed Discord's advantages, suggesting that the perceived benefits may have been influenced by its novelty. Furthermore, classroom

observations occasionally revealed that students opted for face-to-face check-ins instead of using Discord when technical issues occurred. These instances suggest that the platform's effectiveness may be overstated if conclusions rely solely on positive focus group feedback.

From a triangulation perspective, reflective journals provided additional disconfirming evidence. In at least two cases, the lecturer recorded that certain groups demonstrated strong offline collaboration but showed only minimal interaction on Discord. These cases imply that some observed collaborative successes may stem from the natural strengths of high-performing teams rather than from the platform itself. By analysing divergences across data sources such as focus groups, reflective journals, and online observations, this research acknowledges that while Discord offers notable advantages, alternative explanations such as existing teamwork competencies or the use of external communication channels may also account for improved collaborative learning. Recognising these contradictions highlights the importance of exercising caution when attributing enhanced engagement solely to the use of Discord. Taken together, these contradictions collectively demonstrate the iterative progression described in Engeström's (2001) expansive learning cycle, from questioning and analysing tensions, to modelling adaptive strategies, and ultimately implementing refinements that reshape the activity system in practice. Importantly, these findings are not presented as universally generalisable claims about Discord as a platform. Rather, they represent contextually grounded design insights derived from a specific Biology matriculation cohort operating under exam-driven constraints, infrastructural variation, and institutional expectations. The value of these findings therefore lies in their contribution to context-responsive design refinement rather than broad technological generalisation. Collectively, these findings address RQ1 by demonstrating that Discord's features functioned as a mediating Tool whose effectiveness depended on

technical stability, cultural norms, institutional alignment, and adaptive pedagogical strategies within this matriculation context.

### **4.2.3 Design Refinements**

In line with DBR orientation, these refinements are presented as context-specific design responses:

1. Instructional guides on how to configure notification settings were shared to help reduce the chances of missed messages.
2. Low-bandwidth file formats such as PDF summaries and text-based materials were provided to support offline access.
3. A hybrid communication strategy was implemented during synchronous sessions: voice channels accommodated participants with stable internet connections while text-based chat supported those with limited bandwidth.
4. Short voice discussions were complemented by reflective writing prompts in designated text channels.

### 4.3 Synchronous Communication Rules in OCL

In Task 2, students participated in a 45-minute synchronous problem-solving session using Discord voice channels (refer **Appendix C** for instruction details). The discussion focused on Cell Division, specifically how disruptions at the G<sub>1</sub> and M checkpoints in the cell cycle can lead to cancer. Prior to the session, students prepared by reviewing Topic 3.1(c) and conducting individual research on real-world examples of uncontrolled cell proliferation. Each group had a designated student facilitator to manage turn-taking and task progression, reinforcing the establishment of communication norms. While voice chat was prioritized for real-time collaboration, text channels were made available as a contingency for participants facing technical difficulties. This task was guided by the Rules element of AT (RQ2) and concluded with a collaborative output in the form of a flowchart or summary document illustrating the connection between checkpoint failures and cancer development (refer **Appendix I** for student work sample). Data were collected through the lecturer's reflective journal, online observation of group interactions, and a focus group interview conducted at the end of Week 5. These synchronous norms were communicated at the start of the session to guide turn-taking, facilitation, and task completion.

### 4.3.1 Results

#### *Positive Themes*

##### **Theme 1: Effective Communication in Synchronous OCL**

Students frequently highlighted the advantages of synchronous communication for fostering higher engagement and clearer, more immediate interactions. S15 (FG3) pointed out that “*They are actively participating in the conversation and can see the reactions from others.*” [Code: Real-Time Visibility], emphasizing how real-time visibility of peers’ responses strengthens group connectedness. Likewise, S26 (FG6) observed that having everyone online simultaneously, “*ensures every group member is online within that period of time so that we can have an efficient and active interaction.*” [Code: Full Group Presence]. Participants also viewed synchronous discussions as more “*fun*” (S1, FG1; S3, FG1) and better for staying focused (S21, FG5), since everyone tackles the task simultaneously [Code: Increased Focus & Motivation].

Reflective journal entries highlighted how synchronous approaches helped students remain attentive and reduced confusion about discussion topics [Code: Increased Focus & Motivation]. Real-time exchanges prompted swift clarifications, allowing learners to confirm or challenge emerging ideas almost instantly [Code: Real-Time Visibility]. The lecturer noted that this immediacy kept momentum high, as participants were less likely to disengage or forget details between messages [Code: Full Group Presence]. Groups operating synchronously consistently displayed higher rates of idea elaboration, suggesting that direct, immediate interaction heightened their ability to explore and refine concepts.

Observational data demonstrated that Groups 1 and 4 maintained strong interaction and real-time discussion contributions, with participants responding promptly and sustaining

lively dialogue [Code: Real-Time Visibility]. Group 2 similarly showcased balanced participation, where all members contributed throughout [Code: Full Group Presence]. This synchronous communication style helped ensure no one fell behind, as participants clarified misunderstandings immediately.

By contrast, groups with less synchronous cohesion, such as Group 3, where S15 participated minimally, often struggled to maintain the same level of energy, indicating that active, real-time exchanges can be crucial for effective communication [Code: Increased Focus & Motivation]. These findings address RQ2a by demonstrating that synchronous communication “Rules,” when adhered to consistently, strengthened co-presence, immediacy, and collaborative momentum within Biology OCL tasks.

**Table 4.9:** Summary of Theme: Effective Communication

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Real-Time Visibility</b>	“They are actively participating... and can see the reactions from others.” – S15 (FG3)	Lecturer noted that instant responses helped clarify ideas and sustain learner focus.	Groups 1 and 4 showed consistent real-time discussion and prompt replies.
<b>Full Group Presence</b>	“It ensures every group member is online... so that we can have an efficient and active interaction.” – S26 (FG6)	Synchronous setup helped maintain momentum and minimised message delays.	Group 2 displayed balanced participation and continuous dialogue across members.
<b>Increased Focus &amp; Motivation</b>	“Synchronous discussion is more fun... and it helps us stay focused on the task.” – S1 (FG1)	Lecturer linked heightened engagement to reduced distractions and better comprehension in live sessions.	Group 3 showed weaker interaction where S15 rarely responded unless tagged.

**Theme 2: Collaborative Dynamics in Synchronous OCL**

Many participants described synchronous OCL as ideal for collective decision-making and streamlined workflows. S24 (FG5) illustrated this by noting, “*If we want to make a decision, we can directly ask everyone to vote for it on the spot.*” [Code: Real-Time Decision Making], allowing immediate consensus. Others (S21, FG5; S27, FG6) pointed out that real-time exchanges, “*help to facilitate faster decision-making and more efficient online*

*collaboration.*” [Code: Efficient Collaboration], ensuring the team avoids long waiting periods. Additionally, S22 (FG5) remarked that synchronous conversations let the entire group, “*carry out the discussion effectively without waiting for one another.*” [Code: Collective Task Completion], reflecting a shared belief that scheduling a focused session boosts task completion rates.

The lecturer consistently observed that synchronous groups tended to finalize tasks sooner, largely due to reduced delays in feedback and clearer delegation of responsibilities [Code: Real-Time Decision Making]. Journals documented instances where participants quickly allocated roles, confirmed deadlines, and addressed misconceptions, all within a single session [Code: Efficient Collaboration]. This sense of collective momentum was particularly evident in groups that established a set meeting time, capitalizing on real-time synergy to stay aligned and productive [Code: Collective Task Completion].

Groups 2 and 5 demonstrated these collaborative benefits most clearly. In particular, Group 2 engaged in multi-turn conversations that showed evidence of co-constructing ideas, indicating that participants effectively built on one another’s input in real time [Code: Real-Time Decision Making]. Group 5, despite delayed responses from one member (S25), still demonstrated effective personal awareness and sustained momentum through collective decision-making [Code: Efficient Collaboration].

By contrast, minimal real-time engagement in some parts of Group 3 (where S15 responded only when tagged) led to slower coordination [Code: Collective Task Completion]. The overall pattern supported participants’ claims that synchronous OCL enables fluid team dynamics and faster decisions. This theme further answers RQ2a by showing that real-time communication norms facilitated efficient coordination, shared accountability, and collective task completion within the Discord-mediated environment.

**Table 4.10:** Summary of Theme: Collaborative Dynamics

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Real-Time Decision Making</b>	“If we want to make a decision, we can directly ask everyone to vote for it on the spot.” – S24 (FG5)	Lecturer observed quicker task finalization due to immediate decisions and live role distribution.	Group 2 engaged in multi-turn, co-constructed discussions that advanced decision-making in real time.
<b>Efficient Collaboration</b>	“Faster decision-making and more efficient online collaboration.” – S21 (FG5); S27 (FG6)	Journals noted reduced delays, quicker confirmation of deadlines, and stronger alignment among group members.	Group 5 demonstrated clear coordination and sustained group momentum, despite one delayed participant (S25).
<b>Collective Task Completion</b>	“We can carry out the discussion effectively without waiting for one another.” – S22 (FG5)	Lecturer noted high productivity during synchronous sessions, with fewer misunderstandings and more role clarity.	Group 3, with weak real-time participation from S15, had slower coordination and task execution.

**Theme 3: Constructive Feedback in Synchronous OCL**

Several participants emphasized the value of immediate feedback loops in synchronous discussions. S16 (FG4) appreciated that, “*we can interact more with each other and get quick feedback.*” [Code: Quick Feedback Loops], while S30 (FG6) stated, “*I prefer synchronous tasks because we can get immediate response and opinions.*” [Code: Immediate Response]. Participant S21 (FG5) further noted how prompt reactions to one’s ideas could “*boost our confidence*” [Code: Confidence Boost], as individuals felt more assured when peers acknowledged or built on their contributions in real time.

The lecturer’s reflections confirmed that instant feedback mechanisms encouraged a sense of validation and iterative idea refinement [Code: Quick Feedback Loops]. In real-time exchanges, students displayed greater willingness to propose bold or creative ideas, trusting that their peers would respond quickly with praise, critique, or suggestions for improvement [Code: Confidence Boost]. Synchronous clarifications also reduced the risk of enduring misconceptions. The journal showed that once a student expressed confusion,

others rapidly explained or demonstrated the point, significantly cutting down on prolonged misunderstandings [Code: Immediate Response].

Observational notes indicated that Groups 1 and 2, both characterized by active engagement, frequently shared quick reactions such as emoticons or brief affirmations to signal understanding or agreement [Code: Quick Feedback Loops]. This continuous acknowledgment streamlined discussions and maintained a positive atmosphere, helping to resolve ambiguities before they hindered progress. In Groups 5 and 6, the presence of near-instant responses similarly supported ongoing discussions [Code: Immediate Response], although Group 6 saw a few participants remain more surface-level in their involvement [Code: Confidence Boost].

Overall, synchronous feedback loops proved instrumental in creating a vibrant exchange of ideas and in maintaining group coherence. These findings contribute to RQ2a by illustrating how synchronous “Rules” supported immediate feedback mechanisms that enhanced confidence, idea refinement, and sustained engagement in collaborative Biology discussions.

**Table 4.11:** Summary of Theme: Constructive Feedback

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Quick Feedback Loops</b>	“We can interact more with each other and get quick feedback.” – S16 (FG4)	Lecturer noted that real-time idea refinement encouraged bolder contributions and iterative discussions.	Groups 1 and 2 shared immediate reactions (e.g., emoticons, brief affirmations) to maintain a positive flow.
<b>Immediate Response</b>	“I prefer synchronous tasks because we can get immediate response and opinions.” – S30 (FG6)	Journal showed synchronous clarifications drastically reduced misunderstandings before they took hold.	Groups 5 and 6 exhibited near-instant replies, though some participants remained at a surface level of engagement.
<b>Confidence Boost</b>	“...could boost our confidence.” – S21 (FG5)	Quick, affirmative peer responses instilled reassurance, motivating students to propose new ideas.	Groups 1 and 2 signalled agreement swiftly, fostering an encouraging atmosphere that advanced group coherence.

## *Negative Themes*

### **Theme 4: Connectivity Challenges in Synchronous OCL**

Despite valuing real-time discussions, many participants experienced problems with internet connections and technology. S12 (FG3) described, “*internet connection [as] the main challenge of being online at the same time.*” [Code: Unstable Internet], while S16 (FG4) noted the frustration of suddenly losing connection during crucial moments [Code: Disrupted Flow]. Additional remarks (S25, FG5; S27, FG6; S28, FG6) detailed how poor connectivity, device lag, or software glitches disrupted the flow of synchronous tasks and caused learners to miss portions of the conversation [Code: Device and App Instability].

The lecturer recorded that connectivity issues often forced groups to repeat explanations, revisit decisions, or wait for disconnected members to catch up, slowing overall progress [Code: Unstable Internet]. This phenomenon was especially troublesome during peak usage times or when groups used advanced features like video calls [Code: Disrupted Flow]. The journal suggested that while synchronous OCL has distinct advantages, its reliance on stable internet and functioning devices posed a persistent hurdle for those with unreliable access, leading to potential disengagement or confusion [Code: Device and App Instability].

In practice, connectivity challenges manifested most visibly in Groups 5 and 6, where S25 and S30 had notably delayed responses or short absences, respectively [Code: Unstable Internet]. Observers noticed that these interruptions fragmented discussions, prompting re-explanations upon each reconnection [Code: Disrupted Flow]. Although Groups 1 and 2 generally maintained smooth real-time collaboration, occasional glitches still emerged

[Code: Device and App Instability], supporting participants’ concerns that synchronous success relies heavily on technical stability.

Consequently, strong engagement often stalled whenever participants encountered network or device problems. This theme addresses RQ2a by revealing that the effectiveness of synchronous communication “Rules” was contingent upon infrastructural stability, which directly shaped the quality and continuity of OCL processes.

**Table 4.12:** Summary of Theme: Connectivity Challenges

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Unstable Internet</b>	“Internet connection [is] the main challenge of being online at the same time.” – S12 (FG3)	Lecturer noted that unstable connectivity slowed group progress and required repetition of earlier discussions.	Groups 5 and 6 had fragmented discussions; S25 and S30 missed parts due to disconnection or lag.
<b>Disrupted Flow</b>	“Frustration of suddenly losing connection during crucial moments.” – paraphrased from S16 (FG4)	Connectivity problems led to delayed responses and interrupted synchronous exchanges, particularly during video use.	Even Groups 1 and 2, typically smooth, experienced occasional disruptions that stalled synchronous momentum.
<b>Device and App Instability</b>	“Device lag and glitches disrupted flow.” – paraphrased from S25, S27, S28 (FG5, FG6)	Journal emphasized that technical instability discouraged participation and led to disengagement in some cases.	Reconnection often required re-explanation of points, especially during content-heavy discussions.

**Theme 5: Scheduling Conflicts in Synchronous OCL**

Students frequently pointed out that coordinating a single time for all members to be present can be challenging. S22 (FG5) emphasized the importance of planning, noting that “to ensure synchronous activity goes smoothly, we need to plan the time properly.” [Code: Time Planning Needed], yet personal schedules often conflicted. S21 (FG5) added, “It is hard to ensure everyone is focusing during that time.” [Code: Focus Difficulties], highlighting how external commitments or differing time zones disrupt synchronous collaboration. From the lecturer’s perspective, scheduling difficulties often contributed to incomplete participation or varied levels of preparedness [Code: Time Planning Needed].

While synchronous sessions benefited those who could attend, absent or latecomer members sometimes found it difficult to integrate smoothly, requiring separate updates or additional clarifications [Code: Focus Difficulties]. The journal also documented occasional resentment from group members who felt they had to compromise personal commitments to accommodate collective meeting times [Code: Participation Imbalance].

Groups 1 and 4 generally showed strong real-time discussions, suggesting fewer scheduling barriers [Code: Participation Imbalance]. Conversely, in Groups 5 and 6, some participants struggled to appear or remain active for the entire session [Code: Time Planning Needed]. S25 (FG5) and S30 (FG6) posted less frequently or gave delayed feedback, reflecting the practical difficulties of coordinating synchronous involvement [Code: Focus Difficulties]. Observers noted that these irregular presences caused repeated recaps and fragmented dialogue, leading to slower decision-making and occasional frustration among fully present members [Code: Participation Imbalance]. These findings respond to RQ2a by demonstrating that synchronous participation norms, while promoting immediacy, also introduced constraints related to time coordination and equitable access.

**Table 4.13:** Summary of Theme: Scheduling Conflicts

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Time Planning Needed</b>	“To ensure synchronous activity goes smoothly, we need to plan the time properly.” – S22 (FG5)	Lecturer observed that incomplete attendance often required post-session recaps and delayed group momentum.	Groups 5 and 6 had irregular attendance; discussions were frequently interrupted by late arrivals or absences.
<b>Focus Difficulties</b>	“It is hard to ensure everyone is focusing during that time.” – S21 (FG5)	Journal noted that external obligations led to uneven engagement and occasional resentment among groupmates.	S25 and S30 showed delayed or minimal participation, slowing decisions and requiring repeated instructions.
<b>Participation Imbalance</b>		Lecturer recorded frustration in groups where a few members consistently adjusted their schedules for others.	Groups 1 and 4 maintained stable real-time engagement, indicating stronger scheduling alignment.

### **Theme 6: Unequal Contribution in Synchronous OCL**

Another recurring issue was that not all members contributed equally, even when everyone was online simultaneously. S4 (FG1) lamented that “*It ends up with less people [who] can contribute.*” [Code: Participation Imbalance], and S21 (FG5) observed that “*There will be some people who just enter the chat but [do] nothing.*” [Code: Passive Presence]. This inactivity sometimes stemmed from participants feeling overshadowed or disinterested, while others simply chose to remain silent in real-time settings. S12 (FG3) added that “*Some people are not providing their opinion since many people are online at the same time.*” [Code: Crowded Environment Effect], implying that a crowded virtual room could discourage quieter voices.

The lecturer noted that synchronous sessions could unintentionally amplify uneven participation, as more vocal or faster-typing students tended to dominate the flow of conversation [Code: Participation Imbalance]. Journal entries described a “race to respond” dynamic, where those comfortable with rapid exchanges thrived, while more reflective learners struggled to keep pace [Code: Participation Imbalance]. Additionally, the journal suggested that participants who encountered minor technical or personal distractions sometimes missed the window to contribute before the group moved on to another topic, leading to unequal levels of participation [Code: Passive Presence].

Although Groups 1 and 2 exhibited broad engagement, a closer look revealed that not everyone participated equally. Group 1, for instance, saw S5 providing minimal responses without extending the discussion [Code: Participation Imbalance]. In Group 3, S15 had minimal engagement, responding only when prompted [Code: Crowded Environment Effect]. Similarly, Group 5 documented a pattern of S25 posting standalone comments instead of engaging in back-and-forth exchanges [Code: Passive Presence]. These

observations affirmed participants’ concerns that synchronous presence does not guarantee equitable involvement, which remains a challenge that can undermine the full potential of real-time collaborative learning. This theme addresses RQ2a by indicating that synchronous “Rules” may unintentionally reinforce participation imbalances when rapid exchanges privilege more vocal or technologically confident students.

**Table 4.14:** Summary of Theme: Unequal Contribution

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Passive Presence</b>	“There will be some people who just enter the chat but [do] nothing.” – S21 (FG5)	Lecturer noted that students present in sessions were not always meaningfully engaged or contributing.	In Group 5, S25 posted standalone comments without engaging in dialogue.
<b>Participation Imbalance</b>	“It ends up with less people [who] can contribute.” – S4 (FG1)	Journal described a “race to respond,” where faster typists dominated while slower participants fell behind.	Group 1 had S5 offering minimal input, with no discussion elaboration.
<b>Crowded Environment Effect</b>	“Some people are not providing their opinion since many people are online at the same time.” – S12 (FG3)	Reflections indicated that crowded chats discouraged quieter voices and reduced equitable input opportunities.	In Group 3, S15 only contributed when directly tagged, indicating limited spontaneous participation.

**Theme 7: Communication Overload in Synchronous OCL**

Participants raised concerns that real-time exchanges could sometimes lead to disorganized discussions or overlooked contributions. S4 (FG1) noted that “*As we are busy replying to others’ ideas, we might overlook many other points.*” [Code: Overlooked Contributions], while S16 (FG4) explained that “*Due to lots of chats being sent at almost the same time, our own chat or ideas can be overlooked by others.*” [Code: Simultaneous Posting Confusion]. Others (S2, FG1; S20, FG4) mentioned that rushed or fragmented communication in synchronous settings can cause miscommunication or confusion, potentially dragging discussions off topic [Code: Fragmented Discussion Flow]. The lecturer’s notes indicated that while immediate interaction often stimulated brainstorming,

it also risked overwhelming participants with rapid-fire messages [Code: Fragmented Discussion Flow]. Some groups struggled to maintain a coherent thread of ideas; if multiple topics were addressed simultaneously, crucial comments or questions became buried [Code: Overlooked Contributions]. Additionally, the journal documented that once confusion set in, it sometimes took longer to untangle the conversation, requiring the group to reestablish order and recap missed ideas [Code: Simultaneous Posting Confusion].

In real-time settings, Groups 3 and 6 occasionally showcased these overload symptoms: participants posted multiple ideas in quick succession, leading to partial or fragmented replies [Code: Overlooked Contributions]. The researcher noted that references to older points were sometimes dropped in favour of the latest comment, resulting in unresolved threads [Code: Simultaneous Posting Confusion]. By contrast, Groups 1 and 2, though also active, often designated a lead facilitator or adopted a structured approach, reducing the risk of ignoring significant inputs [Code: Fragmented Discussion Flow]. Hence, while synchronous OCL can spark engaging dialogue, it also demands strategies to prevent message congestion and ensure all ideas receive due consideration. These findings further clarify RQ2a by demonstrating that real-time communication norms may generate cognitive and interactional overload if not carefully structured.

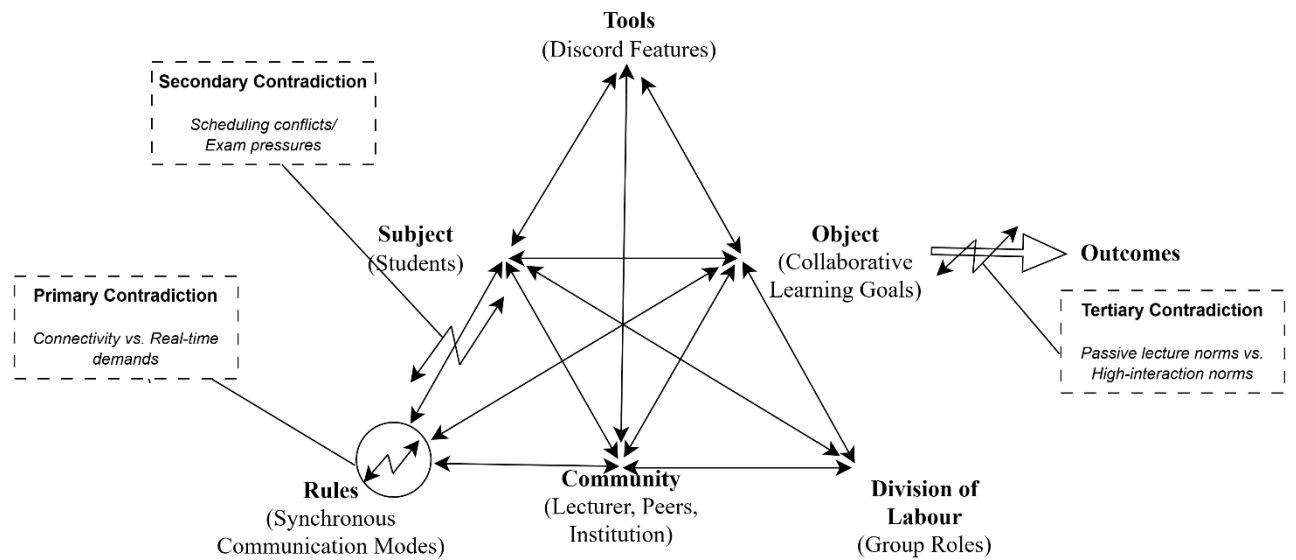
**Table 4.15:** Summary of Theme: Communication Overload

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Overlooked Contributions</b>	“As we are busy replying to others’ ideas, we might overlook many other points.” – S4 (FG1)	Lecturer noted that rapid exchanges sometimes buried key comments, leading to missed ideas and follow-ups.	Groups 3 and 6 showed overlapping posts, with earlier ideas abandoned in favour of newer ones.
<b>Simultaneous Posting Confusion</b>	“Due to lots of chats being sent... our own chat or ideas can be overlooked by others.” – S16 (FG4)	Journal described the need to reestablish order when confusion arose from multi-threaded replies during live sessions.	Participants in Group 6 struggled to maintain a clear thread of discussion amidst high message volume.
<b>Fragmented Discussion Flow</b>	“Rushed or fragmented communication... can cause miscommunication– paraphrased from S2, S20	Real-time brainstorming was productive but often led to off-topic shifts when too many ideas emerged at once.	Groups 1 and 2 mitigated overload by appointing facilitators or maintaining a structured posting flow.

### 4.3.2 Discussion

#### *RQ2a: How do synchronous communication rules influence OCL processes on Discord among Biology matriculation students?*

Within this Malaysian matriculation Biology context, the results demonstrate that when students aligned with real-time meeting “Rules” on Discord, this fostered a stronger sense of co-presence and rapid feedback loops. Similar to existing OCL literature (Martin et al., 2021), participants consistently reported that immediate responses increase motivation and mutual accountability, thus supporting the exam-oriented goal of mastering Biology content swiftly. In direct response to RQ2a, these findings suggest that in this context, students’ positive perceptions of synchronous “Rules” strengthened collaborative momentum by reinforcing immediacy, accountability, and shared presence within OCL tasks. However, these findings also uncovered key contradictions surrounding connectivity, scheduling, and participation, revealing how synchronous “Rules” not only promote efficiency but may also unintentionally limit inclusivity and lead to potential communication overload within this time-pressured matriculation setting. Within the lens of AT, “Rules” represent the formal and informal guidelines that govern how learners (Subjects) interact with each other and with mediating technologies (Tools) to achieve their shared academic objectives (Object). By requiring learners to be online simultaneously, these synchronous communication norms can strengthen group cohesion and accelerate task completion. Yet, the results also show that certain tensions emerge when these norms intersect with personal schedules, technological realities, and exam-driven setting. As Engeström (2001) posits, such contradictions often function as catalysts for expansive learning, prompting reconfigurations of the activity system. Figure 4.3 maps these tensions onto the relevant AT components.



**Figure 4.3:** Contradictions in Synchronous Communication Activity System

**Primary Contradictions** (*Within the Rules Element*)

A primary contradiction emerged within the nature of real-time communication “Rules” on Discord, specifically the dependence on continuous connectivity and immediate attendance. While synchronous norms are intended to support collaborative momentum and prompt feedback, the findings indicate that unstable internet connections, device lag, and user-interface challenges often disrupted the effective implementation of these principles. This tension is internal to the “Rules” component, even though these norms presume that all learners can maintain an active and stable connection, many participants faced repeated disruptions. Similar connectivity constraints have been discussed in other OCL contexts (Buzy et al., 2024). However, in this research, the findings suggest that under high-stakes exam conditions, such disruptions can more significantly hinder collaborative tasks, as each lost moment or missed clarification may compromise students’ exam preparedness. Thus, in relation to RQ2a, students’ perceptions of synchronous “Rules” are shaped not only by their

motivational benefits but also by their vulnerability to infrastructural instability, which directly affects the quality of OCL dynamics.

### **Secondary Contradictions** (*Between Rules and Subjects*)

Scheduling conflicts constitute a secondary contradiction, exposing a misalignment between the synchronous communication “Rules” and the real-life constraints of the “Subjects.” Students reported difficulties coordinating around personal and academic commitments, thereby reducing the effectiveness of designated real-time sessions. Although real-time engagement enhances group focus and energy (Chowdhury, 2021), it also requires significant planning and sometimes forces students to rearrange other obligations. In the matriculation setting, these conflicts become more pronounced because missing even a portion of the discussion can negatively impact one’s preparation (Gaad, 2022). This finding builds on previous research by showing that while synchronous norms can support immediate engagement, they may also unintentionally exclude or disadvantage students who have difficulty meeting strict time requirements. Accordingly, students’ perceptions of synchronous “Rules” are influenced by whether these norms are experienced as supportive structures or as rigid constraints that limit equitable participation.

### **Tertiary Contradictions** (*Old vs. New Forms of Activity*)

Students’ partial disengagement or “quiet presence” points to a tertiary contradiction between conventional lecturer-led approaches (Old Form) and the highly interactive Rules of synchronous OCL (New Form). Certain participants remained silent or contributed minimally, suggesting a holdover from more passive lecture-oriented practices. Although studies conducted in project-based settings such as undergraduate contexts (Altowairiki,

2021) often highlight the ability of synchronous sessions to spark dynamic participation, the exam-focused environment in matriculation setting revealed how real-time norms may amplify domination by quicker or more vocal students. This contrast indicates that although Discord-based synchronous approaches can facilitate vibrant dialogue, they may unintentionally reinforce classroom hierarchies, especially when the pressure to cover content outweighs the emphasis on equitable turn-taking and deep reflection (Miao & Ma, 2022). This tension clarifies that students' perceptions of synchronous "Rules" are mediated by prior learning habits and institutional culture, which shape how confidently they engage within real-time discussions.

**Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

In contrast to the Tool-centered tensions, no major quaternary contradiction surfaced in terms of official policy disallowing or discouraging synchronous "Rules" (and thus this is not illustrated in Figure 4.3). However, the data indicate that minor quaternary tensions arose when some participants preferred asynchronous channels due to scheduling convenience. As Yusoff and Zin (2012) have noted, these peripheral tensions can gradually escalate if institutional norms conflict with preferred student practices. Although this research did not document major policy prohibitions of synchronous Discord use, future expansions of exam-focused tasks could encounter friction if institutional emphasis shifts more heavily toward asynchronous or LMS-based formats. This suggests that students' perceptions of synchronous "Rules" are also shaped by broader institutional expectations, which influence whether real-time participation is viewed as necessary, optional, or burdensome.

These findings partially align with research demonstrating that real-time participation strengthens group bonding, immediate feedback, and motivation (Martin & Bolliger, 2018). However, in more flexible project-based learning environments such as the one examined by Kristian et al. (2023), learners often have more freedom to navigate connectivity or scheduling challenges. Here, time pressure clearly magnified such challenges, leading to more pronounced negative impacts on collaboration. Likewise, while previous studies acknowledge that “*many people are online at the same time*” can enhance social presence (Wiles & Simmons, 2022), the present results highlight the risk of communication overload. This is especially evident when numerous learners contribute messages simultaneously, often leading to off-topic discussions. The tension between these advantages and constraints thus refines existing scholarship by illustrating that synchronous “rules” are not universally beneficial. Instead, they operate within a delicate balance shaped by technological reliability and strict curriculum demands.

While many participants expressed positive views toward synchronous sessions, a few interviewees conveyed mixed feelings. One focus group noted that quick decisions made during live sessions were not always ideal for addressing complex problems, suggesting that asynchronous follow-up might be more suitable for deeper analysis. Observation data also revealed inconsistencies, as some groups that reported successful real-time collaboration showed minimal interaction during the session. This difference may point to social desirability bias, where students spoke positively about synchronous engagement in interviews but actually depended more on asynchronous messaging for meaningful contributions. By taking these conflicting patterns into account, the analysis recognises that real-time interaction does not inherently lead to higher-quality collaboration. The findings highlight the need to maintain a balance between synchronous and asynchronous

approaches, as individual circumstances and learner preferences can significantly influence the effectiveness of each mode. Taken together, these contradictions illustrate key phases of the expansive learning cycle described by Engeström (2001). The initial questioning of real-time participation norms emerged when students experienced connectivity failures and scheduling tensions. This was followed by critical examination of existing synchronous “Rules,” particularly regarding inclusivity and communication overload. The subsequent adjustments to facilitation structures and meeting formats represent early stages of modelling and implementing new forms of activity within the Discord-mediated system. Thus, rather than remaining isolated constraints, the identified contradictions functioned as drivers of pedagogical transformation across iterative DBR cycles. Importantly, these findings are presented as contextually grounded design insights rather than generalisable claims about synchronous communication in OCL. They reflect how synchronous “Rules” operated for this Biology matriculation cohort under exam-driven time pressure, infrastructural variation, and locally situated participation norms. Collectively, these findings answer RQ2a by demonstrating that students’ perceptions of synchronous communication “Rules” in this context enhance immediacy and accountability. At the same time, they also generate tensions related to inclusivity, infrastructure, and institutional alignment. These tensions, in turn, reshape the dynamics of OCL on Discord within this Biology matriculation cohort.

### 4.3.3 Design Refinements

In line with DBR, these refinements are presented as context-specific design responses derived from the identified contradictions:

1. A rotating facilitator role was implemented within each group to manage discussion flow and ensure equitable participation.
2. Groups were offered two scheduled meeting windows instead of a single fixed time to minimise scheduling conflicts while maintaining synchronous engagement.
3. Brief text-based summaries were posted after major discussion points to support participants with unstable internet connections.
4. The use of structured prompts was encouraged during discussions to promote contributions from quieter students (e.g. “Now let’s hear from X”).
5. A shared checklist was pinned in each group’s Discord channel to help track discussion progress and prevent overlooked inputs.

#### 4.4 Asynchronous Communication Rules in OCL

Task 3 shifted to extended asynchronous collaboration within this Biology matriculation cohort to solve two case-based problems related to Genetic Inheritance, focusing on ABO blood groups and X-linked traits (refer **Appendix C** for instruction details). Conducted over nine days, students engaged in structured text-based discussions within their Discord group channels. Each member was assigned a specific role (e.g. discussion leader, jotter) to promote accountability and clarity in communication. Students were required to post progress updates every 48 hours; a strategy implemented to balance academic workload while maintaining collaborative momentum. The activity concluded with each group submitting a final summary supported by genetic diagrams and explanations (refer **Appendix I** for student work sample). This task was also aligned with the Rules element of AT (RQ2) with particular emphasis on how asynchronous interaction shapes collaborative dynamics. These structured posting norms functioned as explicit communication “Rules” governing pacing, accountability, and knowledge exchange within the activity system. Data were collected through the lecturer’s reflective journal, online observation of student exchanges, and a focus group interview conducted at the end of Week 8.

#### 4.4.1 Results

### *Positive Themes*

#### **Theme 1: Enhanced Time Flexibility in Asynchronous OCL**

Students appreciated the flexibility of asynchronous OCL, highlighting its capacity to accommodate individual learning preferences and external commitments. S2 (FG1) praised this aspect by saying, “*We can follow our own schedule. Different individuals will have different ways to arrange their time.*” [Code: Self-Paced Scheduling], while S8 (FG2) observed that asynchronous tasks especially benefit those who need to do “*in-depth research on the assigned topics*” [Code: Supports Deeper Thinking]. Similarly, S11 (FG3) preferred not feeling rushed, explaining, “*Maybe that day you feel tired, then maybe you can do it tomorrow.*” [Code: Reduces Time Pressure], emphasizing that flexible timing lessens performance pressure.

Reflective journal entries indicated that students took advantage of the self-paced nature of asynchronous OCL to generate more comprehensive and thoughtful contributions [Code: Self-Paced Scheduling]. In contrast to synchronous settings, learners had time to refine posts, revisit group discussions, and engage at their convenience [Code: Supports Deeper Thinking]. However, the journal also noted that some students treated the flexibility as open-ended, leading to uneven participation when no strict deadlines or peer prompts were in place [Code: Reduces Time Pressure].

Observations indicated that Groups 2 and 5 demonstrated moderate to frequent engagement spread over several days, suggesting that flexibility allowed participants to plan their involvement strategically [Code: Self-Paced Scheduling]. These groups distributed their posts more evenly, posting thoughtful comments derived from additional research

[Code: Supports Deeper Thinking]. Conversely, Group 1 and 6 showed sporadic bursts of activity, often triggered by facilitator reminders, indicating that some students procrastinated or prioritized other tasks until prompted [Code: Reduces Time Pressure]. These findings address RQ2b by demonstrating that asynchronous communication “Rules” enhance flexibility and self-paced engagement but require structured checkpoints to sustain consistent participation within OCL processes.

**Table 4.16:** Summary of Theme: Enhanced Time Flexibility

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Self-Paced Scheduling</b>	“We can follow our own schedule. Different individuals will have different ways to arrange their time.” – S2 (FG1)	Lecturer noted that students engaged more thoughtfully when allowed to respond at their own pace.	Groups 2 and 5 posted regularly over time, reflecting planned and distributed engagement.
<b>Supports Deeper Thinking</b>	“Asynchronous is useful... to do in-depth research on the assigned topics.” – S8 (FG2)	Journal recorded that several students submitted well-developed responses after deeper exploration.	Contributions in Groups 2 and 5 were content-rich and well-reasoned, indicating use of research and reflection.
<b>Reduces Time Pressure</b>	“Maybe that day you feel tired, then maybe you can do it tomorrow.” – S11 (FG3)	Lecturer noted reduced anxiety and more confident posts but cautioned against lack of structure.	Groups 1 and 6 exhibited burst-like activity, often following facilitator nudges, suggesting last-minute engagement.

**Theme 2: Quality of Learning in Asynchronous OCL**

Participants frequently credited asynchronous interactions for fostering deeper critical thinking and higher-quality discussions. S21 (FG5) highlighted how, “*asynchronous discussion gives us more time to think and explore, thus making our sharing more valuable.*” [Code: Reflective Contribution]. S4 (FG1) considered extended deadlines ideal for tackling challenging tasks [Code: Complex Task Handling]. These remarks indicated how additional time for reflection can yield more thoughtfully constructed contributions.

The lecturer’s notes supported these claims, finding that student posts in asynchronous discussions often showed greater depth and structure [Code: Reflective

Contribution]. Groups that took advantage of the extra time (e.g. FG2 and FG5) refined their ideas through iterative exchanges, expanding upon initial comments with additional evidence and clarifications [Code: Research-Driven Response]. The journal particularly emphasized how reflective intervals supported mature reasoning, enabling students to identify flaws in their earlier reasoning and propose more advanced arguments [Code: Complex Task Handling].

Observational data revealed that groups that consistently revisited earlier posts such as FG2 demonstrated deeper levels of analytical reasoning [Code: Reflective Contribution]. Many of FG2’s contributions involved in-depth discussions, including the use of external information to support their viewpoints [Code: Research-Driven Response]. Conversely, FG1 and FG6 engaged mostly in brief, logistical-based interactions, reflecting a minimal uptake of reflective opportunities [Code: Complex Task Handling]. These contrasting behaviours illustrated how asynchronous formats can facilitate deeper learning, although sustained and active participation remains a key determinant of success. This theme answers RQ2b by showing that asynchronous communication “Rules” can deepen cognitive engagement when learners actively utilise reflective intervals.

**Table 4.17:** Summary of Theme: Quality of Learning

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Reflective Contribution</b>	“Asynchronous discussion gives us more time to think and explore, thus making our sharing more valuable.” – S21 (FG5)	Lecturer noted posts were more structured and thoughtful compared to synchronous discussions.	Group 2 revisited earlier threads and refined their responses through layered discussions.
<b>Research-Driven Response</b>	“Do in-depth research before posting.” – S8 (FG2)	Journal highlighted mature reasoning and idea revision following additional information gathering.	Group 2 posts often included external references or elaborated justifications.
<b>Complex Task Handling</b>	“Extended deadlines are ideal for tackling challenging tasks.” – S4 (FG1)	Lecturer observed that longer windows supported development of deeper arguments and clearer conceptualization.	Groups 1 and 6 tended to post shorter, task-oriented responses with limited elaboration.

### **Theme 3: Effective Idea Management in Asynchronous OCL**

Participants identified the ability of asynchronous platforms to store and retrieve discussions as a critical feature for managing and revisiting ideas. S24 (FG5) explained that “*The sent messages will not be deleted... You can even edit your messages after it is sent.*” [Code: Persistent Recordkeeping], emphasizing how stored records enabled ongoing refinement. S26 (FG6) likewise appreciated “*more time to think and generate ideas before hitting send*” [Code: Idea Generation with Delay], while S9 (FG2) liked “*scrolling back*” to check if anyone added new evidence or revised an argument [Code: Retrieval Assists Reflection]. This capacity to preserve and evolve conversations facilitated collaborative knowledge-building.

The lecturer’s reflections aligned with these observations, showing that regular reference to archived posts helped maintain a logical progression of ideas [Code: Persistent Recordkeeping]. FG2 demonstrated iterative improvements as members revisited previous discussions, modifying their stances or adding references to support claims [Code: Idea Generation with Delay]. By contrast, FG3 and FG6 rarely revisited earlier exchanges, missing opportunities to deepen analysis or correct misunderstandings [Code: Retrieval Assists Reflection]. The lecturer stressed that the real value of asynchronous OCL lies in making thoughtful use of past discussions to enhance collaborative learning.

Practical examples emerged from FG2’s logs, where students frequently revisited older threads to contribute updates or respond to previously unaddressed questions [Code: Persistent Recordkeeping]. This practice sustained longer discussions, generating a coherent thread of ideas over time [Code: Idea Generation with Delay]. Meanwhile, Groups 1 and 3 rarely revisited initial posts once new items were introduced, thereby losing potential opportunities for refining earlier insights [Code: Retrieval Assists Reflection]. These

findings illustrated that while asynchronous tools offer robust data management, the quality of idea progression depends on user initiative to revisit and integrate past contributions. These findings contribute to RQ2b by indicating that asynchronous “Rules” strengthen knowledge construction when students deliberately engage with persistent discussion records to refine and extend ideas over time.

**Table 4.18:** Summary of Theme: Effective Idea Management

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Persistent Recordkeeping</b>	“The sent messages will not be deleted... You can even edit your messages after it is sent.” – S24 (FG5)	Lecturer noted that students referred back to earlier posts to maintain continuity and develop arguments further.	Group 2 frequently revisited older threads to refine or add to earlier contributions.
<b>Idea Generation with Delay</b>	“More time to think and generate ideas before hitting send.” – S26 (FG6)	Reflection showed asynchronous posting allowed more measured contributions and deeper follow-up.	Group 2’s posts showed ongoing development, often returning to prior questions or ideas.
<b>Retrieval Assists Reflection</b>	“I like scrolling back to check if anyone added new evidence.” – S9 (FG2)	Lecturer emphasized that revisiting previous content helped scaffold higher-order thinking in some groups.	Groups 1 and 3 rarely returned to earlier discussions, limiting progression and missed refinement opportunities.

### *Negative Themes*

#### **Theme 4: Time Management Issues in Asynchronous OCL**

Although flexibility was deemed advantageous, many participants struggled with procrastination and deadline management. S11 (FG3) admitted, “*Haha, I always procrastinate if I do asynchronous tasks.*” [Code: Procrastination Tendency], and S22 (FG5) cautioned that “*Asynchronous tasks could lead to procrastination... if we are not careful about scheduling.*” [Code: Lack of Scheduling Discipline]. S21 (FG5) similarly warned that without reminders, “*We might forget about the task entirely.*” [Code: Forgetting the Task]. These concerns highlighted how unstructured timelines often contributed to poor time

management habits. The lecturer observed that students with strong self-direction thrived in asynchronous contexts, but those requiring more guidance or immediate deadlines often produced rushed or incomplete work [Code: Procrastination Tendency]. Journal notes detailed repeated last-minute surges of activity, with participants submitting numerous posts just before a due date. This pattern was especially noticeable in FG3 and FG6, indicating that a lack of structured checkpoints can hinder productivity and collaboration quality [Code: Lack of Scheduling Discipline].

Groups 1 and 6 provided clear examples of inconsistent engagement, as participants often responded meaningfully when prompted by peers or facilitators [Code: Lack of Scheduling Discipline]. At other times, discussions remained stagnant or incomplete for days, echoing participants’ warnings about procrastination [Code: Procrastination Tendency]. Conversely, FG2’s regular postings appeared to reduce these risks, implying that timely updates and self-imposed mini-deadlines could help counterbalance the temptation of unrestricted timelines [Code: Forgetting the Task]. This theme addresses RQ2b by revealing that while asynchronous communication norms promote autonomy, insufficient temporal structure can weaken collaborative momentum in exam-driven contexts.

**Table 4.19:** Summary of Theme: Time Management Issues

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Procrastination Tendency</b>	“Haha, I always procrastinate if I do asynchronous tasks.” – S11 (FG3)	Lecturer observed frequent last-minute posting spikes close to deadlines, especially among students needing structure.	Groups 3 and 6 showed delayed engagement, with bursts of activity near task deadlines.
<b>Lack of Scheduling Discipline</b>	“Asynchronous tasks could lead to procrastination... if we are not careful about scheduling.” – S22 (FG5)	Journal noted that productivity suffered in the absence of external reminders or structured checkpoints.	Group 1 had periods of inactivity between facilitator prompts, delaying collaborative momentum.
<b>Forgetting the Task</b>	“We might forget about the task entirely.” – S21 (FG5)	-	FG2 maintained steady posting, suggesting that self-regulation helped mitigate time mismanagement.

### **Theme 5: Passive Interaction in Asynchronous OCL**

Many participants reported frustration with the low participation levels often observed in asynchronous discussions. S1 (FG1) found it “*hard to collaborate*” because responses are unpredictable or infrequent [Code: Infrequent Replies], while S25 (FG5) viewed sporadic engagement as leading discussions to feel one-sided [Code: One-Sided Participation]. Additionally, S9 (FG3) expressed frustration over delayed replies slowing progress [Code: Delayed Responses Frustrate Flow]. These accounts indicate how inconsistent peer engagement weakens collaborative synergy.

The lecturer’s notes confirmed that unresponsive peers often led to feelings of isolation and diminished motivation. Students who initiated threads without receiving sufficient feedback became progressively disengaged [Code: Infrequent Replies]. This dynamic occurred even in groups generally identified as high-performing, illustrating how a few passive members can disrupt momentum for the entire team [Code: One-Sided Participation]. Journal entries emphasized the importance of clearly defined participation norms and supportive peer interactions to combat passive communication [Code: Delayed Responses Frustrate Flow].

Observational data reflected these patterns. Group 3 had no active engagement, with members only responding when explicitly tagged, hindering continuous discussion [Code: Infrequent Replies]. Group 1 similarly showed minimal reciprocal conversation, with participants mostly leaving standalone comments [Code: One-Sided Participation]. In contrast, Groups 2 and 5 employed more active back-and-forth exchanges, thereby avoiding extended periods of inactivity and demonstrating the benefits of consistent peer-to-peer engagement in asynchronous settings [Code: Delayed Responses Frustrate Flow]. These findings respond to RQ2b by showing that asynchronous “Rules” can either enable sustained

dialogic exchange or foster passive interaction, depending on the strength of participation expectations and reciprocal engagement norms.

**Table 4.20:** Summary of Theme: Passive Interaction

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Infrequent Replies</b>	“It’s hard to collaborate when responses were unpredictable.” – S1 (FG1)	Lecturer noted that thread initiators often lost motivation when their posts received little or no response.	Group 3 lacked ongoing dialogue; members only responded when tagged.
<b>One-Sided Participation</b>	“Sporadic engagement makes discussions feel one-sided.” – S25 (FG5)	Reflections emphasized the negative impact of passive members even in otherwise high-performing groups.	Group 1 had mostly standalone comments, with minimal reciprocity in responses.
<b>Delayed Responses Frustrate Flow</b>	“Delayed replies slow progress.” – S9 (FG3)	Journal stressed the need for clearer participation norms to maintain active interaction and prevent stagnation.	Groups 2 and 5 showed more sustained, reciprocal engagement, avoiding the passivity seen in Groups 1 and 3.

**Theme 6: Challenges in Maintaining Productivity in Asynchronous OCL**

Participants often cited delayed feedback cycles and ambiguity in roles as reasons for slowed progress. S10 (FG2) mentioned incomplete outputs when “*feedback comes too late.*” [Code: Delayed Feedback Reduces Impact], while S28 (FG6) highlighted the demotivating effect of “*losing the flow*” after days without responses [Code: Loss of Momentum]. Similarly, S16 (FG4) found it “*tough to keep everyone focused*” when discussions dragged [Code: Lack of Sustained Focus]. Such pauses in interaction reduced overall efficiency, even among groups that otherwise demonstrated strong analytical performance.

The lecturer repeatedly noted how prolonged intervals between messages reduced momentum and caused confusion around task distribution [Code: Loss of Momentum]. Journal entries indicated that high-quality posts often lost their impact when later inputs arrived too late for meaningful integration [Code: Delayed Feedback Reduces Impact].

Groups with structured timelines or regular checkpoints performed better. As a result, the lecturer recommended simple measures such as shared calendars and milestone reminders to help keep members aligned with the project timeline [Code: Lack of Sustained Focus].

Evidence of these challenges appeared across multiple groups. FG1 and FG6 frequently postponed significant engagement until deadlines approached, resulting in a surge of last-minute posts [Code: Delayed Feedback Reduces Impact]. Even FG2 and FG5, typically more engaged, occasionally experienced slowdowns when participants did not respond promptly, forcing last-minute coordination [Code: Loss of Momentum]. Overall, these findings highlighted that while asynchronous formats support reflective, high-quality work, they require deliberate strategies such as interim deadlines and continuous peer monitoring to sustain productivity [Code: Lack of Sustained Focus]. This theme clarifies RQ2b by demonstrating that asynchronous communication “Rules” influence OCL processes through a balance between reflective depth and temporal discipline, where delayed feedback cycles can either enhance reasoning or disrupt collaborative continuity.

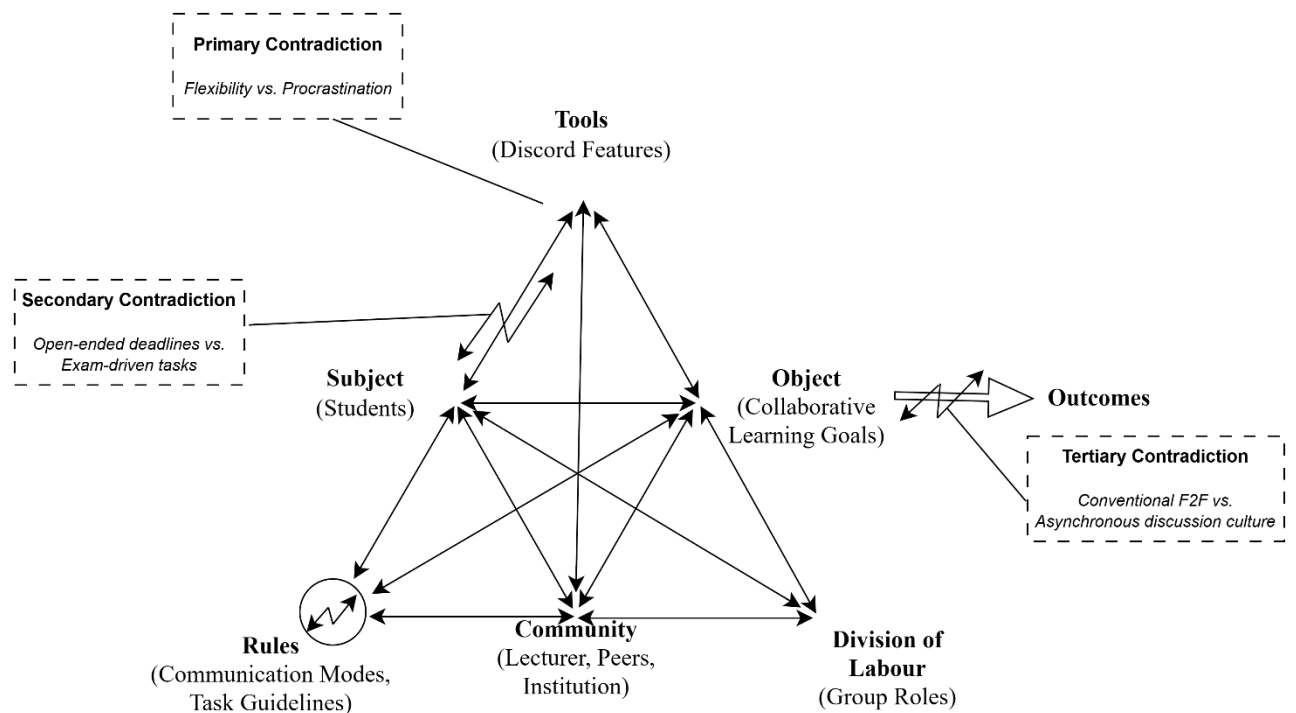
**Table 4.21:** Summary of Theme: Challenges in Maintaining Productivity

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Delayed Feedback Reduces Impact</b>	“Feedback comes too late” and leads to incomplete outputs. – S10 (FG2)	Lecturer observed that late responses disrupted idea integration and diluted the value of earlier contributions.	FG1 and FG6 showed bursts of late activity, often compressing final collaboration into the last moments.
<b>Loss of Momentum</b>	“Losing the flow” after inactivity reduces engagement. – S28 (FG6)	Journal emphasized that momentum dropped significantly when no responses occurred within a reasonable time window.	FG2 and FG5, despite being generally active, showed dips when delayed responses stalled progression.
<b>Lack of Sustained Focus</b>	“Tough to keep everyone focused” during prolonged discussions. – S16 (FG4)	Lecturer recommended shared calendars and check-ins to help with consistent role clarity and coordination.	Multiple groups required reminders or facilitator input to maintain pacing and prevent mid-task disengagement.

#### 4.4.2 Discussion

##### *RQ2b: How do asynchronous communication rules influence OCL processes on Discord among Biology matriculation students?*

Within this Malaysian matriculation Biology context, the findings indicate that participants appreciated the flexibility and reflective nature of asynchronous communication on Discord. This supports previous research suggesting that asynchronous interaction promotes deeper cognitive engagement and better fits varied schedules (Lin & Wang, 2024; McCarron et al., 2021). In direct response to RQ2b, these findings demonstrate that students' positive perceptions of asynchronous "Rules" enhance reflective participation, self-paced contribution, and cognitive depth within OCL activities within this exam-oriented matriculation context. However, within the matriculation environment, extended timelines and open-ended posting norms also introduced procrastination and uneven engagement, aligning with AT emphasis on how "Rules" can both enable and inhibit goal-directed actions (Cong-Lem, 2022; Engeström, 2000). The present research findings showed that students who managed asynchronous tasks proactively utilized archived discussions to refine their ideas and conduct thorough research before posting, resulting in high-quality collaborative outputs. Yet, others postponed contributions until the last minute, resulting in disjointed dialogue and delayed feedback cycles that hindered meaningful collaborative engagement. These findings highlight how the "Rules" associated with asynchronous modes can lead to contrasting outcomes, as they enable thoughtful analysis in some cases but also risk idle or passive participation. Several contradictions emerged when asynchronous rules designed to foster in-depth collaboration intersected with the exam-oriented culture of the Biology matriculation course. Figure 4.4 illustrates these tensions, mapping them onto the activity system components that govern asynchronous communication.



**Figure 4.4:** Contradictions in an Asynchronous Communication Activity System

**Primary Contradictions** (*Within the Rules Element*)

A primary contradiction emerged in the internal structure of asynchronous Rules themselves, as flexibility simultaneously functioned as both an enabling and destabilizing condition within the activity system. These norms allowed students to post whenever they found it most convenient, fulfilling a flexible and inclusive ideal, but the lack of structured time checkpoints led to poor time management for some participants. This tension was particularly evident when students waited until just before the deadline to post, triggering rushed discussions and undermining the reflective potential of asynchronous OCL. In contrast to the research context described by Mansour (2024), this matriculation setting appeared to amplify the negative effects of flexible deadlines, highlighting the importance of clear scheduling guidelines or peer-driven reminders. Thus, students’ perceptions of asynchronous flexibility were shaped by whether such openness was experienced as

empowering autonomy or as an absence of structure that weakened collaborative momentum and diluted collective pacing.

**Secondary Contradictions** (*Between Rules and Object*)

The program's demand for rapid completion of collaborative tasks (Object) sometimes conflicted with the slower-paced and flexible norms of asynchronous communication (Rules). It was found that some learners eager to complete assignments quickly grew frustrated with peers who contributed sporadically. This tension aligns with Chang and Brickman's (2018) warning that unmonitored asynchronous tasks can lead to scattered contributions and a lack of coordination. The depth of critical thinking demonstrated by students who embraced the flexible format confirms that asynchronous communication supports advanced reasoning when the group maintains consistent and structured interaction (Lin & Wang, 2024). Accordingly, students' perceptions of asynchronous "Rules" influenced OCL dynamics by either strengthening depth-oriented collaboration or generating frustration when collective pacing was misaligned with exam-driven expectations.

**Tertiary Contradictions** (*Old vs. New Forms of Activity*)

A tertiary contradiction emerged when the "New Form" of asynchronous practices on Discord intersected with the "Old Form" of traditional synchronous or face-to-face norms shaped by the matriculation culture. Students previously accustomed to immediate feedback from lecturers or peers found the delayed response times unsettling, leading to uncertainties about accountability and role distribution. This partial application of Discord's features, in which some members shared in-depth responses while others awaited "real-time"

confirmation. This reflects the tension that Engeström (1987) describes when an innovative tool enters a setting shaped by established habits. This suggests that students' prior exposure to lecturer-led immediacy shaped their perceptions of asynchronous "Rules," influencing how confidently they engaged in delayed yet reflective exchanges.

### **Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

Finally, quaternary contradictions materialized when institutional guidelines or unspoken norms about academic conduct clashed with students' reliance on asynchronous channels for complex tasks. Although the use of Discord was not officially restricted (and thus this is not illustrated in Figure 4.4), the strong focus on exam results often led students to overlook deeper and more reflective discussions in favour of quick answers or simple study tips. This tension builds on findings by Yusoff and Zin (2012) and highlights that while asynchronous OCL can enhance learning, its potential remains partly unrealized when institutions fail to explicitly support or integrate such approaches within official schedules and assessment structures. Therefore, students' perceptions of asynchronous "Rules" were indirectly shaped by institutional priorities that privileged speed and measurable outcomes over sustained dialogic engagement, thereby constraining the full developmental potential of reflective collaboration.

Overall, these contradictions partially align with studies that support asynchronous OCL as a means to foster reflective thinking and sustained collaboration (Lin & Wang, 2024). At the same time, they revealed how tightly scheduled curricula can intensify its limitations (Chang & Brickman, 2018). In other educational contexts, flexible posting schedules generally present minimal challenges. However, within the matriculation setting, they heighten the risk that asynchronous norms become excessively open-ended, thereby

disrupting group momentum. By viewing these tensions through an AT lens, educators can design targeted interventions that reduce procrastination, clarify participation roles, and align asynchronous communication. Importantly, these findings are presented as contextually grounded design insights rather than generalisable claims about asynchronous OCL. They reflect how asynchronous “Rules” operated for this Biology matriculation cohort under exam-driven pacing, variable participation patterns, and locally situated expectations for collaboration. Collectively, these findings respond to RQ2b by demonstrating that students’ perceptions of asynchronous “Rules” shape OCL dynamics through a balance between cognitive depth and temporal discipline, influencing both the quality and pacing of collaborative Biology learning on Discord.

Although student testimonies and observational data generally supported the benefits of asynchronous communication, several disconfirming points emerged. For instance, some participants noted that asynchronous discussions occasionally resembled isolated “mini-essays” rather than genuine dialogue, as learners tended to post polished statements with limited follow-up or interaction. This pattern may reflect the influence of an exam-oriented academic culture, in which students appear to prioritise individually refined output over collaborative knowledge construction.

Furthermore, reflective journals identified at least two groups that held face-to-face meetings despite contributing minimally to the asynchronous Discord channels. Their successful project outcomes, as evidenced by online observation, suggest that relying solely on Discord activity logs may underestimate the true extent of collaboration occurring across multiple interaction spaces. These cases point to alternative explanations, suggesting that some successful instances of OCL may be driven by offline interactions rather than the asynchronous format itself. Acknowledging these divergent patterns reinforces the

importance of triangulating data sources to more accurately assess the role of asynchronous communication in supporting deeper learning.

Viewed through the expansive learning framework (Engeström, 2001), these contradictions reflect a progressive questioning of overly flexible asynchronous norms, followed by critical examination of how such “Rules” intersected with exam-driven expectations and participation patterns. The subsequent restructuring of timelines, participation requirements, and feedback cycles represents a modelling and implementation phase within the activity system. In this way, the tensions identified were not treated as static constraints but as developmental triggers that informed iterative refinement across DBR cycles, contributing to a gradual transformation of asynchronous collaborative practices.

#### **4.4.3 Design Refinements**

In line with DBR, these refinements are context-specific design responses to the contradictions identified in this cohort:

1. Short internal deadlines were embedded into each task to encourage regular progress updates and reduce last-minute submissions.
2. Posting guidelines required students to respond within 24 hours when tagged and contribute at least twice per discussion cycle to maintain consistent group engagement.
3. Groups set specific times during the discussion period to give and receive feedback, helping them improve their work before the final submission.

#### 4.5 Large Group Size and Division of Labour in OCL

Task 4 addressed the topic Expression of Biological Information and required students to work in large groups of 15 members to create three concept maps on DNA replication, transcription, and translation (refer **Appendix C** for instruction details). The task combined synchronous discussions via voice channels with asynchronous coordination through dedicated text channels on Discord. Clear role definition was emphasized from the outset with roles such as concept lead or editor assigned to streamline collaboration, prevent redundancy, and ensure balanced contributions across subtopics. Group members were responsible for explaining mechanisms, relevant enzymes or proteins, and the sequential stages of genetic information flow. Final concept maps were submitted as the work output (refer **Appendix I** for student work sample). This task was aligned with the Division of Labour element of AT (RQ3), focusing on how structured role distribution supported collaboration within large groups. Data were collected from the lecturer's reflective journal, online observation, and a focus group interview conducted at the end of Week 10.

#### 4.5.1 Results

### *Positive Themes*

#### **Theme 1: Effective Division of Work in Large Group OCL**

Focus group participants commonly emphasized that large-group OCL makes workload distribution more manageable. Participant S5 (FG1/LG1) explained, “*It makes the work much easier. We can distribute the task evenly, especially a heavy workload task.*” [Code: Manageable Workload]. Another student, S5 (FG2/LG1), shared a practical example by saying, “*Like before, we had the video creation task. So, four people create one video. It is much easier, and we can complete the work faster.*” [Code: Efficient Task Completion]. Similarly, S11 (FG3/LG1) highlighted reduced individual pressure, noting, “*Members will not be too stressful and feeling burden while ensuring the quality of work.*” [Code: Reduced Individual Burden].

The lecturer observed in journal entries that breaking a large assignment into smaller components encouraged students to take ownership of specific portions [Code: Manageable Workload]. This approach reduced duplication of effort and enhanced motivation as each member felt responsible for completing a distinct part of the project [Code: Reduced Individual Burden]. According to the lecturer, when roles were clearly defined, students stayed on track, resulting in higher-quality deliverables and balanced workloads across the group [Code: Efficient Task Completion].

Observational data across all groups indicated that large Group 1 often relied on a few active initiators (S1, S4, S8, S11, S12, and S13) while the rest contributed sporadically [Code: Reduced Individual Burden]. Although some learners (S1–S10) did engage in back-and-forth discussions, five participants posted only standalone comments, resulting in

uneven task distribution. In contrast, large Group 2 exhibited more balanced engagement: S16, S17, and S18 took the lead in initiating discussions, while S19 and S20 consistently responded, thus demonstrating stronger reciprocity [Code: Manageable Workload]. This facilitated a smoother Division of Labour and reduced the workload burden on individual members, suggesting that clarity in role assignments and collective leadership promotes more equitable task allocation in large group contexts [Code: Efficient Task Completion]. These findings address RQ3a by demonstrating that large group size can strengthen the Division of Labour through role-based workload sharing, but that equitable task allocation depends on consistent participation and visible role enactment.

**Table 4.22:** Summary of Theme: Effective Division of Work

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Manageable Workload</b>	“It makes the work much easier. We can distribute the task evenly, especially a heavy workload task.” – S5 (FG1/LG1)	Lecturer noted that dividing tasks into smaller components encouraged accountability and minimised duplication.	Group 2 showed strong role clarity, with members initiating and responding in a balanced manner.
<b>Efficient Task Completion</b>	“Four people create one video... we can complete the work faster.” – S5 (FG2/LG1)	Clearly assigned portions allowed parallel progress, improving turnaround and group confidence.	Group 2 members contributed consistently across tasks, supporting efficient task progress.
<b>Reduced Individual Burden</b>	“Members will not be too stressful and feeling burden while ensuring the quality of work.” – S11 (FG3/LG1)	Journal highlighted that role clarity reduced stress and enhanced individual motivation to deliver quality input.	Group 1 relied heavily on a subset of active members, with others contributing sporadically, leading to workload imbalances.

**Theme 2: Enhanced Idea Development in Large Group OCL**

Student participants routinely highlighted the creative benefits of larger group sizes, citing the potential for collecting diverse opinions. S16 (FG4/LG2) commented, “*A large group size means more brains will think about the tasks... so more ideas could be collected.*” [Code: Idea Diversity]. Likewise, S25 (FG5/LG2) called it “*The fun of communicating, where we can get many ideas.*” [Code: Creative Stimulation], and S21 (FG5/LG1)

concluded, *“Overall, I would say that I prefer large group. With a good management, I can make use of more ideas.”* [Code: Broadened Perspectives]. These statements highlight that multiple perspectives often enrich problem-solving and spark innovation.

The lecturer’s reflections indicated that students in larger groups were more likely to engage in broader brainstorming and consider viewpoints they had not initially thought of [Code: Idea Diversity]. This environment seemed to stimulate creativity, as participants built on each other’s suggestions, enhancing both the depth and breadth of ideas [Code: Creative Stimulation]. However, the lecturer also noted that facilitating these discussions required some moderation to ensure that quieter members felt comfortable contributing [Code: Broadened Perspectives].

Observational data from both large groups indicated that large Group 1 demonstrated intermittent collaborative engagement, with S4, S5, S10, and S11 contributing to more critical and in-depth discussions [Code: Creative Stimulation]. However, the large group size was marked by uneven participation, as several members focused on surface-level clarifications or provided isolated contributions. This intermittent pattern limited the collective depth of discussion [Code: Broadened Perspectives]. In contrast, large Group 2 consistently showed stronger reciprocal engagement through multi-turn conversations. About half of the participants in large Group 2 connected their ideas to real-world contexts, resulting in more thorough and innovative outcomes. These findings suggest that deeper and reflective exchanges supported by balanced participation can markedly enhance idea development in large group OCL [Code: Idea Diversity]. This theme answers RQ3a by showing that large group size expands the Division of Labour by enabling broader idea contributions and subtopic coverage, although the quality of knowledge-building relies on balanced engagement across members.

**Table 4.23:** Summary of Theme: Enhanced Idea Development

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Idea Diversity</b>	“A large group size means more brains will think about the tasks... so more ideas could be collected.” – S16 (FG4/LG2)	Lecturer noted that larger groups enabled wider brainstorming and exposure to unfamiliar perspectives.	Group 2 members connected ideas to real-world contexts through extended reciprocal dialogue.
<b>Creative Stimulation</b>	“The fun of communicating and we can get many ideas.” – S25 (FG5/LG2)	Reflection highlighted that students sparked one another’s creativity by building on emerging suggestions.	Group 1 had deeper input from S4, S5, S10, and S11, but lacked full group cohesion, limiting depth across the team.
<b>Broadened Perspectives</b>	“With a good management, I can make use of more ideas.” – S21 (FG5/LG1)	Lecturer stressed the importance of moderating group dynamics to include quieter members in reflective exchanges.	Group 2 consistently displayed balanced participation, with multi-turn engagement enriching collective problem-solving.

**Theme 3: Strengthened Collaboration Dynamics in Large Group OCL**

Many participants described the energy and sociability of large group OCL. S1 (FG1/LG1) remarked, “*I love interacting with many people. I think I would enjoy the online environment with a large group size.*” [Code: Enjoyment in Large Group Setting], while S3 (FG1/LG1) echoed, “*Learning collaboratively in large group is actually fun as we can get much information from each other.*” [Code: Lively Peer Exchange]. S25 (FG5/LG2) also identified large-group exchanges as “*The fun of communicating, where we can get many ideas.*” [Code: Social Engagement Fuels Momentum], stressing the lively dimension that emerges when more members participate simultaneously.

The lecturer’s journal indicated that groups with enthusiastic participants sustained stronger motivation and promoted a supportive atmosphere [Code: Enjoyment in Large Group Setting]. The lecturer reported that when students exchanged resources, provided clarifications, and employed positive language, they established a constructive environment that encouraged deeper engagement [Code: Lively Peer Exchange]. These dynamic interactions enabled participants to address minor challenges promptly, as peers were readily

available to offer real-time assistance or feedback [Code: Social Engagement Fuels Momentum].

Across all observed groups, large Group 1 demonstrated a mix of humour and supportive interactions, though some members (S12/LG1, S13/LG1, and S15/LG1) remained mostly task-focused [Code: Enjoyment in Large Group Setting]. Reciprocity varied, as certain individuals posted isolated comments rather than engaging in sustained back-and-forth discussions. By comparison, large Group 2 showed a high degree of social engagement. Most participants regularly used emoticons, offered encouragement, and acknowledged each other’s insights [Code: Lively Peer Exchange]. These peer-responsive discussions fostered a more cohesive learning community [Code: Social Engagement Fuels Momentum]. The contrast between the two large groups highlights how reciprocal social interactions can amplify collaboration and maintain group momentum. These findings contribute to RQ3a by indicating that large-group Division of Labour is supported when social reciprocity sustains momentum and promotes active help-seeking, thereby improving coordination across distributed roles.

**Table 4.24:** Summary of Theme: Strengthened Collaboration Dynamics

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Enjoyment in Large Group Setting</b>	“I love interacting with many people... I think I would enjoy the online environment with large group size.” – S1 (FG1/LG1)	Lecturer observed that energetic group interactions fostered a positive climate and sustained motivation.	Group 1 showed humour and supportive exchanges, though some members remained task-focused with limited reciprocal input.
<b>Lively Peer Exchange</b>	“Learning collaboratively in large group is actually fun... we can get much information from each other.” – S3 (FG1/LG1)	Journal noted that students actively shared resources and clarifications, promoting a constructive collaborative space.	Group 2 participants frequently encouraged one another and responded supportively using emoticons and affirmations.
<b>Social Engagement Fuels Momentum</b>	“The fun of communicating and we can get many ideas.” – S25 (FG5/LG2)	Positive language and resource-sharing strengthened group cohesion and lowered barriers to help-seeking.	Group 2 demonstrated strong reciprocal peer interaction, resulting in cohesive and continuous discussions.

#### **Theme 4: Supportive Environment in Large Group OCL**

Participants acknowledged the supportive aspects of large group collaboration, particularly the way individual strengths complemented one another. For instance, S21 (FG5/LG2) remarked, “*When we work together with others, we can use the others’ strength to cover our weakness.*” [Code: Complementary Strengths], while S11 (FG3/LG1) noted, “*We can develop leadership too in a large group.*” [Code: Leadership and Role Development]. Similarly, S23 (FG5/LG2) emphasized the group’s ability to make collective decisions, fostering cooperation, mutual assistance, and shared responsibility [Code: Shared Responsibility].

The lecturer’s notes revealed that students who initially appeared hesitant became increasingly engaged upon receiving constructive feedback from multiple peers [Code: Complementary Strengths]. This peer support often enhanced their confidence and motivation, leading to greater participation. The lecturer highlighted that a group environment marked by mutual respect and support helped learners recognize that they were not alone in confronting academic challenges [Code: Shared Responsibility].

Observational notes revealed that large Group 1, core initiators (S1, S4, S8, and S11) actively encouraged one another, but uneven participation from others occasionally hindered ongoing peer support [Code: Complementary Strengths]. While many participants were open to humour and mutual assistance, those who contributed sporadically limited the continuity of feedback and reinforcement. In contrast, large Group 2 maintained balanced participation alongside frequent expressions of appreciation and assistance [Code: Shared Responsibility]. Strong reciprocity conversations in large Group 2 reinforced a shared sense of responsibility, creating a consistently supportive atmosphere that enabled more members to contribute confidently and benefit from collective guidance [Code: Leadership and Role

Development]. This theme addresses RQ3a by illustrating that large group size can strengthen Division of Labour when complementary strengths, shared responsibility, and role development enable members to contribute in differentiated but mutually supportive ways.

**Table 4.25:** Summary of Theme: Supportive Environment

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Complementary Strengths</b>	“When we work together with others, we can use the others’ strength to cover our weakness.” – S21 (FG5/LG2)	Lecturer noted that students became more confident after receiving encouragement and constructive peer feedback.	Group 1’s core contributors supported one another, but uneven participation disrupted continuity of peer support.
<b>Leadership and Role Development</b>	“We can develop leadership too in a large group.” – S11 (FG3/LG1)	-	Group 2 exhibited balanced collaboration and clear sharing of responsibilities, supporting role growth and inclusivity.
<b>Shared Responsibility</b>	“The group can make decisions collectively and help each other.” – paraphrased from S23 (FG5/LG2)	Journal stressed that mutual assistance reduced individual pressure and reinforced team cohesion.	Group 2 frequently exchanged appreciation and guidance, promoting confidence and shared commitment to group outcomes.

### *Negative Themes*

#### **Theme 5: Communication Breakdowns in Large Group OCL**

Participants frequently reported challenges associated with large group collaboration, particularly information overload, miscommunication, and difficulty contributing to discussions. S29 (FG6/LG2) observed, “*The downside of working in a large group... is communication difficulties.*” [Code: Difficulty Sharing Ideas], while S30 (FG6/LG2) added, “*Communication can be more difficult in a large group, as team members may struggle to find opportunities to share their ideas.*” [Code: Difficulty Sharing Ideas]. Similarly, S17 (FG4/LG2) and S27 (FG6/LG2) described feeling confused or missing parts

of the conversation when multiple individuals spoke simultaneously [Code: Information Overload]. S5 (FG1/LG1) highlighted the difficulties faced by introverted students, stating, *“It is difficult for introverts to work in large group... it takes time for introverts to adapt.”* [Code: Challenges for Introverts].

According to the lecturer’s reflections, a surge of simultaneous posts often led to essential points being overlooked, resulting in repeated questions and instructions [Code: Difficulty Sharing Ideas]. In the absence of a designated moderator, confusion intensified as participants were uncertain about which ideas had been acknowledged [Code: Information Overload]. The lecturer's journal further noted that quieter members tended to remain silent, often feeling overshadowed or losing track of the discussion threads [Code: Challenges for Introverts].

Observational data across all groups indicated that large Group 1’s reliance on a few active contributors (S1, S4, S8, S11, S12, and S13) led to rapid exchanges, sometimes overwhelming those who participated sporadically [Code: Difficulty Sharing Ideas]. Several learners engaged in reciprocal dialogues, but five participants primarily posted standalone messages, prompting repeated clarifications and overlooked points [Code: Challenges for Introverts]. Large Group 2 also encountered occasional message overload despite generally balanced engagement and strong peer acknowledgment [Code: Information Overload]. The nature of its discussions sometimes caused confusion when too many members posted concurrently. These patterns highlight the need for structured communication strategies to help participants keep track of ongoing conversations in larger group settings. These findings address RQ3a by demonstrating that as group size increases, communicative density can disrupt Division of Labour by obscuring responsibilities and weakening coordination, thereby increasing the risk of duplicated or missed work.

**Table 4.26:** Summary of Theme: Communication Breakdowns

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Difficulty Sharing Ideas</b>	“Communication can be more difficult in large group... team members may struggle to find opportunities to share.” – S30 (FG6/LG2)	Lecturer noted that essential contributions were often buried in a surge of messages, leading to repeated clarifications.	Group 1 relied heavily on a few initiators, resulting in missed input from quieter members and disjointed dialogue.
<b>Information Overload</b>	“Felt confused or missed parts of the conversation when many people spoke at once.” – paraphrased from S17/S27	Journal emphasized that lack of moderation led to confusion and uncertainty over which contributions were acknowledged.	Group 2 occasionally experienced message congestion when multiple members posted simultaneously.
<b>Challenges for Introverts</b>	“It is difficult for introverts to work in large group... it takes time to adapt.” – S5 (FG1/LG1)	Lecturer observed that passive members were often overshadowed and disengaged from fast-paced discussion threads.	Some participants in both groups posted only standalone messages, failing to engage in sustained back-and-forth dialogue.

**Theme 6: Free-Riding Challenges in Large Group OCL**

Free-riding emerged as a common concern, with several participants describing uncommitted peers who benefited from the efforts of others. S4 (FG1/LG1) remarked that some members “*will not contribute and just watch or sleep.*” [Code: Passive Participation], while S2 (FG1/LG1) asserted, “*There will always be free-riders in large groups in online tasks especially if the task is easy.*” [Code: Task Evasion]. Similarly, S26 (FG6/LG2) noted that some participants “*try to ‘hide’ themselves*” to avoid contributing [Code: Hiding Behavior], reflecting students’ frustration with uneven workload distribution in larger teams.

The lecturer’s observations highlighted ongoing tensions related to perceived or actual imbalances in group effort. Some students expressed resentment when they felt overburdened by peers’ lack of contribution [Code: Passive Participation]. Journal entries further indicated that larger group sizes, when not supported by clear accountability mechanisms, enabled passive members to remain unnoticed [Code: Task Evasion]. This issue was intensified when tasks did not explicitly require individual contributions, resulting in vague or poorly defined roles [Code: Hiding Behavior].

Observational notes indicated that in Group 1, highly active members (S1, S4, S8, S11, S12, and S13) propelled most of the work, while others contributed minimally or made only sporadic appearances, thus raising concerns about free-riding [Code: Passive Participation]. The moderate reciprocity overall did not fully reduce the possibility of members benefiting from collaborative efforts without meaningful input [Code: Task Evasion]. Conversely, large Group 2 had more balanced engagement, with multi-turn exchanges and strong peer acknowledgment that helped discourage free-riding by making individual contributions more visible [Code: Hiding Behavior]. Nevertheless, the potential for uncommitted behavior remained whenever roles were poorly defined or when only a few individuals took consistent initiative. This theme answers RQ3a by showing that large group size can amplify accountability risks within the Division of Labour, enabling free-riding behaviours when contribution visibility and monitoring mechanisms are insufficient.

**Table 4.27:** Summary of Theme: Free-Riding Challenges

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Passive Participation</b>	“Some members will not contribute and just watch or sleep.” – S4 (FG1/LG1)	Lecturer noted rising resentment in groups where effort was uneven, especially in tasks lacking accountability.	Group 1 relied on a subset of members (e.g., S1, S4, S8) while others contributed infrequently or not at all.
<b>Task Evasion</b>	“There will always be free-riders in large groups in online tasks.” – S2 (FG1/LG1)	Journal highlighted that large groups without structured role assignment enabled passive members to remain unnoticed.	Reciprocity in Group 1 was moderate, failing to fully mitigate unnoticed non-participation.
<b>Hiding Behavior</b>	“Some participants try to ‘hide’ themselves to avoid contributing.” – S26 (FG6/LG2)	Lecturer emphasized the need for tasks that clearly define and track individual roles to prevent disengagement.	Group 2 showed better peer acknowledgment and balanced dialogue, reducing the risk of free-riding.

### **Theme 7: Challenges of Navigating Group Dynamics in Large Group OCL**

Many participants found it daunting to coordinate tasks and handle diverse opinions within large teams. Across focus groups, recurring concerns centred on role ambiguity, overlapping responsibilities, and discomfort in voicing opinions within a crowded discussion space. For example, S19 (FG4/LG2) noted that “*dividing works among members in a large group is quite difficult.*” [Code: Role Confusion], while S11 (FG3/LG1) highlighted that “*more people mean more different and clashing opinions.*” [Code: Clashing Opinions]. Additionally, some students expressed hesitation in contributing, particularly those who identified as introverted, with S6 (FG2/LG1) explaining that they would “*not dare to speak up in a large group.*” [Code: Social Discomfort for Introverts].

Rather than representing isolated incidents, these accounts collectively indicate recurring structural coordination challenges inherent in large-group configurations. Evidence from lecturer journals and online observations converged on three interrelated issues: unclear task allocation, difficulty managing divergent viewpoints, and uneven participation patterns. The lecturer’s notes confirmed that broader group sizes often resulted in vague or overlapping responsibilities [Code: Role Confusion]. Without clear leadership or conflict resolution mechanisms, disagreements sometimes escalated and tasks were duplicated or neglected [Code: Clashing Opinions]. Scheduling and role allocation also became increasingly complex as groups attempted to accommodate varied availability and skill levels, further intensifying participation imbalances.

Observational data reinforced these findings. In large Group 1, several participants attempted to clarify roles, yet inconsistent responses led to confusion and overlapping efforts. Repeated instances of duplicated task submissions and delayed acknowledgement of assigned responsibilities were observed, indicating fragmented coordination rather than

sustained collaborative exchange. Although there were moments of social bonding and humour, this did not fully offset the organizational challenges caused by partial engagement [Code: Social Discomfort for Introverts]. In one observed session, fewer than half of the members responded to role-allocation prompts, resulting in two students completing the same subsection while another task remained unattended. In contrast, large Group 2 established clearer task allocations early in the process and engaged in sustained multi-turn discussions, which reduced role ambiguity and minimised duplication. Although both groups demonstrated moments of social bonding, such relational cohesion did not fully offset procedural inefficiencies in coordination.

Taken together, the data suggest that while large groups offer diversity of perspectives, they simultaneously intensify coordination demands, role negotiation, and socio-emotional complexity. The convergence of focus group accounts, lecturer reflections, and observational evidence demonstrates that these challenges are structurally embedded within the Division of Labour when group size increases, rather than merely interpersonal issues. Clear facilitation, explicit role confirmation, and structured conflict-management strategies therefore become essential in sustaining effective collaboration. These findings address RQ3a by indicating that large group size intensifies Division of Labour complexity through role negotiation demands, divergent viewpoints, and socio-emotional barriers that shape who contributes, how tasks are allocated, and whether responsibilities are fulfilled.

**Table 4.28:** Summary of Theme: Challenges of Navigating Group Dynamics

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Role Confusion</b>	“For me, dividing works among members in a large group is quite difficult.” – S19 (FG4/LG2)	Lecturer noted overlapping or vague task divisions in large groups lacking clear role definitions.	Group 1 showed attempts at role-setting, but inconsistent engagement led to duplication and task confusion.
<b>Clashing Opinions</b>	“More people mean more different and clashing opinions as well. Then things will get ugly.” – S11 (FG3/LG1)	Journal described tension in some groups without conflict resolution strategies, which affected task continuity.	Group 2 managed to agree early on roles, though differences in opinion still occasionally delayed progress.
<b>Social Discomfort for Introverts</b>	“Introvert people like me would not dare to speak up in large group.” – S6 (FG2/LG1)	Lecturer highlighted that quieter students were often hesitant to speak, especially without encouragement or structure.	Despite humour and bonding moments in Group 1, partial engagement hindered overall coordination and contribution balance.

**Theme 8: Technical Issues in Large Group OCL**

Technical obstacles remained significant in large group OCL. S6 (FG2/LG1) observed that video calls “*will not be stable as well.*” [Code: Unstable Video Connectivity], and S8 (FG2/LG1) recalled instances where “*the platform glitched, and we had to restart our meeting.*” [Code: Session Interruptions]. Participants such as S14 (FG3/LG1) felt anxious after disconnections, fearing missed instructions or lost progress [Code: Fear of Missing Out]. Larger groups amplified these difficulties as more people tried to connect simultaneously, heightening the risk of lags and dropped sessions.

Across data sources, a consistent pattern emerged: connectivity strain increased when multiple members accessed voice or video features simultaneously. The lecturer documented frequent complaints about connectivity strain, particularly when multiple members accessed voice or video features at once [Code: Unstable Video Connectivity]. Temporary disconnections forced participants to rejoin mid-discussion, creating information gaps that required recapping [Code: Session Interruptions]. These incidents repeatedly broke

the conversation flow, leading to frustration and time lost in reorienting the group [Code: Fear of Missing Out].

Observations across all groups indicated that neither large Group 1 nor Group 2 experienced sustained platform failures. However, minor connectivity and synchronization issues were common. In large Group 1, intermittent disconnections forced some members to rejoin sessions, causing gaps in communication and brief pauses for recapping [Code: Unstable Video Connectivity]. Similarly, large Group 2 encountered occasional lags, which led to duplicated posts when several participants typed simultaneously [Code: Session Interruptions]. While these technical disruptions were usually short-lived, they momentarily derailed the flow of discussion and required additional coordination to ensure that critical information was not lost in the process [Code: Fear of Missing Out]. This theme contributes to RQ3a by demonstrating that large group Division of Labour is further shaped by technical constraints, where connectivity interruptions and synchronization issues increase coordination load and can compound role ambiguity in Discord-mediated collaboration.

**Table 4.29:** Summary of Theme: Technical Issues

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Unstable Video Connectivity</b>	“Video calls will not be stable as well.” – S6 (FG2/LG1)	Lecturer noted that voice/video features placed strain on group connectivity, especially with many users active.	Group 1 experienced occasional disconnections requiring members to rejoin and pause for clarification.
<b>Session Interruptions</b>	“The platform glitched, and we had to restart our meeting.” – S8 (FG2/LG1)	Reflections described session restarts and missed content due to instability, requiring recap time and follow-ups.	In Group 2, short lags occasionally caused multiple users to post simultaneously, leading to repeated or missed ideas.
<b>Fear of Missing Out</b>	“I felt anxious after disconnections... worried I missed instructions.” – S14 (FG3/LG1)	Lecturer reported students’ anxiety about losing track of progress during tech interruptions and frequent recapping.	Minor but recurring issues in both groups briefly disrupted flow and required repeated coordination.

#### 4.5.2 Discussion

##### ***RQ3a: How does large group size affect the “Division of Labour” in OCL among Biology matriculation students who use Discord?***

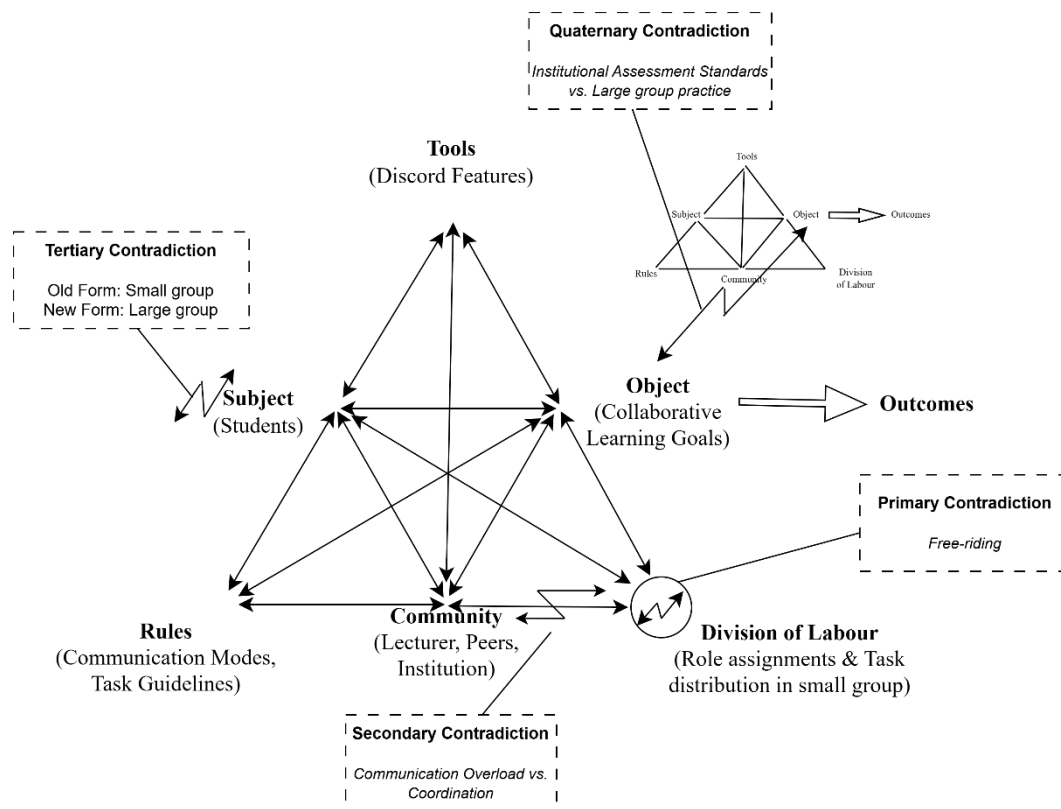
The findings presented in Section 4.5.1 reveal that forming a large group of 15 students to complete Biology assignments on Discord can both facilitate and hinder collaborative practices. From an AT standpoint, these patterns primarily unfold around the Division of Labour (Engeström, 2000) as students strive to delegate tasks, coordinate roles, and manage the interplay of multiple perspectives. While larger groups can offer diverse ideas and distribute workload more effectively, the data indicate that increasing group size gives rise to various contradictions that can either facilitate or hinder collaboration.

In direct response to RQ3a, the findings demonstrate that large group size reshapes the Division of Labour by expanding role distribution opportunities while simultaneously increasing coordination complexity and accountability risks. This pattern is reflected across the results, where large groups supported workload sharing, idea diversity, and peer support (Themes 1–4) while also intensifying overload, free-riding, role ambiguity, and technical coordination demands (Themes 5–8). Consistent with previous OCL research, many participants praised large groups for distributing tasks and reducing individual burden (Al Mulhim & Eldokhny, 2020; Saqr et al., 2019). When students assigned roles, they minimised duplication and encouraged accountability. The lecturer’s journal confirmed that dividing assignments into smaller tasks enriched students’ sense of ownership and potentially enhanced the quality of their output. These observations highlight how well-structured Division of Labour can align with the Object of OCL (Engeström, 2000).

Students consistently noted that the “many brains” in large groups nurtured deeper brainstorming and idea generation. Such heterogeneity aligns with prior findings that larger

group sizes yield creative problem-solving when guided appropriately (Mei et al., 2024). Here, the exam-driven context did not diminish the potential for innovation but rather highlighted the importance of balanced participation. While large Group 2 demonstrated effective multi-turn dialogue, sporadic posts in large Group 1 hindered deeper collaborative thinking. These results refine existing literature by demonstrating that diverse viewpoints enrich knowledge construction, although active facilitation is necessary to ensure even contribution (Hackett et al., 2024). Thus, large group size positively influences OCL when Division of Labour is intentionally structured but becomes counterproductive when coordination mechanisms are weak.

As the results show, larger groups can also heighten sociability and mutual support. Students appreciated being able to “cover each other’s weaknesses” while the lecturer observed that enthusiastic clusters of members often promoted a positive group climate. This synergy aligns with Martin and Bolliger (2018), who highlight that collaborative environments are strengthened by peer-driven feedback and emotional support. In exam-focused scenarios, these supportive dynamics can lessen stress, encourage broader engagement, and enable more members to feel comfortable contributing. Figure 4.5 complements these findings by illustrating how large-group interactions give rise to key tensions as mapped across the components of Discord-mediated activity system. Importantly, these findings are reported as contextually grounded design insights drawn from this Biology matriculation cohort and its exam-driven constraints, rather than generalisable claims about large-group OCL across settings.



**Figure 4.5:** Contradictions in Large Group Activity System

**Primary Contradictions** (*Within Division of Labour Element*)

A primary contradiction emerged within the Division of Labour when explicit role assignments were either missing or insufficiently enforced. Observational data revealed that large Group 1 depended heavily on a handful of initiators, leaving several members to post infrequent or one-off messages. This uneven participation pattern meant the formal “division of tasks” did not always translate into actual engagement. Although prior studies highlight the potential for large-group synergy (Al Mulhim & Eldokhny, 2020), this current finding emphasizes the risk of free-riding and lack of accountability if role clarity is not consistently maintained, particularly in exam-oriented contexts where unfulfilled tasks may compromise learning outcomes. This indicates that large group size can amplify participation inequality when monitoring mechanisms within the Division of Labour are insufficient.

### **Secondary Contradictions** (*Between Division of Labour and Community*)

A key secondary contradiction arose between Division of Labour and the Community (i.e. the large group itself) when communication overload compromised coordination. As seen in both large Group 1 and Group 2, surges of simultaneous posts or voice-chat interruptions caused confusion about acknowledged ideas. Students struggled to track conversation threads, leading to duplicated instructions or missed feedback. These communication breakdowns highlight a tension between the ideal of everyone contributing and the practical challenge of orchestrating numerous voices at once. Although prior OCL literature acknowledges the benefits of large group OCL (McCarron et al., 2021), exam-oriented contexts intensify the consequences of delays or misunderstandings, where even a single missed clarification can hinder the group's ability to meet important deadlines. Accordingly, large group size influences OCL dynamics by increasing communicative density, which strengthens idea diversity but simultaneously complicates coordination within the Community element.

### **Tertiary Contradictions** (*Old vs. New Forms of Activity*)

A tertiary contradiction emerged as students accustomed to smaller study groups or lecturer-led instruction encountered challenges in adjusting to the more complex dynamics of large group tasks conducted on Discord. Although large-group collaboration can foster deeper idea exchange, some participants withdrew when they felt overshadowed by more vocal peers. This pattern aligns with previous studies highlighting the reluctance of introverted individuals to engage in online forums with large group sizes (Chang & Brickman, 2018). The mismatch between traditional small group structures (Old Form) and the new large group OCL format (New Form) reveals a tension between established norms

and emergent practices (Engeström, 1987). In high-stakes settings, students may revert to passive roles or offer minimal input to avoid potential conflict or confusion. This suggests that the shift to large group Division of Labour requires behavioural adaptation that not all students immediately achieve, thereby affecting participation balance.

### **Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

A quaternary contradiction emerged when large group collaboration on Discord intersects with institutional assessment standards (Other Activity System) that typically emphasize clear individual accountability. The lecturer's observations revealed that some students expressed concern about how their contributions would be recognized in final exams or continuous assessments. Although similar institutional tensions have been reported by Yusoff and Zin (2012), the exam-oriented urgency in the matriculation context intensifies the issue. To address this, large group work on Discord requires clearly defined grading criteria and institutional support to ensure that individual contributions are fairly recognized and not overlooked within the group effort. Therefore, large group size affects Division of Labour not only at the interactional level but also in relation to institutional accountability structures.

Overall, these findings build on OCL scholarship by underlining how large group configurations enrich idea generation and peer support but also raise concerns about free-riding, communication overload, and role ambiguity (Biasutti, 2017; Saqr et al., 2019). The results challenge the assumption that advanced platform features such as Discord's channel organization can automatically guarantee balanced participation. While Hackett et al. (2024) highlight the creative virtues of large group synergy, the present findings emphasize that consistent leadership, conflict resolution protocols, and institutional alignment are vital to

fully realizing those benefits within a matriculation landscape. Collectively, these findings answer RQ3a by demonstrating that large group size reshapes Division of Labour through expanded task distribution, intensified coordination demands, and heightened accountability concerns.

Despite the general agreement on the challenges associated with large-group OCL, some data sources presented contrasting perspectives. In certain focus groups, a minority of participants reported that working in large groups increased their motivation rather than enabling free-riding. These students explained that observing high levels of participation from peers created social pressure to contribute as they wished to avoid peer disapproval. Similarly, the lecturer's journals documented a notable case in which a group of 15 students maintained effective collaboration. This was attributed to strong leadership from three members who consistently delegated tasks, monitored progress, and supported peer accountability.

Online observations further revealed that in at least one group categorised as large, only 12 or 13 members were actively involved while the remaining participants rarely engaged. In such cases, the group functioned more like a medium-sized team with inactive members having minimal influence on group dynamics. These findings suggest that the commonly reported drawbacks of large-group collaboration such as communication overload or coordination issues may be less significant when full participation is not uniformly distributed.

Taken together, these contrasting cases indicate that the effectiveness of large-group collaboration is not determined solely by numerical size but by the clarity of role allocation, strength of leadership, and degree of collective accountability established within the group. In the Malaysian matriculation context where time constraints and examination pressures

shape student behaviour, large-group OCL requires structured role monitoring, explicit communication norms, and assessment mechanisms that recognise individual contributions. At a broader pedagogical level, these findings suggest that digital learning policies in matriculation programmes should support clear guidelines for group-based assessment, provide training on collaborative role management. They should also encourage platforms that enable transparent tracking of participation to sustain equitable Division of Labour in large-group OCL.

Viewed through the expansive learning cycle (Engeström, 2001), these contradictions within the Division of Labour prompted collective questioning of how large-group roles were structured and monitored. The identification of free-riding, communication overload, and accountability tensions led to a critical re-examination of task allocation practices, followed by the modelling of clearer role-tracking mechanisms and structured interaction protocols. This progression reflects movement from recognition of systemic tensions toward iterative redesign within the activity system.

### **4.5.3 Design Refinements**

In line with DBR, these refinements represent context-specific design responses to the contradictions identified in this cohort:

1. Role-tracking sheets were used to assign tasks clearly and make the progress of each member visible.
2. A structured messaging system was introduced, including turn-taking rules and thread use to reduce communication overload.
3. Short peer feedback sessions were held to help students manage group differences and avoid passive participation.

#### 4.6 Small Group Size and Division of Labour in OCL

In Task 5, the focus shifted to small groups of five members to explore chromosomal abnormalities under the Mutation topic, including conditions such as Trisomy 21 (Down syndrome), Turner syndrome, and Klinefelter syndrome (refer **Appendix C** for instruction details). Students compared and contrasted autosomal and sex chromosomal abnormalities, synthesizing their findings into a written summary posted in their group's text channel on Discord (refer **Appendix I** for student work sample). Role allocation was pre-assigned based on individual strengths and availability, enabling greater flexibility while promoting peer accountability. This task provided insight into how smaller group configurations influence role balance and interaction quality within this cohort and task design. Both synchronous and asynchronous communication modes were employed during the activity. The task was aligned with the Division of Labour element of AT (RQ3), examining how collaboration dynamics differ in small group settings. Data were collected from the lecturer's reflective journal, online observation, and a focus group interview conducted at the end of Week 12.

#### 4.6.1 Results

### *Positive Themes*

#### **Theme 1: Enhanced Communication and Collaboration in Small Group OCL**

Focus group participants widely agreed that small groups greatly improve communication and collaboration in OCL. For example, S4 (FG1) noted, “*It is much easier to start a conversation in a smaller group. We can get responses quickly.*” [Code: Easier Conversation Flow], highlighting the benefits of prompt replies. Similarly, S19 (FG4) stated, “*I believe that a small group division will help the shy students to speak out more compared to the large group.*” [Code: Comfortable for Introverts], pointing out how fewer members reduce social barriers. S8 (FG2) highlighted that “*Small group makes the members collaborate more, as communication is the key, which is useful to introvert people too.*” [Code: Communication Boosts Collaboration]. This suggests that smaller group settings enhance communication, promoting greater engagement and inclusivity, especially for introverted individuals.

The lecturer’s observations supported these sentiments, noting that smaller group sizes enabled participants to voice their opinions with fewer interruptions [Code: Easier Conversation Flow]. This setting was particularly beneficial for introverted members, who felt more at ease and were inclined to participate in a smaller and supportive environment [Code: Comfortable for Introverts]. The reflective journals emphasized that small group OCL sessions often ran smoothly because participants could engage more deeply with each other’s ideas while also demonstrating attentive listening and empathy in their interactions [Code: Communication Boosts Collaboration].

Participation data indicated that Groups 1, 2, 4, and 5 demonstrated consistently high levels of engagement. In Group 1, for example, all participants (S1–S5) actively contributed by initiating and responding to messages [Code: Easier Conversation Flow]. Notably, the group exhibited strong reciprocity, with members building on each other’s ideas rather than making disconnected comments. Similar dynamics were observed in Groups 2 and 4, where active discussions were coupled with supportive interactions and deeper cognitive exchanges [Code: Comfortable for Introverts], reinforcing the notion that smaller groups facilitate more coherent and collaborative communication [Code: Communication Boosts Collaboration]. These findings address RQ3b by demonstrating that small group size strengthens the Division of Labour through clearer communication channels, higher reciprocity, and more visible individual participation within distributed roles.

**Table 4.30:** Summary of Theme: Enhanced Communication and Collaboration

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Easier Conversation Flow</b>	“It is much easier to start a conversation in smaller group. We can get responses quickly.” – S4 (FG1)	Lecturer noted smoother dialogue and fewer interruptions in smaller group sessions.	Group 1 participants (S1–S5) actively initiated and replied to messages with strong reciprocity.
<b>Comfortable for Introverts</b>	“Small group... helps the shy students to speak out more compared to the large group.” – S19 (FG4)	Reflections indicated that quieter students were more willing to express themselves in smaller, less intimidating groups.	Groups 2 and 4 showed active and inclusive participation, with members responding supportively and elaborating on peers’ input.
<b>Communication Boosts Collaboration</b>	“Small group makes the members collaborate more... communication is the key.” – S8 (FG2)	Journal described a collaborative environment where attentive listening and empathy promoted deeper discussions.	Groups 1, 2, 4, and 5 consistently demonstrated engaged, idea-driven dialogue with high levels of mutual responsiveness.

## **Theme 2: Effective Group Dynamics in Small Group OCL**

Many students perceived small group settings as conducive to fostering supportive environments that enhanced group cohesion. S10 (FG2) reported finding it “*easier to discuss and more comfortable*” [Code: Comfort and Ease of Discussion], while S22 (FG5) noted that “*somehow small size group could be effective as there are no fighting and nobody fight to give opinion, so it’s kind of peaceful.*” [Code: Conflict-Free Interaction]. Similarly, S18 (FG4) remarked, “*The best aspect in small group task is that people can be more of themselves and give their ideas and opinion easily,*” highlighting how smaller groups promote openness and mutual trust [Code: Conflict-Free Interaction].

According to the lecturer’s reflective notes, these supportive dynamics contributed to reduced interpersonal conflicts. In smaller teams, misunderstandings were quickly resolved and members were more inclined to offer constructive feedback [Code: Conflict-Free Interaction]. The journal also recorded that participants felt comfortable addressing disagreements at early stages, which helped prevent larger disputes [Code: Openness and Mutual Trust]. Positive relationships among team members were essential for maintaining motivation and mutual respect [Code: Comfort and Ease of Discussion].

Observational data further supported these findings. Groups 1, 2, 4, and 5 demonstrated high levels of social engagement and cohesive discussion patterns. In Group 1, participants used humour and supportive language to strengthen interpersonal rapport [Code: Comfort and Ease of Discussion]. In Group 5, members frequently expressed encouragement and acknowledged each other’s contributions [Code: Conflict-Free Interaction]. Similarly, Group 4 exhibited strong interpersonal bonds with all participants (S16–S20) actively affirming and building upon each other’s ideas [Code: Openness and Mutual Trust]. These patterns confirmed that small group environments often foster

friendlier, more unified, and collaborative team interactions. This theme answers RQ3b by showing that small group Division of Labour is supported when cohesive interpersonal dynamics reduce conflict, enhance trust, and enable smoother coordination of assigned responsibilities.

**Table 4.31:** Summary of Theme: Effective Group Dynamics

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Comfort and Ease of Discussion</b>	“Easier to discuss and more comfortable.” – S10 (FG2)	Lecturer observed that students were more relaxed and willing to communicate openly in smaller groups.	Group 1 participants used humour and informal language, fostering a relaxed and engaged environment.
<b>Conflict-Free Interaction</b>	“Small size group... there are no fighting... so it’s kind of peaceful.” – S22 (FG5)	Reflections noted fewer interpersonal tensions and quicker resolution of misunderstandings in small teams.	Group 5 members frequently encouraged and acknowledged one another, reinforcing a conflict-free and collaborative tone.
<b>Openness and Mutual Trust</b>	“People can be more of themselves and give their ideas and opinion easily.” – S18 (FG4)	Journal emphasized that small group size promoted mutual respect and constructive feedback during disagreements.	Group 4 showed strong interpersonal bonds with all members contributing meaningfully and building on each other’s ideas.

**Theme 3: Efficient Task Management in Small Group OCL**

Participants frequently emphasized the ease of organizing and completing tasks within small group OCL settings. S11 (FG3) noted, “*The best aspect in small group size is easier to divide the tasks and arrange everything.*” [Code: Clear Task Division]. Similarly, S20 (FG4) observed that “*since there are not many people in a group, everyone will have many tasks to do, which lowers the risk of having free riders.*” [Code: Reduced Free-Riding]. S2 (FG1) and S12 (FG3) also pointed out that smaller groups help maintain focus, with S12 stating, “*It is easier to control the topic so that it will not be out of the range.*” [Code: Focused Discussion and Efficiency].

The lecturer’s reflective notes documented several instances where small groups exhibited structured role allocation and smoother project workflows [Code: Clear Task Division]. Students generally had clear responsibilities, provided regular progress updates, and sought assistance when necessary. The notes also highlighted that smaller team sizes enhanced accountability [Code: Reduced Free-Riding]. It was easier to monitor individual contributions and quickly address any confusion or lack of participation.

Observational data further supported these findings. Groups 1, 2, 4, and 5 consistently demonstrated effective organization. In Group 2, participants (S6–S10) were highly engaged and proactively clarified task responsibilities at the start of each discussion [Code: Clear Task Division]. A similar pattern was evident in Group 4, where clear role distribution and regular check-ins minimised misunderstandings and boosted productivity [Code: Reduced Free-Riding]. These groups reached decisions efficiently, and their strong reciprocal communication ensured that all members remained informed [Code: Focused Discussion and Efficiency]. These findings respond to RQ3b by illustrating that small group size concentrates accountability, clarifies role allocation, and reduces free-riding risks, thereby stabilising the Division of Labour structure.

**Table 4.32:** Summary of Theme: Efficient Task Management

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Clear Task Division</b>	“The best aspect in small group size is easier to divide the tasks and arrange everything.” – S11 (FG3)	Lecturer noted that smaller groups allowed clearer task assignments and smoother workflows.	Group 2 members (S6–S10) clarified roles early and updated each other frequently, ensuring high task coordination.
<b>Reduced Free-Riding</b>	“Everyone will have many tasks to do, so lower the risk of having free riders.” – S20 (FG4)	Journal emphasized that accountability was easier to maintain in smaller teams, reducing passive participation.	Group 4 showed structured role distribution and consistent check-ins that enhanced individual accountability.
<b>Focused Discussion and Efficiency</b>	“It is easier to control the topic so that it will not be out of the range.” – S12 (FG3)	-	Groups 1, 2, 4, and 5 reached task goals efficiently due to high engagement and ongoing reciprocal communication.

#### **Theme 4: Idea Exchange in Small Group OCL**

Participants commended small group discussions for promoting more focused idea-sharing and deeper elaboration on key points. S3 (FG1) stated that “*we can obtain all information better and in more details.*” [Code: Detailed Idea Sharing] in a smaller team. Similarly, S2 (FG1) emphasized, “*We also have more time to read each and everyone’s ideas.*” [Code: Ample Time for Reflection], illustrating how manageable group sizes help ensure that valuable contributions are not overlooked. S18 (FG4) observed that in a small group, “*most or all people can collaborate and contribute their opinions and ideas comfortably.*” [Code: Inclusive Idea Contribution], which led to more meaningful and inclusive dialogue.

The lecturer’s reflective notes echoed these perspectives, highlighting that small groups frequently engaged in more rigorous discussions as members felt a heightened sense of responsibility to examine and refine each suggestion [Code: Detailed Idea Sharing]. The journal further noted that with fewer contributors, each idea received closer attention, reducing the chances of rushed decisions or unexamined assumptions [Code: Ample Time for Reflection]. As a result, students expressed greater confidence in their final outcomes, knowing their perspectives had been fully considered [Code: Inclusive Idea Contribution].

Observation data reinforced these findings. Groups 1, 2, 5, and 6 consistently demonstrated reciprocal idea-building. In Group 2, all participants (S6–S10) contributed to sustained cognitive engagement through in-depth analysis [Code: Ample Time for Reflection]. Similarly, in Groups 1 (S1–S5) and 5 (S21–S25), members regularly extended one another’s points, posed relevant follow-up questions, and arrived at well-developed conclusions [Code: Detailed Idea Sharing]. These patterns highlighted the capacity of small groups to effectively harness collective knowledge and foster enriched idea exchange [Code:

Inclusive Idea Contribution]. This theme addresses RQ3b by demonstrating that small group Division of Labour supports deeper cognitive engagement when each member’s contribution receives sustained attention and integration.

**Table 4.33:** Summary of Theme: Idea Exchange

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Detailed Idea Sharing</b>	“We can obtain all information better and more details.” – S3 (FG1)	Lecturer noted that students examined and refined ideas more thoroughly in small groups.	Groups 1 and 5 regularly extended each other’s ideas, contributing to well-rounded discussions.
<b>Ample Time for Reflection</b>	“We also have more time to read each and everyone’s ideas.” – S2 (FG1)	Journal highlighted that each contribution received more attention, enhancing thoughtfulness and deliberation.	Group 2 participants (S6–S10) sustained focused engagement, leading to in-depth analytical exchanges.
<b>Inclusive Idea Contribution</b>	“Most or all people can collaborate and contribute their opinions and ideas comfortably.” – S18 (FG4)	Lecturer observed increased comfort and inclusivity, with students showing greater confidence in collaborative outcomes.	All members in Groups 1, 2, 5, and 6 engaged in reciprocal, constructive dialogue throughout discussions.

### *Negative Themes*

#### **Theme 5: Structural Limitations of Small Group Task Management in OCL**

Some participants expressed concerns regarding the limitations of small group composition, particularly in terms of human resources. S25 (FG5) remarked, “*The main challenge of small group is the number of people for work division will be limited.*” [Code: Limited Division of Labour], while S30 (FG6) noted, “*it is hard to get various ideas and points of view of others because [of the] small number of people in the group.*” [Code: Lack of Diverse Expertise]. Similarly, S29 (FG6) cautioned that “*if the task is too complicated but the group members are too few, everyone may be forced to do so much work and may feel stressed.*” [Code: Overburdened Team Members].

The lecturer's reflective journal documented instances in which complex tasks imposed significant demands on small teams, particularly when group members lacked specialized skills [Code: Limited Division of Labour]. Although students generally valued the manageability of smaller groups, the journal highlighted that certain projects required a wider range of expertise than what was available within a limited team [Code: Lack of Diverse Expertise]. In such cases, students were compelled to either quickly acquire new competencies or seek external assistance, thus increasing the overall pressure [Code: Overburdened Team Members].

Observational data from Group 3 and Group 6 illustrated these constraints. In Group 3, four participants (S11–S14) contributed actively while one member (S15) demonstrated minimal engagement, requiring the others to compensate for the reduced input [Code: Limited Division of Labour]. A similar dynamic was observed in Group 6, where one participant (S30) was less involved, placing a greater workload on the remaining members (S26–S29) [Code: Overburdened Team Members]. These examples suggest that small teams may become overburdened if full participation is not achieved [Code: Lack of Diverse Expertise], highlighting a key vulnerability in limited group structures. These findings clarify RQ3b by revealing that small group size can constrain the Division of Labour when limited human resources reduce expertise diversity and increase workload intensity for active members.

**Table 4.34:** Summary of Theme: Structural Limitations of Task Management

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Limited Division of Labour</b>	“The main challenge of small group is the number of people for work division will be limited.” – S25 (FG5)	Lecturer noted that small teams struggled with dividing complex tasks across fewer members, increasing workload pressure.	Group 3’s active members (S11–S14) compensated for S15’s low engagement, creating workload imbalances.
<b>Lack of Diverse Expertise</b>	“It is hard to get various ideas and points of views... [with] small number of people.” – S30 (FG6)	Journal highlighted that small groups sometimes lacked the necessary breadth of knowledge for multidisciplinary tasks.	Group 6 showed limited idea diversity when one member (S30) contributed infrequently.
<b>Overburdened Team Members</b>	“Everyone may be forced to do so much work and may feel stressed.” – S29 (FG6)	Reflections noted that students often had to learn new skills quickly or take on extra roles to meet project demands.	Both Groups 3 and 6 experienced increased pressure on remaining members due to uneven participation.

**Theme 6: Impact of Member Participation on Task Management in Small Group OCL**

Participants also acknowledged that small group dynamics can be negatively affected when even one member underperforms or disengages. S10 (FG2) remarked, “*It will end up the work will be postponed, and possibly it will not be completed as well.*” [Code: Delayed Completion Due to Inactivity], illustrating how the absence or inactivity of a single member can significantly delay progress. Likewise, S25 (FG5) observed, “*There might be someone who will get more work than others, thus it is kind of unfair.*” [Code: Unequal Workload Distribution], pointing to the issue of uneven workload distribution. S29 (FG6) added that in smaller groups, heavier responsibilities “*may feel stressed*” [Code: Stress from Overcompensation] for those handling an unequal share of the work.

Reflective notes indicated that such challenges were more pronounced in small group contexts where the absence or lack of preparation by a single member had a greater impact due to limited human resources [Code: Delayed Completion Due to Inactivity]. The lecturer’s journal recorded some instances where deadlines were missed or tasks delayed because a key member failed to deliver on time [Code: Unequal Workload Distribution].

Additionally, the lack of role rotation occasionally led to burnout among students who consistently managed complex components of group tasks [Code: Stress from Overcompensation].

Observations in Group 3 revealed that minimal participation by S15 placed additional strain on the remaining members (S11–S14) who had to absorb the extra workload [Code: Delayed Completion Due to Inactivity]. A similar pattern emerged in Group 6, where limited involvement of S30 resulted in increased pressure on S26–S29 [Code: Unequal Workload Distribution]. These examples highlight the importance of active participation in small teams, where the absence of even one member can delay progress. Without consistent engagement, issues such as incomplete tasks and unequal workload distribution can negatively affect group productivity and morale [Code: Stress from Overcompensation]. This theme contributes to RQ3b by showing that in small groups, the Division of Labour becomes highly sensitive to individual performance, where under participation by a single member disproportionately disrupts coordination and task completion.

**Table 4.35:** Summary of Theme: Member Participation on Task Management

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Delayed Completion Due to Inactivity</b>	“It will end up the work will be postponed, and possibly it will not be completed as well.” – S10 (FG2)	Lecturer noted that a single member’s failure to contribute often caused delays or missed deadlines in small teams.	In Group 3, low participation from S15 delayed workflow, placing additional pressure on S11–S14.
<b>Unequal Workload Distribution</b>	“There might be someone who will get more work than others, thus it is kind of unfair.” – S25 (FG5)	Reflections described instances of burnout in students consistently assigned more demanding or complex roles.	In Group 6, limited engagement from S30 led to heavier responsibilities falling on S26–S29.
<b>Stress from Overcompensation</b>	“Heavier responsibilities may feel stressed.” – S29 (FG6)	Journal emphasized that lack of role rotation and imbalance in task contribution increased stress for engaged members.	Both Groups 3 and 6 exhibited productivity gaps tied to underperformance of one member within otherwise functional teams.

### **Theme 7: Limited Idea Generation in Small Group OCL**

Although many participants praised the depth of discussion fostered by small group settings, some noted that smaller teams offered a more limited pool of ideas. S3 (FG1) remarked, “*But, in small group size, sometimes to get the ideas it is quite limited, right?*” [Code: Limited Pool of Ideas]. S9 (FG2) echoed this concern by stating, “*The main challenge in small group discussion is that the ideas are limited.*” [Code: Narrow Perspective Range]. Similarly, S30 (FG6) observed that “*it is hard to get various ideas and points of views.*” in a small group [Code: Lack of Contrasting Opinions].

The lecturer’s reflections supported these observations, noting that smaller groups occasionally lacked fresh or contrasting perspectives [Code: Limited Pool of Ideas]. When consensus was reached too quickly, opportunities for deeper exploration or alternative approaches were often missed. While close interpersonal dynamics promoted collaboration and comfort, they sometimes restricted the diversity of perspectives when members shared similar views [Code: Narrow Perspective Range]. The lecturer also noted that some groups attempted to address this limitation by seeking external input or consulting additional resources to broaden their perspectives [Code: Lack of Contrasting Opinions].

In Groups 1 and 2, participants engaged in meaningful discussions, but the range of ideas was sometimes narrower than other teams [Code: Limited Pool of Ideas]. Group 3 similarly demonstrated reflective engagement, though the limited number of contributors reduced the presence of competing viewpoints [Code: Narrow Perspective Range]. While these small groups exhibited strong participation and cohesion, the lack of diverse perspectives occasionally constrained the development of more creative or alternative solutions [Code: Lack of Contrasting Opinions]. These findings address RQ3b by indicating that while small group Division of Labour enhances focus and cohesion, it may

simultaneously narrow perspective diversity, thereby limiting the breadth of collaborative knowledge construction.

**Table 4.36:** Summary of Theme: Limited Idea Generation

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Limited Pool of Ideas</b>	“But, in small group size, sometimes to get the ideas it is quite limited, right?” – S3 (FG1)	Lecturer observed that limited group diversity sometimes led to premature consensus or missed alternative views.	Groups 1 and 2 showed consistent participation but occasionally lacked divergent or novel perspectives.
<b>Narrow Perspective Range</b>	“The main challenge in small group discussion is that the ideas are limited.” – S9 (FG2)	Journal noted that interpersonal closeness fostered comfort but sometimes hindered idea diversity and critical tension.	Group 3 engaged reflectively but the limited number of active contributors reduced viewpoint variety.
<b>Lack of Contrasting Opinions</b>	“It is hard to get various ideas and points of views.” – S30 (FG6)	Some groups sought external input or resources to supplement the limited perspectives available internally.	Although small groups were cohesive, idea development occasionally plateaued due to homogeneous input.

**Theme 8: Social Pressure in Small Group OCL**

Participants also highlighted moments of discomfort and pressure associated with smaller group sizes. S2 (FG1) stated, “*Everyone [is] waiting for others to initiate the conversation.*” [Code: Hesitation to Initiate], highlighting the awkwardness that arises when no one assumes a leadership role. Similarly, S22 (FG5) observed, “*The main challenge in small group size is when everyone is too shy to give their opinion.*” [Code: Shyness and Silence], pointing to the risk of prolonged silence. S21 (FG5) added, “*Uneven assignment of work can cause feeling of unsatisfied among the group mates.*” [Code: Perceived Inequity], noting that imbalances in participation may lead to frustration when a few members dominate or bear most of the workload.

The lecturer’s reflections documented several instances of such social tensions. When group members hesitated to contribute, discussions often stalled until a more assertive participant took the lead [Code: Hesitation to Initiate]. This dynamic sometimes led to

feelings of exclusion or pressure among quieter members who felt overshadowed or compelled to match the pace of more vocal peers. The journal also noted that effective facilitation of small group discussions occasionally required deliberate instructor intervention to promote balanced participation [Code: Shyness and Silence].

Group 3 provided a clear example of this dynamic: S11 and S12 initiated most of the conversation while S14 and S15 contributed minimally [Code: Hesitation to Initiate]. This imbalance occasionally resulted in decisions being made without broader input, thus generating minor tension [Code: Perceived Inequity]. In contrast, Groups 1, 2, 4, and 5 had fewer issues because members took turns leading discussions and defining roles [Code: Shyness and Silence]. Nevertheless, the overall data indicated that social hesitation and unequal participation can hinder small group OCL effectiveness, particularly when members do not actively share responsibilities or encourage one another to engage. This theme answers RQ3b by demonstrating that small group size intensifies interpersonal visibility within the Division of Labour, where social hesitation, perceived inequity, or uneven initiative can significantly reshape collaborative dynamics.

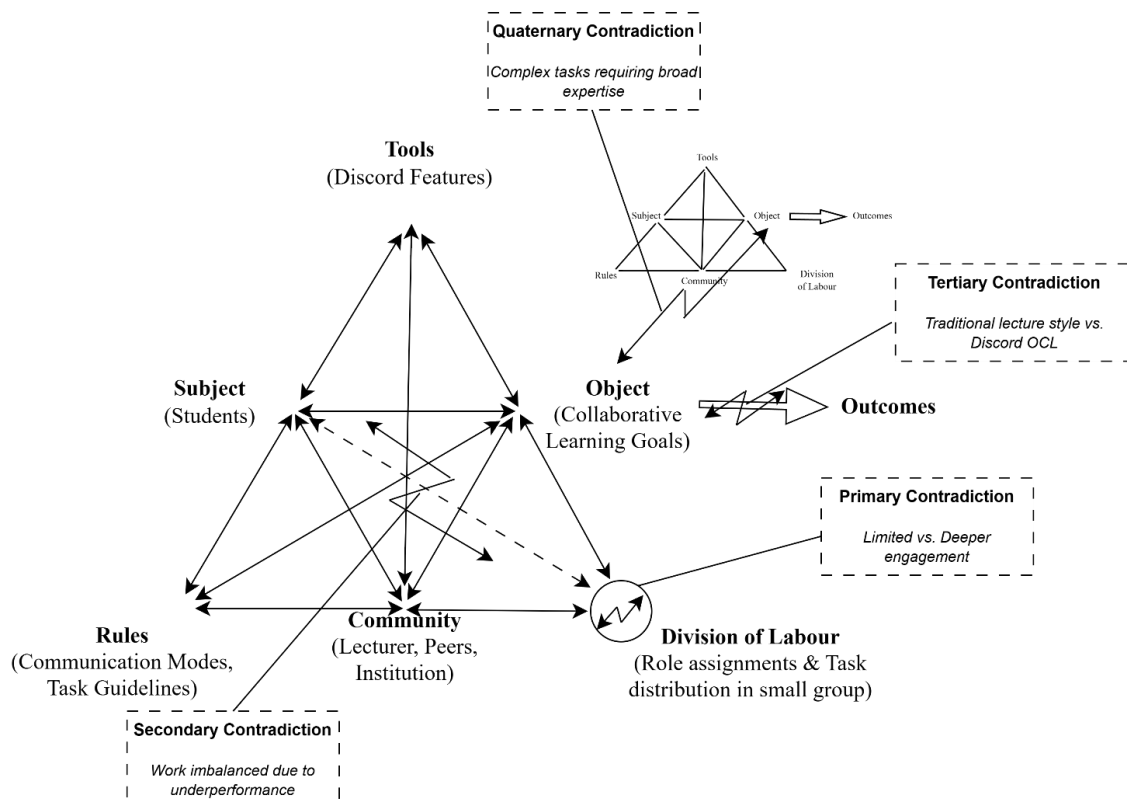
**Table 4.37:** Summary of Theme: Social Pressure

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Hesitation to Initiate</b>	“Everyone [is] waiting for others to initiate the conversation.” – S2 (FG1)	Lecturer noted that discussions often stalled until one member took initiative, creating pressure for quieter students.	In Group 3, conversations were led primarily by S11 and S12, while others remained passive.
<b>Shyness and Silence</b>	“The main challenge... is when everyone is too shy to give their opinion.” – S22 (FG5)	Reflections emphasized that shy students needed support or structured prompts to engage fully in group tasks.	Groups 1, 2, 4, and 5 mitigated this through role rotation, reducing silence and boosting participation.
<b>Perceived Inequity</b>	“Uneven assignment of work can cause feeling of unsatisfied among the group mates.” – S21 (FG5)	-	Group 3 showed uneven contribution, where key decisions were often made by a few members without broader input.

#### 4.6.2 Discussion

##### *RQ3b: How does small group size affect the “Division of Labour” in OCL among Biology matriculation students who use Discord?*

The results illustrate how small group size significantly shapes the Division of Labour element of AT in Discord-mediated OCL among Biology matriculation students. Consistent with previous research, the present findings show that smaller teams foster more direct communication and clearer role allocation (Al Mulhim & Eldokhny, 2020; Mei et al., 2024). This effect can enhance accountability and inclusivity as highlighted by a few participants who noted that shy or introverted learners felt more comfortable sharing in these small group settings. These observations build on earlier OCL research by Johnson and Johnson (1999) by showing that small group size is well aligned with the exam-oriented demands observed in this matriculation context, where effective time management and rapid feedback are essential. In direct response to RQ3b, the findings indicate that small group size reshapes the Division of Labour by concentrating responsibility among fewer members, thereby strengthening clarity of roles while increasing vulnerability to imbalance when participation falters. Nevertheless, the results also uncover several contradictions around Division of Labour when small groups undertake collaborative tasks in Discord. In AT, contradictions are not mere problems but serve as drivers of potential “expansive learning” (Engeström, 2001). Figure 4.6 maps these tensions onto the relevant activity system components. These findings are presented as contextually grounded design insights arising from this Biology matriculation cohort, its exam-driven constraints, and the specific Discord task structures, rather than as generalisable claims about small-group OCL across settings.



**Figure 4.6:** Contradictions in Small Group Activity System

**Primary Contradictions** (*Within the Division of Labour*)

A primary contradiction emerges within the “Division of Labour” element itself, highlighting the tension between deeper individual engagement and limited diversity of perspectives. On the one hand, participants appreciated that smaller groups encouraged active contribution from each member, leading to more coherent and focused discussions. On the other hand, some noted that a limited number of contributors reduced the diversity of perspectives, occasionally leading to premature consensus formed without sufficient deliberation. These dual outcomes extend the findings of Kalaian et al. (2018) by demonstrating that while a smaller number of participants may enhance group cohesion, this configuration can also unintentionally constrain creative thinking. Thus, small group size

positively influences sustained participation but may restrict the breadth of idea generation within the Division of Labour structure.

### **Secondary Contradictions** (*Between Division of Labour and Subjects*)

Several tensions emerged between the elements of “Division of Labour” and “Subjects.” Although smaller team sizes were designed to enhance participation, the underperformance or absence of even a single member as observed in Group 3 and Group 6 significantly increased the workload for the remaining participants. This finding supports existing concerns about social loafing in small group OCL contexts (Afify, 2019) while also highlighting the disproportionate burden placed on more engaged members. Such outcomes partially challenge the assumption that smaller groups naturally promote individual accountability (Mei et al., 2024). The data suggest that small group structures can only reduce free-riding when all members consistently fulfil their responsibilities. Accordingly, small group size intensifies the impact of individual behaviour on collective performance, making accountability more visible but also more fragile.

### **Tertiary Contradictions** (*Old vs. New Forms of Activity*)

A tertiary contradiction arises when the newly introduced “small group discussion-oriented” activity (New Form) meets the older and more traditional “lecture-focused” model (Old Form) prevalent in matriculation programs. Although students recognized that small groups on Discord facilitate idea exchange and deeper discourse, some retained exam-driven habits such as seeking quick notes instead of collaborative exploration. This echoes Engeström's (1987) description of tension between emerging and established practices, where the shift toward student-led processes conflicts with the priority of covering extensive

curricula rapidly for exams. While prior studies illustrate the strengths of smaller teams for inquiry-based tasks (Johnson & Johnson, 1999; Lauricella et al., 2024), the current results show that a time-pressured context can partially undermine these benefits as students prioritize exam preparation over in-depth dialogue. This suggests that small group Division of Labour requires cultural adaptation to fully realise its collaborative potential within exam-oriented systems.

**Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

Quaternary contradictions emerged between the small group OCL system and external institutional frameworks (Other Activity System). The lecturer's notes indicated that while small groups fostered engagement, certain complex projects demanded broader expertise, thus prompting some teams to seek external help or additional resources. This tension aligns with the notion in Haugland et al. (2022) that tasks of higher complexity might benefit from larger groups or cross-group collaboration. Here, the limited human resources within smaller teams collided with academic pressures for high-quality outputs, raising the question of how to balance the efficiency of small group tasks with the richness of multi-perspective collaborations. Therefore, small group size influences Division of Labour not only internally but also in relation to institutional performance expectations.

Overall, these findings largely affirm research suggesting that smaller teams can achieve higher intimacy and accountability in OCL (Al Mulhim & Eldokhny, 2020; Mei et al., 2024). Yet, the present results also refine or challenge established claims by demonstrating in this setting how small group size intensifies both the advantages such as increased communication and a sense of belonging, and also the risks such as workload imbalance and limited diversity of ideas. Collectively, the findings answer RQ3b by showing

that small group size strengthens role clarity and interpersonal engagement while simultaneously heightening the consequences of uneven participation and limited idea diversity.

Not all small groups functioned as effectively as the theoretical framework might predict in practice. In several focus groups, participants identified an unexpected drawback of working in small teams: a reluctance to challenge close peers due to concerns about harming personal relationships. This social dynamic calls into question the assumption that smaller group size inherently promotes deeper critical engagement. Contradictory evidence also appeared in the lecturer's journal where high-performing tasks were completed successfully despite minimal contributions from one or two group members. These instances indicate that strong outcomes may sometimes result from the initiative of a few highly motivated students rather than consistent participation from all members.

Furthermore, online observations revealed that while some small groups engaged in focused and meaningful discussions, others produced final outputs that lacked the depth and complexity observed in larger teams. This may reflect a limited diversity of perspectives or insufficient idea exchange within the small-group composition. Such variation highlights that the effectiveness of small groups is influenced not only by structural factors such as size but also by group composition and interpersonal dynamics. These exceptions highlight the importance of contextual factors in shaping collaborative outcomes and suggest that small group formats although often advantageous, do not guarantee sustained or high-quality engagement in all cases.

Viewed through the expansive learning cycle (Engeström, 2001), the contradictions identified within small-group Division of Labour prompted collective reflection on how accountability, role clarity, and idea diversity were structured. Recognition of workload

imbalance, early consensus formation, and uneven contribution led to deliberate questioning of existing task allocation practices. Subsequent modelling of rotating leadership, cross-group exchange, and structured brainstorming represents iterative attempts to reconceptualize how small groups function within the activity system. Rather than signalling failure, these tensions operated as developmental drivers, enabling refinement of collaborative structures and strengthening alignment between the Division of Labour and the Object of meaningful OCL.

#### **4.6.3 Design Refinements**

In line with DBR, these refinements represent context-specific design responses to the contradictions identified in this cohort and task cycle:

1. Leadership roles were rotated within small groups to ensure balanced task distribution and prevent over-reliance on the same individuals.
2. Groups were allowed brief collaborations with nearby teams to exchange ideas and strengthen task outcomes.
3. Brainstorming prompts were introduced at the start of each session to encourage varied perspectives and improve idea generation.
4. Brief instructor check-ins were scheduled to resolve group tensions and support equitable task engagement.

#### **4.7 Lecturer-Student Interaction in OCL Community**

Task 6 focused on Recombinant DNA Technology, where student groups constructed mind maps (refer **Appendix I** for student work sample) to illustrate the five key steps of gene cloning: gene isolation, cleavage, insertion, transformation/amplification, and screening (refer **Appendix C** for instruction details). The activity was conducted over three days through both synchronous and asynchronous interactions on Discord. The lecturer (Mdm. S) played an active facilitating role by conducting synchronous formative assessments via voice channels. These real-time sessions enabled her to clarify misconceptions, probe student understanding, and prompt deeper inquiry into each step of the cloning process. Within this cohort and task design, lecturer guidance supported conceptual depth and collaborative focus in the OCL environment. The task was aligned with the Community element of AT (RQ4), highlighting the lecturer's role in shaping the learning dynamics. Data collection methods included the lecturer's reflective journal, online observation, and a focus group interview conducted at the end of Week 14.

#### 4.7.1 Results

### *Positive Themes*

#### **Theme 1: Guidance in Lecturer-Student OCL Community**

Participants consistently reported that direct lecturer guidance in OCL helped ensure accurate discussions and reduced confusion. S1 (FG1) stated, “*They can give us guidance.*” [Code: Lecturer as Guide], while S4 (FG1) added, “*When lecturer joins in the discussion... he/she can give hints or pinpoint which part is incorrect.*” [Code: Error Correction and Clarity]. S15 (FG3) mentioned that lecturer presence kept the group “*on the right track.*” [Code: Staying on Track], and S20 (FG4) explained that “*when lecturers are involved, they would give us guidance on what we are discussing on.*” [Code: Lecturer as Guide]. These responses reflect a shared view that lecturer input supports and sharpens student thinking.

The lecturer’s journal supported this perspective. Groups that received regular feedback from the lecturer showed more focused discussions and resolved confusion more quickly [Code: Lecturer as Guide]. Several entries noted that the correction of factual errors helped students avoid trial-and-error approaches [Code: Error Correction and Clarity]. These timely interventions increased clarity, built student confidence, and encouraged deeper engagement with the subject [Code: Staying on Track].

Observations showed that visible lecturer involvement made discussions more purposeful even in lower participation groups. In Group 3, focus improved briefly when the lecturer clarified roles or concepts [Code: Lecturer as Guide]. Group 2 showed moderate engagement but developed ideas more effectively after lecturer input [Code: Error Correction and Clarity]. Although Groups 1, 4, 5, and 6 varied in participation, lecturer presence consistently led to more active and meaningful exchanges [Code: Staying on

Track]. Overall, across the observed groups, lecturer input functioned as a stabilising influence on discussion focus. This theme answers RQ4a by showing that lecturer guidance within the Discord Community functions as cognitive scaffolding that stabilises task direction and reduces conceptual drift.

**Table 4.38:** Summary of Theme: Guidance

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Lecturer as Guide</b>	“They can give us guidance.” – S1 (FG1)	Lecturer noted that instructor presence helped keep group discussions focused and reduced off-topic diversions.	In Group 3, participation improved after the lecturer clarified roles and key discussion points.
<b>Error Correction and Clarity</b>	“He/she can give hints or pinpoint which part is incorrect.” – S4 (FG1)	Journal emphasized that correcting factual mistakes helped students avoid trial-and-error learning.	Group 2 developed ideas more effectively after lecturer input helped resolve conceptual misunderstandings.
<b>Staying on Track</b>	“Lecturer presence kept the group on the right track.” – S15 (FG3)	Reflections noted that lecturer involvement increased confidence and encouraged deeper academic engagement.	Across all groups, lecturer guidance led to more focused, purposeful exchanges even in groups with low baseline participation.

**Theme 2: Support System in Lecturer-Student OCL Community**

Participants emphasized that lecturer involvement boosts morale and creates a supportive learning environment. S6 (FG2) stated, “*Lecturer can also motivate students to collaborate more.*” [Code: Lecturer Encouragement Boosts Morale], highlighting the lecturer’s role in driving group momentum. S11 (FG3) shared that receiving praise from the lecturer “*will make me feel happy and more interested in that particular subject.*” [Code: Recognition Increases Interest], reflecting the positive emotional impact of recognition. Similarly, S19 (FG4) noted that encouraging comments from lecturers help reduce anxiety by stating, “*This can motivate the students.*” [Code: Encouragement Reduces Anxiety], especially when they are uncertain about their contributions.

Reflective journal entries supported these views, showing that lecturer encouragement increased student confidence and sustained engagement. The lecturer

observed that even brief messages of praise or constructive advice made students feel supported and less anxious [Code: Encouragement Reduces Anxiety]. These moments of affirmation reduced group tension and promoted a more open exchange of ideas [Code: Lecturer Encouragement Boosts Morale]. As a result, students were more likely to seek clarification and share their thoughts, which improved overall collaboration [Code: Recognition Increases Interest].

Observation data revealed a clear link between lecturer support and group cohesion. In Group 5, although general activity was moderate, participants (S21, S22, and S24) engaged in more collaborative and reciprocal discussions when lecturer feedback was present [Code: Recognition Increases Interest]. In Group 2, lecturer encouragement led S6-S8 to actively build on one another's ideas [Code: Lecturer Encouragement Boosts Morale]. However, Groups 1 and 3 still showed variable engagement patterns, indicating that lecturer presence alone did not guarantee sustained participation [Code: Encouragement Reduces Anxiety]. These findings suggest that emotional and motivational support from lecturers plays a key role in maintaining student interaction and confidence in OCL. This theme addresses RQ4a by demonstrating that lecturer encouragement shapes the socio-emotional climate of the Community by increasing confidence, reducing anxiety, and sustaining willingness to collaborate.

**Table 4.39:** Summary of Theme: Support System

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Lecturer Encouragement Boosts Morale</b>	“Lecturer can also motivate students to collaborate more.” – S6 (FG2)	Lecturer noted that motivational input from lecturers enhanced group energy and willingness to collaborate.	In Group 2, lecturer support led S6–S8 to engage in more sustained and reciprocal discussions.
<b>Recognition Increases Interest</b>	“Receiving praise from the lecturer will make me feel happy and more interested...” – S11 (FG3)	Reflections highlighted that praise and recognition helped reduce anxiety and built student confidence.	Group 5 members (S21, S22, S24) showed stronger collaboration during and after lecturer interactions.
<b>Encouragement Reduces Anxiety</b>	“This can motivate the students.” – S19 (FG4)	Encouraging feedback reduced group tension, prompting more active participation and idea-sharing.	Groups 1 and 3, with minimal lecturer presence, showed less consistent engagement compared to lecturer-supported sessions.

**Theme 3: Boosting Productivity in Lecturer-Student OCL Community**

Participants frequently associated lecturer involvement with greater efficiency in completing tasks. S2 (FG1) stated, “*We can finish our task faster when the lecturer is present.*” [Code: Faster Task Completion], linking faster progress to immediate feedback and reduced trial-and-error attempts. Similarly, S23 (FG5) described lecturer participation as promoting a “*safe, controlled, and efficient discussion*” [Code: Controlled Discussion] which helped prevent unnecessary debates or off-topic conversations. S6 (FG2) added that “*playful group members will be more serious*” when a lecturer is present [Code: Promotes Serious Participation], highlighting the role of instructor oversight in maintaining focus.

The lecturer’s journal entries consistently supported this view. Lecturer moderation often improved the flow of discussions by identifying flawed assumptions early, which reduced confusion and kept the group focused on viable ideas [Code: Faster Task Completion]. This guidance was particularly valuable under time constraints, as lecturer feedback helped clarify expectations, minimised misunderstandings, and accelerated decision-making [Code: Controlled Discussion].

Observations confirmed the positive impact of lecturer involvement on productivity. Groups 2 and 5, which demonstrated moderate participation levels, exhibited more structured collaboration when guided by lecturer feedback [Code: Faster Task Completion]. This led to clearer task division and reduced repetitive discussion. In Groups 1 and 3, where general engagement was lower, lecturer interventions shifted the focus toward task completion [Code: Controlled Discussion]. While not all students consistently responded to lecturer input, these moments generally reduced wasted effort and aligned with participant feedback that lecturer presence helps “*avoid unnecessary debates*” (S23, FG5) [Code: Promotes Serious Participation]. This theme responds to RQ4a by indicating that lecturer participation strengthens the Community’s capacity to achieve the Object efficiently through timely clarification, moderation, and focused task progression.

**Table 4.40:** Summary of Theme: Boosting Productivity

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Faster Task Completion</b>	“We can finish our task faster when the lecturer is present.” – S2 (FG1)	Lecturer feedback reduced trial-and-error approaches, helping groups stay on track and meet deadlines.	Groups 2 and 5 became more task-focused and organized when lecturers clarified goals and next steps.
<b>Controlled Discussion</b>	“Safe, controlled, and efficient discussion.” – S23 (FG5)	Journal noted lecturer moderation prevented topic derailment and reduced time spent on non-essential arguments.	Lecturer presence helped streamline discussion in Groups 1 and 3, increasing clarity and alignment during low engagement phases.
<b>Promotes Serious Participation</b>	“Playful group members will be more serious” when lecturer is present. – S6 (FG2)	-	Lecturer guidance in moderately active groups increased focus and decreased repetition of ideas or misunderstandings.

#### **Theme 4: Enhancing Engagement in Lecturer-Student OCL Community**

Lecturer involvement often increased student engagement by initiating discussions and providing structured prompts. S1 (FG1) stated, “*Lecturer can initiate the discussion and give us some sort of ideas where to start.*” [Code: Lecturer-Initiated Participation], while S6 (FG2) shared that it becomes “*really fun when lecturer is with us... no one will dare not to contribute.*” [Code: Motivation Through Presence]. S24 (FG5) added that lecturer-led questions “*trigger the thinking of students to give their ideas.*” [Code: Idea Stimulation via Lecturer Input], emphasizing that guided input can stimulate deeper thinking and shared interest in the topic.

The lecturer wrote that activities led by her significantly enhanced participation and reciprocal interaction. Students were more likely to offer critical feedback when lecturers posed open-ended questions or facilitated brainstorming [Code: Idea Stimulation via Lecturer Input]. This approach reduced surface-level responses and encouraged engagement at a higher cognitive level. Journal entries also indicated that lecturer-led discussions promoted accountability, making passive participation less common [Code: Motivation Through Presence].

Although participation levels varied across groups, lecturer presence consistently supported deeper collaboration. In Group 2, which showed moderate engagement, strong interaction emerged when the lecturer encouraged analytical thinking [Code: Lecturer-Initiated Participation]. Group 6 similarly demonstrated moments of deep analysis, particularly among S26, S27, and S28, when the lecturer introduced complex questions [Code: Idea Stimulation via Lecturer Input]. Even in Group 4, which generally had low engagement, lecturer involvement briefly increased interaction between S16 and S17 [Code: Motivation Through Presence]. These findings support students’ views that lecturer-driven

dialogue fosters more active and thoughtful exchanges in OCL environments. This theme answers RQ4a by showing that lecturer-initiated prompts and questioning increase participatory intensity and higher-order idea exchange within the Community.

**Table 4.41:** Summary of Theme: Enhancing Engagement

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Lecturer-Initiated Participation</b>	“Lecturer can initiate the discussion and give us some sort of ideas where to start.” – S1 (FG1)	Lecturer-led prompts sparked early engagement and guided idea development during brainstorming activities.	Group 2 showed increased analytical dialogue when the lecturer initiated questioning.
<b>Motivation Through Presence</b>	“Really fun when lecturer is with us... no one will dare not to contribute.” – S6 (FG2)	Reflections indicated lecturer involvement reduced passivity and improved accountability among group members.	Lecturer presence elevated participation in Group 4, temporarily engaging otherwise passive members like S16 and S17.
<b>Idea Stimulation via Lecturer Input</b>	“Lecturer-led questions trigger the thinking of students to give their ideas.” – S24 (FG5)	Open-ended questions from lecturer were linked to higher-order thinking and more critical feedback among students.	Group 6 participants (S26–S28) demonstrated deeper engagement and elaboration when guided by the lecturer.

### *Negative Themes*

#### **Theme 5: Psychological Barriers in Lecturer-Student OCL Community**

While lecturer presence offered clear benefits, several participants also reported feelings of anxiety or intimidation. S6 (FG2) noted, “*The main challenge is when lecturer is involved in the discussion, some students will be too afraid of getting their ideas wrong.*” [Code: Fear of Being Wrong], while S21 (FG5) added, “*Students will become passive as they are afraid of giving wrong answers.*” [Code: Shyness and Formality Tension]. S9 (FG2) expressed this tension clearly by saying, “*Woo...if the lecturer is with us in the discussion, to be honest we automatically feel afraid, anxious, worried and everything.*” [Code: Anxiety in Lecturer Presence]. Some participants also mentioned feeling “*too shy*” or concerned

about appearing “*rude*” if their informal language did not match formal expectations [Code: Shyness and Formality Tension].

The lecturer’s journal recorded several instances where fear of judgment led to reduced student participation. In some discussions, students avoided sharing creative or exploratory ideas to prevent criticism [Code: Fear of Being Wrong]. The journal also noted that while lecturer-led discussions provided structure, they sometimes created a formal atmosphere that limited spontaneous interaction [Code: Anxiety in Lecturer Presence]. This effect was especially apparent when students were unsure of the correct answer and hesitated to speak [Code: Shyness and Formality Tension].

Observation data supported these findings. Groups with frequent lecturer engagement often showed a decline in reciprocity when students felt uncertain. For example, in Group 1 and Group 3, only one or two participants contributed regularly while others posted infrequently or offered surface-level responses [Code: Fear of Being Wrong]. Although lecturer involvement maintained order and clarity, it occasionally reinforced a formal tone that discouraged open sharing [Code: Anxiety in Lecturer Presence]. These findings confirm that psychological barriers such as fear of making mistakes or being judged can reduce student participation in OCL settings [Code: Shyness and Formality Tension]. This theme addresses RQ4a by indicating that lecturer presence can also constrain Community participation when fear of error and perceived evaluation suppress risk-taking and peer dialogue.

**Table 4.42:** Summary of Theme: Psychological Barriers

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Fear of Being Wrong</b>	“Some students will be too afraid getting their ideas wrong.” – S6 (FG2)	Lecturer noted reduced creativity and idea-sharing due to students’ fear of judgment or criticism.	In Groups 1 and 3, only a few members actively participated, while others remained silent or posted only basic responses.
<b>Anxiety in Lecturer Presence</b>	“If the lecturer is with us... we automatically feel afraid, anxiety, worried...” – S9 (FG2)	Reflections described how lecturer-led sessions sometimes created a formal atmosphere that discouraged spontaneous input.	Lecturer presence helped with structure but sometimes led to surface-level engagement, especially when students felt uncertain.
<b>Shyness and Formality Tension</b>	“Students will become passive... too shy to share or afraid of being rude.” – S21 (FG5), paraphrased	Journal highlighted how fear of using informal language or making errors limited students’ willingness to contribute.	Participation declined in groups where students appeared overly focused on correctness or formal expectations.

**Theme 6: Impact of Lecturer Characteristics in Lecturer-Student OCL Community**

Participants expressed concern that certain lecturer behaviours, such as being overly controlling or too serious could limit creativity and autonomy. S25 (FG5) noted, “*Lecturers are not allowing their students to be creative or to give free opinions.*” [Code: Limits on Creativity and Autonomy]. S1 (FG1) and S11 (FG3) also indicated that when lecturers maintain a strictly formal approach, students feel pressured to remain “*professional*” or “*serious*” throughout [Code: Pressure to Be Serious or Formal]. S22 (FG5) added, “*Sometimes lecturers are too controlling.*” [Code: Lecturer Control Reduces Initiative], reflecting a wider view that an authoritative teaching style may suppress spontaneous contributions.

Reflective journal entries supported these concerns. Although intended to guide, lecturer-directed activities occasionally sidelined student-led initiatives [Code: Limits on Creativity and Autonomy]. The lecturer observed that in some cases, groups relied heavily on her suggestions without considering alternative approaches. This lecturer-dependent dynamic was more common when lecturers were perceived as strict or inflexible, resulting

in fewer student-generated ideas [Code: Lecturer Control Reduces Initiative]. Over time, such conditions appeared to foster passivity, with students increasingly waiting for lecturer input rather than taking initiative [Code: Pressure to Be Serious or Formal].

Observational data showed that Groups 1, 3, and 6 displayed signs of dependence on lecturer direction. In these groups, initiative was often limited to one or two members such as S4 in Group 1 and S11 in Group 3 [Code: Lecturer Control Reduces Initiative]. When lecturers offered clear instructions or opinions, most participants followed them without further elaboration [Code: Limits on Creativity and Autonomy]. This pattern suggests that a highly directive approach may discourage risk-taking and reduce creative engagement. While lecturer involvement can effectively guide discussion, excessive control can silence student voices and weaken collaborative learning. This theme responds to RQ4a by showing that lecturer characteristics can reshape Community norms by either enabling autonomy and creativity or producing dependence and reduced student initiative.

**Table 4.43:** Summary of Theme: Impact of Lecturer Characteristics

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Limits on Creativity and Autonomy</b>	“Lecturers are not allowing their students to be creative or giving free opinion.” – S25 (FG5)	Lecturer observed reduced student-led initiatives when students perceived lecturers as strict or overly directive.	In Groups 1 and 3, participants followed lecturer directions with minimal elaboration or alternative suggestions.
<b>Pressure to Be Serious or Formal</b>	“We have to be professional and serious all the time.” – S1 (FG1), S11 (FG3)	Reflections noted that formality in tone sometimes suppressed spontaneity and limited peer-to-peer exploration.	-
<b>Lecturer Control Reduces Initiative</b>	“Sometimes lecturers are too controlling.” – S22 (FG5)	Journal highlighted increasing student dependence on lecturer feedback, which reduced proactive thinking and discussion.	Initiative was concentrated among one or two students in lecturer-led groups; others waited for explicit instruction before engaging.

### **Theme 7: Technical Challenges in Lecturer-Student OCL Community**

Technical challenges frequently emerged as a major barrier to sustained effective lecturer-student interaction in OCL. S29 (FG6) reported that “*poor internet connection or hardware malfunctions*” disrupted online discussions and prevented continuous lecturer participation. These interruptions not only delayed feedback but also fragmented the flow of discussion. S21 (FG5) expressed frustration over longer wait times for lecturer clarification during connectivity issues, which slowed progress and allowed misconceptions to persist.

The lecturer’s notes repeatedly highlighted technology-related issues including unstable internet connections and device limitations. In many instances, lecturer input was delayed or unavailable due to connection failures. Students viewed timely feedback as essential for confirming the accuracy of their work. Journal entries noted that when the lecturer’s connection was lost, students often hesitated to proceed with key decisions out of concern for making mistakes without expert guidance.

Observation data supported these findings. Groups 4 and 5 experienced noticeable disruptions in lecturer engagement due to technical problems. In Group 5, which initially demonstrated moderate activity, particularly among S21, S22, and S24, discussions stalled during episodes of connectivity loss while students waited for the lecturer to reconnect. Group 4, which already showed low engagement, experienced further declines whenever the lecturer’s feedback was delayed. These patterns highlight the importance of reliable technological infrastructure for maintaining continuous lecturer support and maximizing the effectiveness of OCL. This theme answers RQ4a by demonstrating that infrastructure instability disrupts Community continuity, weakening timely scaffolding and lowering students’ confidence to proceed collaboratively.

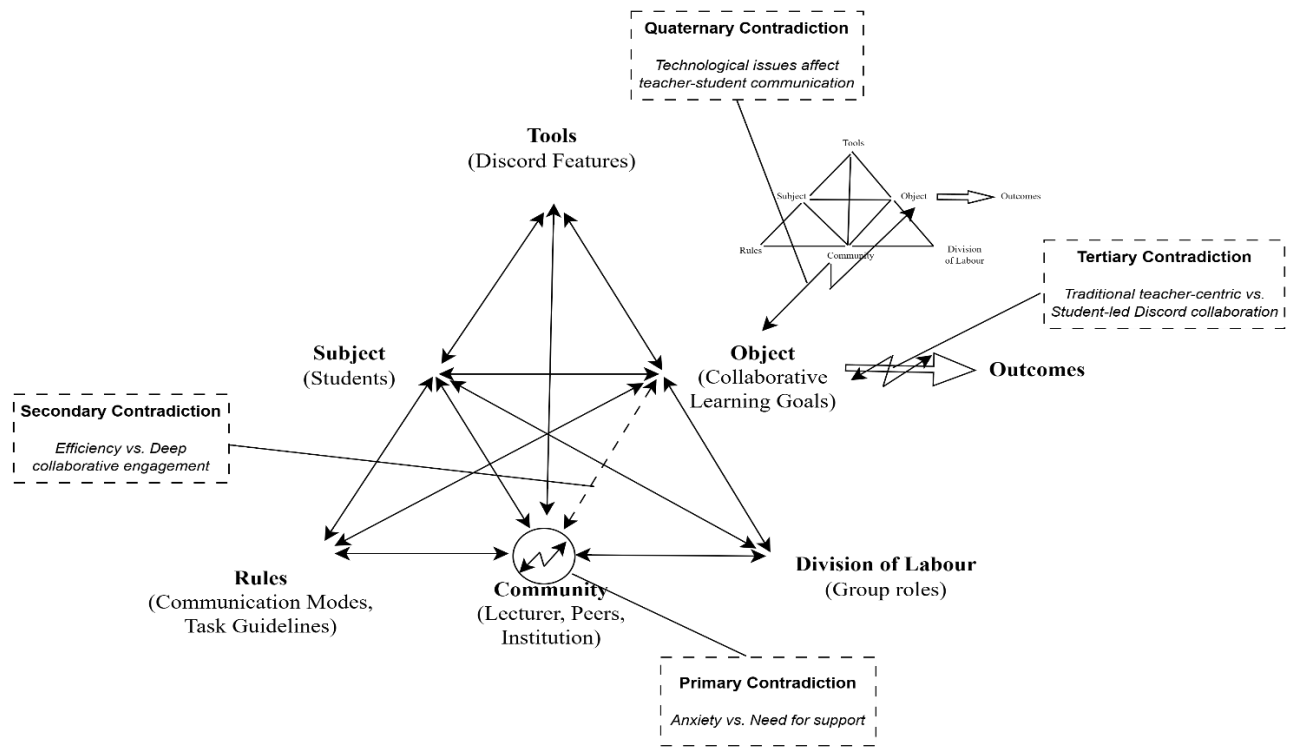
**Table 4.44:** Summary of Theme: Technical Challenges

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Disruption to Lecturer Presence</b>	“Poor internet connection or hardware malfunctions” disrupted discussion. – S29 (FG6)	Lecturer’s connection failures delayed feedback and limited continuity of lecturer-student engagement.	In Group 5, student discussions stalled when the lecturer disconnected, interrupting interaction with S21, S22, and S24.
<b>Delayed Clarification Slows Progress</b>	“Longer wait times for lecturer clarification” led to frustration. – S21 (FG5)	Journal noted that students were reluctant to proceed without lecturer input, resulting in decision-making delays.	In Group 4, already low engagement declined further when lecturer responses were delayed or absent due to technical issues.
<b>Reduced Feedback Affects Confidence</b>	-	Lack of timely lecturer feedback led students to fear making mistakes and reduced their willingness to explore solutions.	Groups experiencing tech interruptions displayed uncertainty and disengagement until lecturer presence was restored.

#### 4.7.2 Discussion

*RQ4a: What roles do lecturer–student interactions within Discord “Community” play in affecting OCL among Biology matriculation students?*

The results demonstrate how lecturer–student interactions situated within the Community element of AT shaped both cognitive and socio-emotional dimensions of OCL in this Discord-mediated intervention (Engeström, 2000). Lecturer presence is a powerful factor in guiding student thinking, providing emotional support, improving efficiency, and increasing engagement. This aligns with previous studies that highlight the importance of instructor facilitation in effective OCL (Garrison, 2000; Miao & Ma, 2022). However, the present findings also show that certain lecturer behaviours, formality, or overreliance on instructor input can limit creative participation. This supports earlier research warning that excessive lecturer control may hinder collaborative inquiry (Salehudin et al., 2023; Silseth & Furberg, 2024). In direct response to RQ4a, the findings indicate that lecturer–student interactions function simultaneously as cognitive scaffolds and socio-emotional regulators within the Community element, shaping how students participate, take risks, and construct knowledge collaboratively. These interpretations are presented as context-specific insights from this cohort, topic (Recombinant DNA Technology), and facilitation design, rather than generalisable claims about lecturer–student interaction in all OCL contexts. Figure 4.7 maps these tensions onto the activity system components, highlighting multiple contradictions that arise when lecturer–student interactions intersect with a demanding exam-oriented context.



**Figure 4.7:** Contradictions in Lecturer–Student Interactions Activity System

**Primary Contradictions** (*Within the Community Element*)

A primary contradiction appears in the Community element itself. Students see lecturer participation as essential for clarifying content, providing motivation, and maintaining group cohesion, aligning with Vygotsky's (1978) idea of expert support (More Knowledgeable Other) within the ZPD. However, the same involvement can cause anxiety and discourage open exploration due to fear of making mistakes. This tension reflects a trade-off between the perceived value of expert validation and the emotional risk of public error. While guided participation is helpful, the psychological pressure can reduce collaborative engagement when students feel intimidated (Chang & Brickman, 2018; Butarbutar et al., 2023). Thus, lecturer presence influences OCL dynamics not only by enhancing clarity but also by shaping the emotional climate of participation.

Over successive DBR cycles, recognition of this contradiction led to deliberate adjustments in facilitation style, including the use of open-ended questioning, delayed feedback, and explicit reassurance that exploratory errors were part of learning. This shift reflects an expansive learning process in which both lecturer and students reconceptualised their roles within the Community element, moving from a validation-dependent interaction model toward a more dialogic and shared inquiry approach.

**Secondary Contradictions** (*Between Community and Object*)

Several secondary contradictions arise between the Community (lecturer–student interactions) and the Object (OCL learning goals). Although lecturer feedback enhances task completion and accuracy, it may unintentionally shift students’ focus away from meaningful collaborative problem-solving toward prioritising efficiency and correct outcomes. Some groups depended heavily on lecturer direction and described a more controlled environment where students were less willing to try creative or alternative strategies. This finding builds on Yusoff and Zin's (2012) use of AT by showing that institutional norms and teaching practices can affect how students balance collaboration with completing tasks efficiently.

Through iterative redesign, lecturer intervention was gradually repositioned from directive correction toward facilitative scaffolding. This modification enabled groups to attempt independent reasoning before receiving confirmation, thereby expanding the Object of activity from mere task completion to deeper conceptual engagement. In AT terms, the contradiction stimulated transformation in how the Community supported the Object, strengthening collaborative autonomy without removing instructional guidance. Accordingly, lecturer–student interaction influenced OCL by determining whether collaboration centred on performance efficiency or conceptual co-construction.

### **Tertiary Contradictions** (*Old vs. New Forms of Activity*)

A tertiary contradiction emerges when the traditional lecturer-centred model (Old Form) conflicts with the collaborative culture of OCL (New Form) on Discord. Students who are used to seeing lecturers as the main source of knowledge often hesitated to share ideas without lecturer validation. This reflects Engeström's (1987) concept of conflicting activity types where the norm of relying on the lecturer clashes with a setting in which learners are expected to co-construct knowledge. The formality introduced by lecturer presence (lecturer's journal) sometimes reduced the informal and dialogic potential of Discord as noted by Xie et al. (2022), who observed similar tensions in lecturer-student interactions that limit engagement in online learning environments.

As cycles progressed, some students began initiating discussions without waiting for lecturer confirmation, indicating partial transformation of established participation norms. This behavioural shift illustrates expansive learning, where participants collectively redefined acceptable forms of engagement within the activity system. Rather than viewing the lecturer solely as the authority, students gradually embraced peer validation and shared responsibility for knowledge construction. This transition demonstrates how lecturer-student interactions gradually reshaped participation norms within the Community element.

### **Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

A quaternary contradiction arises when the lecturer-student community on Discord clashes with broader institutional policies and technological infrastructures. Participants noted that unstable internet and hardware issues repeatedly disrupted real-time feedback and lecturer facilitation, an experience consistent with Lagat and Concepcion (2022) and Martin and Bolliger (2018), who noted that such barriers hinder the continuity of online learning.

These disruptions often impede group discussions as students are reluctant to proceed without lecturer validation. Furthermore, institutional mandates requiring the use of official systems for attendance, grading, and exam documentation may marginalize the pedagogical value of Discord. In the matriculation context, educators are compelled to navigate administrative expectations while fostering meaningful engagement on Discord. This tension may lead to a disproportionate emphasis on formal procedures, thereby limiting the effective utilization of collaborative features in Discord for OCL. In response, hybrid documentation strategies and clearer communication protocols were introduced to align Discord practices with institutional accountability requirements. This adjustment represents a system-level adaptation in which Discord-mediated activity system sought compatibility with broader institutional structures rather than functioning in isolation. Taken together, the sequence of identifying tensions, experimenting with revised facilitation practices, and observing shifts in participation reflects the cyclical phases of expansive learning—questioning existing norms, modelling alternative interaction patterns, implementing new practices, and consolidating transformed roles within the Community element (Engeström, 2001).

Overall, these findings support existing research that highlights the importance of instructor facilitation in motivating students and sustaining collaborative focus in online settings (Garrison, 2000; Miao & Ma, 2022). Lecturer involvement functioned as a critical scaffold (Vygotsky, 1978; Said et al., 2014). This research extends the literature by showing that while direct guidance can improve efficiency and boost learner confidence, it may also inhibit creativity and student-led inquiry when delivered in a highly formal or controlling manner (Salehudin et al., 2023). Furthermore, the data highlight the impact of technological

infrastructure on the frequency and quality of lecturer intervention, a factor acknowledged in broader OCL discussions (Gaad, 2022).

These contradictions show that lecturer–student interactions are not always beneficial. They require careful orchestration and a deliberate balance between structured support and learner autonomy (van de Pol et al., 2019). While lecturer facilitation can enhance clarity and motivation, excessive control or psychological pressure may restrict active exploration and student initiative (Y. Xie et al., 2022). In line with AT, such tensions are not merely obstacles but can function as catalysts for expansive learning and system transformation (Engeström, 2001). Across the DBR cycles, these contradictions prompted gradual transformation in facilitation strategies, participation norms, and student confidence. The expansive learning outcome was not merely improved task performance but a reconfiguration of lecturer–student roles within the Community element, supporting more balanced authority distribution and shared epistemic responsibility. Collectively, these findings answer RQ4a by demonstrating that lecturer–student interactions within Discord play a dual role: enhancing conceptual clarity and emotional support while simultaneously shaping autonomy, participation norms, and the depth of collaborative engagement.

The findings carry important implications for Malaysian matriculation pedagogy and digital learning policy. First, professional development programmes should move beyond technical platform training and explicitly address facilitation strategies for balancing authority and autonomy in digital collaborative environments. Lecturers require structured guidance on using questioning techniques, delayed intervention, and peer-led moderation to cultivate dialogic interaction rather than compliance-driven participation. Second, institutional policy frameworks should formally recognise third-party collaborative platforms as pedagogically legitimate spaces for structured learning, provided that clear

documentation, assessment alignment, and data protection protocols are established. Without institutional endorsement and infrastructural support, lecturers may default to conservative facilitation styles that prioritise compliance over collaborative inquiry. Third, assessment policies within matriculation settings should incorporate mechanisms that recognise collaborative reasoning processes, not solely individual performance outcomes. Such alignment would reduce the tension between Community practices and the Object of examination success, thereby enabling lecturer–student interactions to support expansive, inquiry-oriented learning rather than purely efficiency-driven outcomes.

#### **4.7.3 Design Refinements**

In line with DBR, these refinements represent context-specific responses to tensions observed in this cohort and task cycle:

1. The lecturer used open-ended questions and positive feedback to make students feel more comfortable sharing.
2. Informal language was allowed to reduce pressure and encourage natural conversation.
3. Student facilitators led group discussions with minimal lecturer involvement to support peer interaction.
4. Optional channels without the lecturer were added for independent student discussions.

#### **4.8 Student-Student Interaction in OCL Community**

Task 7 addressed the topic Reproduction and Development with a focus on fostering peer-driven collaboration (refer **Appendix C** for instruction details). Working in groups, students explored subtopics such as spermatogenesis, the ovarian cycle, and the menstrual cycle. Each group discussed hormonal regulation and step-by-step mechanisms involved in their assigned topic using both synchronous voice discussions and asynchronous planning via text channels on Discord. The task required groups to collaboratively produce an explanatory essay that was then posted in their respective group text channels (refer **Appendix I** for student work sample). Role allocation was entirely student-led, encouraging autonomy and mutual support. Within this task design, peer learning communities developed through sustained student–student interaction that supported engagement and knowledge co-construction. The task was aligned with the Community element of AT (RQ4), examining the nature and impact of peer collaboration. Data were collected from the lecturer’s reflective journal, online observation, and a focus group interview conducted at the end of Week 15.

#### 4.8.1 Results

### *Positive Themes*

#### **Theme 1: Effective Communication in Student-Student OCL Community**

Participants consistently reported that student–student interactions created a relaxed environment conducive to open communication. S3 (FG1) explained, “*Among ourselves, of course we can give opinions freely, we can joke around as well, so there is less pressure.*” [Code: Casual and Comfortable Dialogue], emphasizing the benefits of casual dialogue. S17 (FG4) expressed a preference for mixed-language use by stating, “*I prefer student-student interaction because I can use mixed language... during the discussion.*” [Code: Flexible Language Use], suggesting that flexible language use contributed to a more natural and inviting atmosphere. Similarly, S5 (FG1) noted feeling “*not shy to ask simple questions since it’s just us among friends.*” [Code: Encouragement of Questioning]. Across accounts, informality reduced social barriers and supported question-asking.

Reflective journal entries supported these observations. The lecturer frequently noted that students communicated more openly in peer-led groups [Code: Casual and Comfortable Dialogue]. Quieter or less confident participants often contributed more actively when lecturer presence was absent, resulting in increased openness and comfort in addressing complex topics [Code: Encouragement of Questioning]. The use of informal language also appeared to strengthen peer relationships, with students offering encouragement and building on one another’s ideas rather than feeling pressured to maintain formal discourse [Code: Flexible Language Use].

Observational data from Groups 1, 2, and 5 provided further evidence of effective peer communication. In Group 2, all members actively contributed, expanded on each

other’s points, and used humour to sustain a positive tone [Code: Casual and Comfortable Dialogue]. Group 1 showed strong reciprocity among three participants (S1–S3) who engaged in extended discussions, although two members were less involved [Code: Flexible Language Use]. Overall, observed peer-only environments supported comfortable communication, though engagement remained uneven in some groups [Code: Encouragement of Questioning]. This theme answers RQ4b by showing that student–student interaction strengthens the Discord Community through relaxed communication norms, flexible language use, and increased willingness to ask questions, which together broaden participation and support peer scaffolding.

**Table 4.45:** Summary of Theme: Effective Communication

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Casual and Comfortable Dialogue</b>	“Among ourselves... we can give opinions freely, we can joke around as well, so less pressure.” – S3 (FG1)	Lecturer noted that peer-only groups fostered comfort and openness, especially for quieter students.	Group 2 maintained a friendly, humorous tone while consistently expanding on each other’s points.
<b>Flexible Language Use</b>	“I prefer student-student interaction because I can use mixed language...” – S17 (FG4)	Informal speech strengthened peer bonds and supported more relaxed, supportive interactions.	Group 1 displayed extended peer dialogue (S1–S3), using accessible language to sustain interaction.
<b>Encouragement of Questioning</b>	“Not shy to ask simple questions since it’s just us among friends.” – S5 (FG1)	Students showed more willingness to express uncertainty and explore ideas in peer-led discussions.	Groups 1, 2, and 5 exhibited high reciprocity and a collaborative tone, even in complex or challenging topics.

**Theme 2: Collaboration Dynamics in Student-Student OCL Community**

Participants described peer-only OCL settings as environments where teamwork and collaborative problem-solving were strongly supported. S1 (FG1) stated that student-student interaction “*promotes teamwork and encourage[s] us to share ideas.*” [Code: Peer-Driven Teamwork]. This view was echoed by S22 (FG5) who observed, “*Students tend to share ideas that are out of the box and somehow can be more creative around their peers.*” [Code:

Creativity and Openness]. Several participants (e.g. S11 [FG3]; S27 [FG6]; S28 [FG6]) also noted that reduced anxiety in peer settings led to more productive idea generation and smoother discussions [Code: Reduced Anxiety Enhances Interaction].

Reflective journal entries reinforced these insights. In the absence of lecturer oversight, students were more likely to take initiative in managing discussions and dividing responsibilities [Code: Peer-Driven Teamwork]. The lecturer recorded increased instances of peer support when resolving misunderstandings and incorporating diverse viewpoints [Code: Reduced Anxiety Enhances Interaction]. This collaborative dynamic was most evident in smaller, well-connected groups where students naturally assumed leadership roles and worked together to sustain progress [Code: Creativity and Openness].

Groups 2 and 5 demonstrated particularly strong collaboration, with all members actively contributing to ongoing discussions. In Group 5, participants showed full engagement by consistently building on each other's ideas and maintaining a supportive tone [Code: Peer-Driven Teamwork]. Group 2 displayed a similarly high level of peer interaction, resulting in smooth exchanges and rapid consensus [Code: Creativity and Openness]. These findings align with student reflections that low-pressure and peer-driven environments fostered open communication and allowed ideas to be shared, refined, and integrated more effectively [Code: Reduced Anxiety Enhances Interaction]. This theme addresses RQ4b by demonstrating that student–student interaction enables peer-driven teamwork, creativity, and reduced anxiety, thereby shaping knowledge co-construction and coordinated task completion within the Community element.

**Table 4.46:** Summary of Theme: Collaboration Dynamics

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Peer-Driven Teamwork</b>	“Student-student interaction promotes teamwork and encourages us to share ideas.” – S1 (FG1)	Lecturer observed that students in peer-only groups took initiative and managed task division independently.	Group 5 showed full participation with members actively contributing and maintaining collaborative dialogue.
<b>Creativity and Openness</b>	“Students tend to share ideas that are out of the box... around their peers.” – S22 (FG5)	Journal noted that low-pressure peer settings encouraged the generation of more original and exploratory ideas.	Group 2 engaged in creative problem-solving and quick consensus-building through reciprocal peer exchanges.
<b>Reduced Anxiety Enhances Interaction</b>	“Peer interaction helps reduce anxiety and improve idea generation.” – Paraphrased from S11 (FG3), S27 & S28 (FG6)	Without lecturer presence, students were more relaxed, leading to smoother discussions and broader participation.	Groups 2 and 5 demonstrated high levels of coordination and mutual support in idea development and task execution.

**Theme 3: Personal Development through Student-Student Community**

Participants frequently identified peer-led settings as valuable opportunities for developing leadership, communication, and self-management skills. S22 (FG5) remarked that students could “*train leadership and communication skills... to handle and organize discussion.*” [Code: Development of Leadership & Communication], while S28 (FG6) emphasized the “*greater independence and self-motivation*” gained through mutual reliance on peers’ perspectives [Code: Increased Independence & Motivation]. Additionally, S19 (FG4) noted that peer discussions encouraged “*self-reflection,*” allowing students to identify personal strengths and weaknesses through group feedback and comparative learning [Code: Self-Reflection through Peer Feedback].

Reflective journal entries supported these observations. Students were often seen taking on managerial or facilitative roles typically associated with lecturer oversight [Code: Development of Leadership & Communication]. In these instances, participants mediated disagreements, coordinated task distribution, and kept discussions focused. The lecturer

noted that such experiences contributed to greater confidence and accountability, as students became more aware of how their leadership directly influenced group outcomes [Code: Increased Independence & Motivation]. This growth was particularly evident in autonomous groups managing complex tasks without relying on immediate external intervention [Code: Self-Reflection through Peer Feedback].

Observational data from Groups 2 and 5 highlighted strong peer leadership and consistent reciprocal engagement. In Group 2, students regularly volunteered clarifications and solutions during discussions, demonstrating collaborative initiative [Code: Development of Leadership & Communication]. Group 5 displayed similar dynamics, with members encouraging one another to participate and exchanging constructive feedback [Code: Increased Independence & Motivation]. This theme addresses RQ4b by indicating that sustained peer interaction distributes leadership and responsibility across students, supporting skill development (leadership, communication, self-management) that strengthens Community functioning during OCL.

**Table 4.47:** Summary of Theme: Personal Development

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Development of Leadership &amp; Communication</b>	“Train leadership and communication skills... to handle and organize discussion.” – S22 (FG5)	Lecturer noted students assuming facilitator roles, coordinating tasks and leading focused discussions.	In Group 2, participants regularly initiated and organized collaborative work without lecturer direction.
<b>Increased Independence &amp; Motivation</b>	“Greater independence and self-motivation” from relying on peers. – S28 (FG6)	Journal highlighted that peer-led settings fostered accountability and confidence in task ownership.	Group 5 maintained consistent momentum through mutual encouragement and constructive peer-led decision-making.
<b>Self-Reflection through Peer Feedback</b>	“Peer discussions encouraged self-reflection.” – S19 (FG4)	Lecturer observed that peer feedback helped students assess their strengths and adapt their roles in real time.	Groups 2 and 5 exchanged feedback actively, creating opportunities for personal awareness and collaborative growth.

#### **Theme 4: Enhanced Engagement in Student-Student OCL Community**

Students consistently expressed appreciation for the fun and relaxed atmosphere fostered by student-student interactions. S5 (FG1) remarked, “*If just among us students, it is fun because we can interact freely.*” [Code: Fun and Free Peer Interaction], while S15 (FG3) noted, “*We will be more outspoken... without feeling shy that we might get it wrong.*” [Code: Reduced Fear of Mistakes]. Similarly, S23 (FG5) stated that informal conversation “*will not be too formal.*” [Code: Informality Encourages Creativity], making it easier to share creative or exploratory ideas. Many participants perceived peer-led sessions as a welcome alternative to the structured and formal nature of traditional academic settings. Lecturer observations supported these perceptions, noting that peer-driven discussions boosted morale and encouraged engagement with complex topics [Code: Fun and Free Peer Interaction]. Humour, relatable content, and personal experiences during brainstorming fostered a stimulating learning environment. Journal entries further revealed that typically quiet students became more vocal when they felt accepted and free from judgment [Code: Reduced Fear of Mistakes].

Group observations aligned with these findings. In Group 2, four participants (S6–S9) frequently used humour and positive reinforcement, fostering connection and energising interaction [Code: Fun and Free Peer Interaction]. Group 5 demonstrated excellent social cohesion, with all members actively engaged in peer bonding [Code: Reduced Fear of Mistakes]. These interpersonal dynamics enhanced discussion quality, as mutual trust encouraged deeper questions and creative thinking [Code: Informality Encourages Creativity]. However, a few members in some groups remained reserved, suggesting that supportive environments may not entirely eliminate participation gaps. This theme answers RQ4b by showing that peer-only interaction increases social presence and engagement

through humour, trust, and reduced fear of mistakes, which can intensify participation and idea exchange in Discord-mediated OCL.

**Table 4.48:** Summary of Theme: Enhanced Engagement

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Fun and Free Peer Interaction</b>	“If just among us students, it is fun because we can interact freely.” – S5 (FG1)	Lecturer noted that humour and relatability increased morale and helped students stay engaged in complex topics.	In Group 2, participants (S6–S9) used humour and encouragement, sustaining active, energized participation.
<b>Reduced Fear of Mistakes</b>	“We will be more outspoken... without feeling shy that we might get it wrong.” – S15 (FG3)	Reflections showed that students became more vocal and confident in low-pressure, peer-only spaces.	Group 5 demonstrated strong social cohesion, with open participation and frequent positive peer reinforcement.
<b>Informality Encourages Creativity</b>	“It will not be too formal.” – S23 (FG5)	-	Although most participants engaged actively, a few members in each group remained more reserved despite the relaxed atmosphere.

### *Negative Themes*

#### **Theme 5: Productivity Challenges in Student-Student OCL Community**

A common limitation of peer-only discussions was the tendency for students to drift away from academic objectives. S4 (FG1) acknowledged, “*We tend to discuss off topics... if it is just among us.*” [Code: Off-Topic Discussions], illustrating how unstructured peer-only settings could shift into casual conversation. S6 (FG2) raised a similar concern, noting time wasted on “*wrong ideas*” [Code: Lack of Academic Direction], while S15 (FG3) shared that clarifications often had to be sought afterward, which delayed task completion [Code: Delayed Clarifications]. Participants linked these problems to the lack of a leader or facilitator who could keep the group focused and provide timely guidance.

Reflective journal entries supported these concerns, documenting frequent instances of prolonged social interaction before meaningful academic engagement began [Code: Off-Topic Discussions]. Although informal exchanges sometimes strengthened group cohesion, they also extended the time required to complete tasks. The lecturer observed that groups lacking clear leadership or regular checkpoints often spent large portions of their sessions on off-topic discussions or inactive waiting periods, which negatively affected productivity [Code: Lack of Academic Direction].

These patterns were evident in Groups 1 and 6. Despite moderate overall participation, Group 1 experienced long stretches of informal conversation among three members (S1–S3) during which academic progress was minimal [Code: Off-Topic Discussions]. In Group 6, while participants S26, S28 and S30 contributed regularly, they were occasionally sidetracked by off-topic discussions [Code: Lack of Academic Direction]. These examples highlight the ongoing challenge of maintaining academic focus in student-led environments where the absence of structured facilitation can compromise the efficiency and quality of collaborative learning [Code: Delayed Clarifications]. This theme addresses RQ4b by showing that peer interaction can also weaken Community productivity when academic direction is absent, allowing off-topic drift and delayed clarification to disrupt collaborative momentum and output quality.

**Table 4.49:** Summary of Theme: Productivity Challenges

Code (Atlas.ti)	Focus Group Quote	Journal Insight	Online Observation
<b>Off-Topic Discussions</b>	“We tend to discuss off topics... if it is just among us.” – S4 (FG1)	Lecturer noted that peer-led groups often began with prolonged social exchanges before addressing academic content.	Group 1 showed frequent casual chat among S1–S3, with delayed transitions into academic discussion.
<b>Lack of Academic Direction</b>	“We wasted time on wrong ideas.” – S6 (FG2)	Journal described groups drifting or revisiting incorrect ideas in the absence of real-time corrective feedback.	Group 6 occasionally pursued irrelevant points, requiring redirection or later clarification from peers.
<b>Delayed Clarifications</b>	“Clarifications often had to be sought afterward.” – S15 (FG3)	-	In both Groups 1 and 6, confusion or inaccuracy sometimes persisted due to limited accountability and structure.

**Theme 6: Constraints on Idea Generation in Student-Student OCL Community**

Participants expressed concerns that peer-led OCL discussions could result in limited or misguided outcomes. S10 (FG2) warned, “*If one person is misleading, the whole group might be going in the wrong direction.*” [Code: Risk of Misinformation], while S23 (FG5) noted the risk of running out of ideas without external input, stating that student-only discussions might lack the expertise needed for sustained depth [Code: Lack of Expert Guidance]. Several participants (e.g. S9, FG2; S26, FG6; S30, FG6) pointed out that the lack of expert knowledge made it harder to complete tasks that required a deeper understanding, increasing the risk of incorrect or shallow conclusions [Code: Shallow or Incomplete Understanding].

The lecturer’s notes documented several cases where participants shared information confidently without checking its accuracy, leading to incomplete or shallow understanding [Code: Risk of Misinformation]. Without subject-matter expertise, misconceptions often went uncorrected. While peer brainstorming sometimes generated creative ideas, the journal

entries showed that technical or complex topics needed expert input to ensure accuracy and avoid reinforcing incorrect assumptions [Code: Lack of Expert Guidance].

Evidence from Groups 1 and 4 showed that ideas were sometimes accepted without careful examination, indicating limited critical scrutiny [Code: Risk of Misinformation]. While Group 3 demonstrated strong engagement and deeper exchanges, it encountered difficulties when addressing complex topics beyond the group's shared knowledge [Code: Lack of Expert Guidance]. These findings suggest that while peer-led discussions can encourage creativity and collaboration, they also raise the risk of spreading misinformation and shallow engagement with more complex academic content [Code: Shallow or Incomplete Understanding]. This theme responds to RQ4b by demonstrating that peer-only interaction may constrain the Community's epistemic quality when misinformation spreads, expertise is limited, and complex concepts remain unresolved, leading to shallow or inaccurate knowledge construction.

**Table 4.50:** Summary of Theme: Constraints on Idea Generation

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Risk of Misinformation</b>	"If one person is misleading, the whole group might be going in the wrong direction." – S10 (FG2)	Lecturer observed instances of confidently shared misinformation that went uncorrected in the absence of expert input.	In Groups 1 and 4, ideas were often accepted without scrutiny, leading to shallow or incorrect conclusions.
<b>Lack of Expert Guidance</b>	"Student-only discussions might lack the expertise needed for sustained depth." – S23 (FG5)	Journal emphasized that technical or concept-heavy discussions required lecturer input to ensure accuracy and rigor.	Group 3, while highly engaged, struggled to resolve complex academic questions without guidance.
<b>Shallow or Incomplete Understanding</b>	"Harder to complete tasks that required deeper understanding." – Paraphrased from S9, S26, S30 (FG2, FG6)	-	Observed peer-led discussions sometimes lacked the depth needed for advanced content mastery, especially in Groups 1 and 4.

### **Theme 7: Challenges of Negative Group Dynamics in Student-Student OCL Community**

Some participants were concerned about conflicts and exclusion in peer-led settings without moderation. S22 (FG5) cautioned that “*fighting might somehow occur.*” [Code: Risk of Conflict and Exclusion], while S25 (FG5) raised the risk of potential bullying in the absence of structured mediation [Code: Risk of Conflict and Exclusion]. Other students such as S10 (FG2) noted that without lecturer prompting, some groups struggled to initiate conversations, resulting in prolonged silences [Code: Conversation Initiation Difficulties]. S21 (FG5) added that anxiety persisted for some participants who felt unsure about their ideas even when interacting solely with peers [Code: Anxiety in Peer Settings].

Reflective journal entries documented instances where dominant individuals controlled the flow of discussion, often sidelining quieter members and contributing to heightened tensions [Code: Risk of Conflict and Exclusion]. The lecturer observed that peer-only groups without strategies to manage disagreements were more likely to face unresolved conflicts or growing interpersonal problems [Code: Anxiety in Peer Settings]. These dynamics weakened collaboration and made it harder for quieter students to participate, sometimes leading to lasting resentment within the group [Code: Conversation Initiation Difficulties].

Groups 3 and 6 illustrated some of these challenges. Although Group 3 demonstrated high overall engagement, certain members monopolized the dialogue, leaving one participant (S14) largely inactive [Code: Conversation Initiation Difficulties]. In Group 6, interaction was moderate, but two members contributed in a minimal manner, possibly due to discomfort or low group trust [Code: Risk of Conflict and Exclusion]. These patterns suggest that while student-led environments support autonomy, they can also lead to negative group dynamics if unequal participation or interpersonal tensions are not addressed

[Code: Anxiety in Peer Settings]. This theme answers RQ4b by indicating that student–student interaction can generate exclusion, dominance, and initiation barriers without moderation, reshaping Community participation patterns and potentially undermining inclusive collaboration.

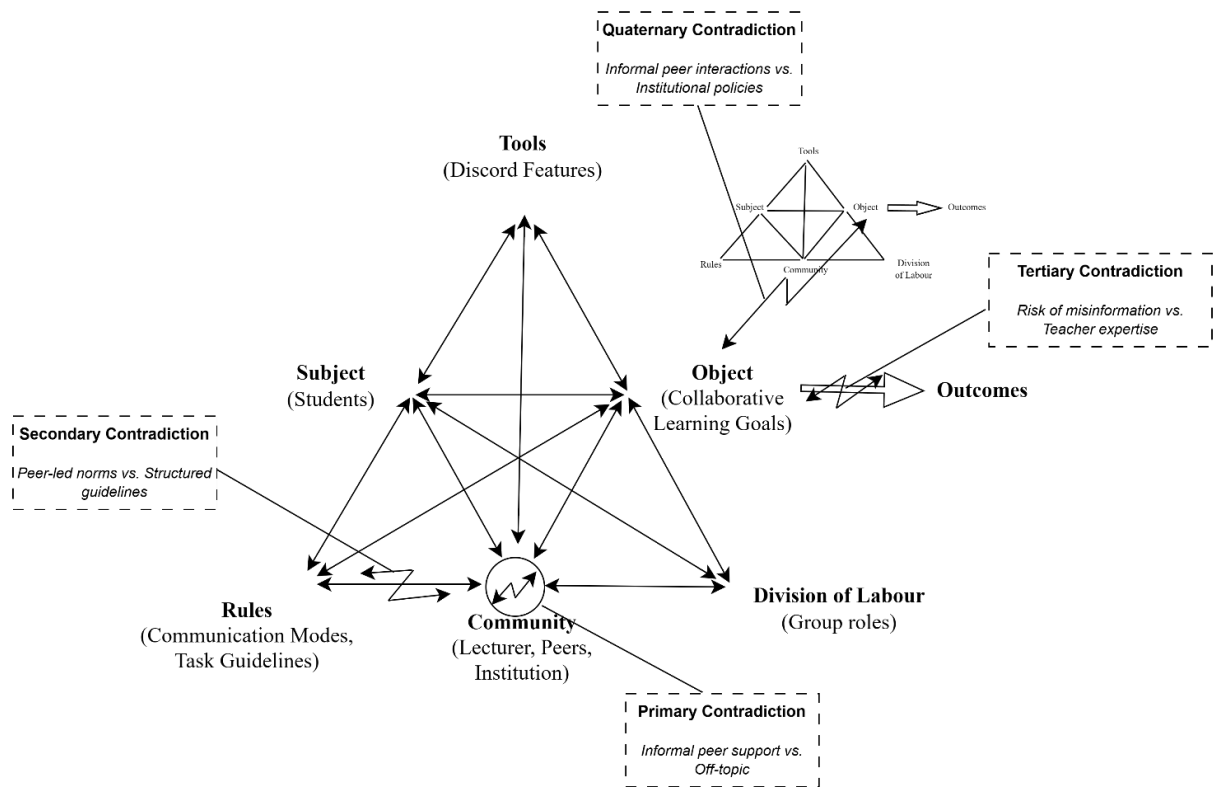
**Table 4.51:** Summary of Theme: Challenges of Negative Group Dynamics

<b>Code (Atlas.ti)</b>	<b>Focus Group Quote</b>	<b>Journal Insight</b>	<b>Online Observation</b>
<b>Risk of Conflict and Exclusion</b>	“Fighting might somehow occur.” – S22 (FG5); “Risk of bullying without structure.” – Paraphrased from S25 (FG5)	Lecturer noted peer-only groups occasionally faced unresolved tensions due to lack of conflict mediation strategies.	Group 6 exhibited limited interaction from some members, potentially due to discomfort or low trust.
<b>Conversation Initiation Difficulties</b>	“Some groups struggled to initiate conversations.” – S10 (FG2)	Reflections highlighted prolonged silences in some groups when no member took on the role of facilitator.	Group 3’s engagement was high, but one member (S14) remained largely silent amid dominant peer interaction.
<b>Anxiety in Peer Settings</b>	“Anxiety persisted... even with just peers.” – S21 (FG5)	Journal indicated quieter students were hesitant to participate when overshadowed by more vocal peers.	In both Groups 3 and 6, uneven participation patterns suggested discomfort and the need for clearer group dynamics management.

#### 4.8.2 Discussion

***RQ4b: What roles do student–student interactions within Discord “Community” play in affecting OCL among Biology matriculation students?***

The results highlight how student-student interaction within the Community element shapes OCL experiences in a Discord-mediated setting, largely echoing the social constructivist principle that open and relaxed communication fosters deeper engagement (Vygotsky, 1978; Roschelle & Teasley, 1995). Consistent with existing OCL literature, the findings indicate that student-student interaction allows learners to share ideas more freely, provide mutual support, and develop leadership skills that are often lacking in more formal lecturer-led environments (Martin & Bolliger, 2018; Alsayer, 2023). In direct response to RQ4b, these findings demonstrate that student–student interactions function as key drivers of social presence, peer scaffolding, and distributed leadership within the Community element, thereby shaping both participation patterns and knowledge construction processes. Nevertheless, several contradictions, as illustrated in Figure 4.8 emerged in the matriculation environment.



**Figure 4.8:** Contradictions in Student–Student Interactions Activity System

**Primary Contradictions** (*Within the Community Element*)

A significant primary contradiction was identified within the “Community” component itself. Students expressed appreciation for relaxed peer-led discussions characterized by humour, informal language use, and reduced anxiety. These informal norms align with Lauricella et al. (2024), who highlight the role of casual communication in fostering student comfort and sustained engagement in online learning environments. However, students also acknowledged that such informality occasionally disrupted academic focus. Some groups drifted into extended social exchanges that failed to yield meaningful academic outcomes. This contradiction reflects the tension between building a supportive peer environment and ensuring consistent academic focus. The present finding builds on Lauricella et al. (2024) by showing that while informality can initially boost engagement, it

may become counterproductive when it results in prolonged off-topic or inaccurate discussions. Thus, peer interaction shapes OCL not only by enhancing comfort and participation but also by influencing the balance between social bonding and academic productivity.

### **Secondary Contradictions** (*Between Community and Rules*)

A secondary contradiction emerged when student-student interaction (Community) conflicted with the formal or informal Rules intended to support academic productivity. Students described long periods of off-topic conversations, especially when lecturers were not actively guiding the discussion. This reflects concerns raised by McCarron et al. (2021) who caution that group discussions without moderation in online settings may drift into superficial talk and contribute to cognitive overload. These findings build on Martin and Bolliger (2018) who emphasize the advantages of peer interaction by highlighting the importance of clear discussion guidelines, designated roles, or student-led facilitation to sustain academic focus and meaningful engagement. Accordingly, student-student interaction influenced OCL dynamics depending on how effectively Community practices were aligned with established Rules for academic collaboration.

### **Tertiary Contradictions** (*Old vs. New Forms of Activity*)

A tertiary contradiction emerged between conventional lecturer-centred approaches (Old Form) which are valued for ensuring conceptual accuracy and the student-driven forms of collaborative learning (New Form) emphasized in OCL. While students expressed appreciation for the independence offered by peer-led discussions, many acknowledged that the lack of immediate expert input sometimes led to misunderstandings or shallow

interpretations. This aligns with Engeström's (1987) concept of systemic tensions that arise when new forms of activity such as learner-centered collaboration challenge established instructional norms. Likewise, Yusoff and Zin (2012) caution that student-student interactions without a lecturer's guidance may lead to the spread of inaccurate information when learners lack adequate subject knowledge or access to timely feedback. This tension illustrates how peer interaction simultaneously promotes autonomy while introducing risks related to conceptual accuracy, thereby directly affecting the quality of OCL outcomes.

### **Quaternary Contradictions** (*Misalignment with Other Activity Systems*)

A quaternary contradiction emerged when student–student collaboration on Discord existed alongside institutional expectations (Other Activity System) for formal oversight and standardised reporting. While students appreciate Discord's informal environment and real-time interaction, lecturer reflections indicate that the lack of direct lecturer involvement or official documentation can undermine the perceived academic value of peer-led discussions. Students may feel compelled to replicate or formalise these interactions within the official LMS to gain recognition or comply with administrative requirements, thereby reducing the spontaneity and efficiency that initially drew them to the platform. This supports Xie et al. (2022) who emphasise that a clear instructional presence and accountability mechanisms are essential for sustaining collaborative learning. When institutional norms prioritize lecturer-led or LMS-monitored activities, peer-driven collaboration may be viewed as unofficial. As a result, students may underutilize or abandon the interactive features of Discord that support autonomous learning, reinforcing a shift toward more structured and lecturer-centred practices within the matriculation framework. These dynamics indicate that the role of student–student interaction is shaped not only by internal group processes but also by

broader institutional expectations that influence how peer collaboration is valued and legitimized.

Overall, these findings support earlier research showing that student-student interaction plays an important role in promoting engagement, shared responsibility, and social presence in OCL (Garrison, 2000; Martin & Bolliger, 2018). However, this research offers a more detailed perspective by showing that the benefits of informal peer interaction can sometimes conflict with the need for timely and accurate content delivery. McCarron et al. (2021) also caution that too much or poorly managed communication can hinder learning. Still, this research highlights positive outcomes in student leadership and self-management which align with Afify (2019) and Gaad (2022) who note that such intensive programs can help students build facilitation skills and develop metacognitive awareness when given appropriate responsibility and support.

In summary, student-student interaction within the Community element remains a key factor in successful OCL. However, tensions between community practices, institutional expectations, and teaching norms highlight the need for intentional design. Supporting both learner autonomy and academic accountability requires flexible structures, timely support, and continuous reflection. As Engeström (2001) suggests, such systemic contradictions can drive innovation and help align peer learning with collaborative learning goals. Across the DBR cycles, these tensions prompted iterative adjustments in peer facilitation structures, participation norms, and accountability mechanisms, reflecting the phases of expansive learning in which existing interaction patterns were questioned, alternative collaborative models were introduced, and more balanced peer-led practices were gradually consolidated (Engeström, 2001). Collectively, these findings answer RQ4b by demonstrating that student-student interactions shape OCL through the dual processes of peer empowerment

and emergent dominance patterns, requiring structured guidance to sustain inclusive, accurate, and academically productive collaboration.

Although focus group data highlighted the benefits of relaxed peer-only discussions, a few participants noted that some of these spaces became exclusive and led to the formation of cliques, making newcomers feel left out. This challenges the idea that peer-led collaboration naturally promotes inclusivity. Reflective journal entries further documented at least one instance in which a group's informal atmosphere hindered task completion as members spent a significant amount of time engaging in non-academic conversation. These cases suggest that while informality can lower barriers to participation, it may also unintentionally lead to exclusivity or decreased productivity.

#### **4.8.3 Design Refinements**

The following adjustments were implemented to address the issues identified:

1. Student leadership roles were rotated to keep discussions focused and balanced.
2. Milestones and interim deadlines were set to help groups stay on track.
3. Quieter students were supported through written-input options and structured prompts.
4. Brief instructor check-ins were scheduled to provide accuracy-focused feedback while maintaining student-led discussion.

## 4.9 Chapter Summary

This chapter explored how Discord shaped collaborative learning in Biology matriculation through seven iterative tasks. Discord's structured channels and multi-device access supported interaction and resource sharing but also presented technical and connectivity challenges. Communication practices were pivotal, with synchronous modes promoting engagement despite scheduling and connectivity challenges, while asynchronous modes supported reflective thinking but increased the risk of procrastination. Group size influenced collaborative dynamics as larger groups provided diverse perspectives but encountered coordination challenges, whereas smaller groups allowed focused interaction but were more susceptible to member disengagement. Lecturer-student interactions provided necessary scaffolding but sometimes led to over-reliance. Peer interactions fostered support but occasionally lacked structure and depth. Using AT, contradictions within the activity system were identified and mapped. Triangulation of interviews, reflective journals, and observations ensured a robust analysis. Overall, effective OCL requires careful integration of platform features, communication strategies, group structures, and facilitation approaches. The next chapter will bring together the findings with existing literature, discuss their theoretical and practical implications, and suggest design principles (RQ5) to support the use of Discord for OCL in Biology matriculation education.

## **CHAPTER 5**

### **DESIGN PRINCIPLES AND CONCLUSION**

#### **5.1 Chapter Overview**

This chapter synthesizes the key findings of the research and outlines how they inform the final design principles for optimizing Discord-mediated OCL (RQ5). Section 5.2 examines the major outcomes in relation to the four research questions (RQ1-4), detailing how Discord’s features, communication norms, group configurations, and interactive roles influence Biology OCL in a matriculation setting. Section 5.3 presents seven design principles derived from these findings, emphasizing the alignment of technological affordances with pedagogical goals, balanced facilitation, and structured participation. Section 5.4 discusses the theoretical, practical, and policy implications of the research, highlighting the importance of platform organization, connectivity support, and institutional support structures. Section 5.5 acknowledges the research limitations, including the constraints of a single-case design and technical disruptions, while Section 5.6 proposes directions for future inquiry such as larger scale mixed-method investigations and further exploration of student autonomy. Finally, Section 5.7 concludes by reiterating the core contributions of the research, particularly the efficacy of repurposing Discord for formal education through AT-informed design and iterative refinement.

## 5.2 Key Findings

### *RQ1: How do Discord's features function as a tool to support OCL among Biology matriculation students?*

The structured layout of Discord which incorporates multiple channels, diverse communication formats such as text messaging, voice communication, and file sharing as well as real-time notifications served as an effective mediating tool (Butarbutar et al., 2023; Lauricella et al., 2024). Students consistently reported that its intuitive interface facilitated the rapid location of resources enabled review of prior discussions for revision purposes and supported seamless transitions between synchronous and asynchronous learning activities. These functionalities encouraged timely exchanges of questions and answers on Biology topics ranging from basic concepts to advanced problem-solving.

The findings also highlighted the significance of stable internet access and efficient data usage (Gaad, 2022). Interruptions due to connectivity issues or application updates during active sessions often led to missed learning materials. This was particularly problematic given the compressed timeline of the matriculation program. While the accessible interface and diverse communication features offered by Discord supported collaborative knowledge construction, equitable participation depended on the availability of stable and reliable technical infrastructure.

In the context of Malaysian cultural norms, students at times hesitated to fully utilise certain Discord features due to indirect communication styles and the perceived formality of interacting with peers or lecturers through unfamiliar technological platforms. This behaviour reflects a broader cultural inclination to defer to authority and uphold group harmony which influenced the extent to which participants engaged with specific tools on the platform. As a result, although Discord offered affordances for more democratic and

open communication, deeply rooted respect for hierarchy occasionally limited critical questioning and open debate within channel discussions.

***RQ2: How do synchronous and asynchronous communication rules influence OCL processes on Discord among Biology matriculation students?***

Synchronous methods including live voice channels and immediate text messaging enhanced students' sense of co-presence, facilitated rapid feedback, and promoted a sense of accountability (Martin et al., 2021; Oyarzun & Martin, 2023). These advantages aligned well with the demands of an examination-focused environment where timely clarification can significantly influence academic performance. However, frequent scheduling conflicts and unstable internet connections occasionally disrupted real-time interactions, supporting prior findings that external interruptions can hinder synchronous engagement (Buzy et al., 2024).

In contrast, asynchronous communication enabled more deliberate contributions and offered greater flexibility in meeting academic deadlines (McCarron et al., 2021; Lin & Wang, 2024). The tendencies toward procrastination and fragmented participation were observed when tasks lacked clearly defined checkpoints (Chang & Brickman, 2018). Overall, a blended approach that integrates the immediacy of synchronous interaction with the reflective depth of asynchronous engagement proved most effective for Biology matriculation students operating within rigid academic schedules.

Culturally, Malaysian students who are accustomed to politeness and maintaining group harmony were more likely to use indirect language in both synchronous and asynchronous communication. While Discord's text-based channels often reduced the discomfort associated with face-to-face hierarchical interactions, the use of synchronous

voice channels sometimes reintroduced a sense of obligation to respect authority which influenced how openly students posed questions or engaged in debate. These communication patterns reveal underlying contradictions within the activity system. Although Discord tool is designed to facilitate open and immediate exchanges, cultural norms related to politeness and respect may constrain full expression. This tension suggests the need for design adaptations that include more structured guidelines for turn-taking and respectful critique in order to support culturally responsive and effective OCL.

***RQ3: How does group size, whether large or small, influence OCL among Biology matriculation students who use Discord?***

Larger group configurations enabled the integration of diverse perspectives and facilitated the effective distribution of complex tasks as highlighted in previous research on group heterogeneity and workload distribution (Al Mulhim & Eldokhny, 2020; Mei et al., 2024). However, large groups were occasionally hindered by overlapping messages, unclear role assignments, and instances of social loafing as noted by Saqr et al. (2019).

In contrast, smaller group configurations fostered greater individual accountability and promoted stronger interpersonal engagement as observed by Johnson and Johnson (1999) in their work on the effectiveness of cohesive group structures. The absence or disengagement of a single member often placed additional burden on the remaining participants and the limited group size reduced the diversity of ideas. Given the accelerated nature of the matriculation program, the implementation of structured role allocation, rotating leadership, and regular progress monitoring was essential to optimize group performance across varying configurations.

These group configurations also intersected with group-oriented cultural norms commonly observed in Malaysian contexts. Larger groups often reinforced a sense of shared identity and harmony. However, this dynamic could limit individual contributions, particularly when students avoided direct confrontation during decision-making processes. Smaller groups, while fostering more intimate and participatory interactions, occasionally encountered tensions between the desire to maintain consensus and the need to ensure individual accountability. Addressing this contradiction required the implementation of clearer guidelines regarding role differentiation and task distribution.

***RQ4: What roles do lecturer–student and student–student interactions play in affecting OCL among Biology matriculation students?***

Lecturer–student interactions played a critical role in clarifying complex concepts (Miao & Ma, 2022). Timely feedback and encouragement from lecturers helped reduce misconceptions which was particularly important given the accelerated nature of the matriculation program. However, some students were reluctant to pose questions or express their ideas in the presence of the lecturer, occasionally resulting in overreliance on lecturer input (Xie et al., 2022; Salehudin et al., 2023).

In contrast, student-student interactions tended to promote more relaxed communication and stimulate creative thinking, thus supporting the development of leadership skills (Martin & Bolliger, 2018). However, the absence of expert guidance sometimes allowed the circulation of inaccurate information and caused groups to deviate from learning objectives (Yusoff & Zin, 2012).

Within the demanding framework of the matriculation Biology curriculum, achieving an appropriate balance between lecturer involvement and student autonomy was

essential. Sufficient lecturer guidance was necessary to ensure conceptual accuracy, while allowing adequate autonomy was important for sustaining student engagement and building confidence in collaborative tasks. This balance was particularly delicate in the Malaysian context, where hierarchical norms and respect for authority could create contradictions in the Division of Labour. Students often hesitated to lead discussions or question lecturers on Discord, despite the platform being designed to support interactive and peer-level collaboration. The cultural expectation of showing respect along with the platform's collaborative nature led to a tension that needed continuous adjustments to improve the learning environment. Strategies such as explicit rotating leadership roles and the use of private student channels were introduced to promote active participation in ways that aligned with cultural expectations.

Across RQ1 to RQ4, the contradictions identified in Chapter 4 point to broader pedagogical implications for Malaysian matriculation beyond platform-level effectiveness. Tensions related to technical reliability, participation norms, group coordination, and lecturer authority reflect misalignments between collaborative digital learning practices and the realities of an exam-driven, time-compressed instructional system. Over the DBR cycles, these contradictions prompted iterative adjustments to task structure, facilitation approaches, and role allocation, indicating gradual movement from compliance-oriented participation toward more distributed responsibility and collaborative inquiry. These patterns suggest that effective adoption of Discord-mediated OCL requires not only tool affordances but also structured pedagogical supports and institutional alignment to sustain equitable participation and deeper learning within high-stakes pre-university settings.

Overall, the findings related to RQ1 to RQ4 suggest that Discord has considerable potential to support OCL in Biology within accelerated academic settings. This potential

arises from its multi-channel structure, diverse communication modalities, and community-oriented design. However, several challenges were identified including issues related to technical reliability, equitable workload distribution, group interaction dynamics, and the need to balance lecturer facilitation with peer-led autonomy. Addressing these challenges requires deliberate task structuring, strategic integration of synchronous and asynchronous communication, and an appropriate level of lecturer involvement that ensures conceptual accuracy while fostering learner engagement and autonomy. Section 5.3 will elaborate on the design principles required to implement these insights effectively with particular emphasis on optimizing Discord-mediated OCL for Biology matriculation students.

### 5.3 Design Principles for Discord-Mediated OCL

*RQ5: Which design principles can strengthen the effectiveness of OCL on Discord for Biology matriculation students?*

In the previous chapter, Section 3.5 outlined the development and iterative refinement of Discord server prototype which functioned as the central intervention for addressing key challenges and leveraging the affordances of OCL. Rather than serving as a static platform, the prototype evolved through a series of carefully planned iterations, each shaped by practical experience and continuous reflection. Initially guided by a set of clearly defined design objectives, the server's structure including its channel configurations, role allocations, and facilitation strategies was progressively adapted in response to insights gathered from student focus groups, the lecturer's reflective journal, and online observational data. This ongoing cycle of testing and refinement ensured that the intervention remained aligned with both pedagogical goals and learner needs. The final version of the prototype represents a synthesis of theoretical understanding and empirical evidence. The design principles presented below summarise the key lessons learned throughout this process and provide guidance for future implementations of Discord-mediated OCL.

#### **Design Principle 1: Align Technology Features with Pedagogical Objectives**

Scholars argue that technology actively shapes learning rather than serving as a neutral tool (Engeström, 2001; Vygotsky, 1978). In this investigation, students required clear navigation, reliable notifications, and low-bandwidth file sharing to manage their workload effectively. To address this, Discord server incorporated pinned announcements, organized text channels, and simplified file formats, aligning platform features with course objectives (Harasim, 2012; Lauricella et al., 2024). For example, pinned weekly task instructions and

revision summaries reduced repeated clarification requests during synchronous sessions, allowing discussions to focus on higher-order Biology problem-solving rather than procedural confusion. Similarly, converting large presentation slides into compressed PDF summaries ensured that students with limited data could still access essential materials without delay. When each feature had a clear instructional purpose, students stayed focused and were less overwhelmed by technical issues. These results show that platforms such as Discord can effectively support OCL when educators intentionally connect each feature to specific learning goals. In lecturer-centred systems where authority dominates, students are conditioned to follow directions rather than explore independently. They tend to avoid tools unless their use is clearly required. To encourage adoption, each feature must be explicitly linked to a defined learning purpose.

### **Design Principle 2: Balance Synchronous and Asynchronous Communication Norms**

Research on OCL consistently emphasizes the importance of balancing immediate interactions with opportunities for reflection (Martin & Bolliger, 2018; Altowairiki, 2021). In this research, real-time voice discussions on Discord encouraged quick idea sharing and boosted motivation but issues with timing and unstable internet connections posed challenges. Asynchronous channels offered flexibility and supported deeper reflection though some students delayed their participation until deadlines. During later DBR cycles, rotating facilitators were appointed to summarise key points at the end of voice sessions and post them in text channels. This feedback loop improved accountability as members who missed the session could respond within 24 hours, sustaining continuity between synchronous and asynchronous modes. In groups where this rotation was consistently applied, participation became more evenly distributed and fewer members remained silent

across cycles. Clear instructions on when and how to use each communication mode helped students benefit from fast feedback while maintaining structured and thoughtful contributions. Additionally, explicit guidelines on respectful language and turn-taking addressed the tension between spontaneous interaction and cultural norms that favour indirect communication, enabling more effective use of both modes.

### **Design Principle 3: Adjust Group Size and Define Roles for Fair Collaboration**

Balanced workload distribution and equitable participation are critical for effective group-based learning (Johnson & Johnson, 1999; Saqr et al., 2019). Larger groups offer greater capacity for complex tasks and idea diversity but are susceptible to overload and uneven engagement when roles are not clearly defined. Smaller groups enhance individual accountability but may suffer from limited perspectives or disruption if one member disengages (Al Mulhim & Eldokhny, 2020; Mei et al., 2024). This research employed both large (15 members) and small (5 members) group formats. Assigning explicit roles such as discussion leader, note-taker, and reviewer helped minimize free-riding and promoted more balanced participation. For instance, in large Group 2, the introduction of a rotating “discussion leader” role reduced message overlap and improved turn-taking, while designated note-takers ensured that final summaries reflected contributions from multiple members. Observation data showed fewer duplicated responses and clearer task progression after roles were made visible in pinned channel posts. Aligning group size with task complexity and ensuring transparent role assignments proved effective in supporting collaboration. However, in contexts with strong group-oriented cultural norms, students may hesitate to assume leadership roles or provide direct critique. To address this, educators

should implement clear role definitions alongside culturally responsive strategies such as rotating leadership to balance group cohesion with clarity in individual responsibilities.

#### **Design Principle 4: Provide Balanced Lecturer Facilitation without Excessive Control**

While direct lecturer support is valuable for correcting misconceptions and maintaining learner motivation, excessive control can increase anxiety and limit student initiative (Vygotsky, 1978; Silseth & Furberg, 2024). In this research, timely and constructive lecturer feedback was especially important in the fast-paced learning environment, helping students gain confidence and accuracy in completing tasks (Garrison et al., 2000). In earlier cycles, immediate lecturer corrections during live discussions sometimes halted peer exchange. In later cycles, the lecturer delayed intervention until students had attempted their own explanations. This adjustment resulted in longer multi-turn peer dialogues before lecturer validation, indicating stronger student confidence and shared reasoning. A balanced facilitation approach marked by open-ended questioning, concise feedback, and minimal intervention allowed students to develop autonomy while still benefiting from expert guidance. In the Malaysian context, this approach also helped ease the cultural tension between the traditionally high status of lecturers and the need for active, participatory dialogue. By addressing this contradiction within the activity system, balanced facilitation supports more meaningful and independent learner engagement.

### **Design Principle 5: Build Peer Community and Encourage Informal Interaction**

Effective online learning communities depend on strong peer connections and a sense of belonging (Martin & Bolliger, 2018). In this research, students were more willing to share difficulties and uncertainties when they engaged informally with peers. Dedicated channels for casual conversation supported rapport-building which in turn fostered more open and effective academic discussions. For example, groups that actively used informal channels to share emojis and encouragement demonstrated higher participation rates in subsequent academic discussions compared to groups that limited interaction strictly to task channels. However, gentle facilitator reminders were occasionally required to redirect extended off-topic exchanges back to learning objectives. These findings indicate that integrating spaces for social interaction within the learning environment enhances motivation, trust, and collaborative engagement. In the Malaysian context, where group-oriented cultural values are prominent, such informal spaces promote cohesion and reduce the barrier of formality in academic communication, supporting both social and cognitive aspects of OCL.

### **Design Principle 6: Scaffold Task Progression with Clear Milestones and Intermediate Deadlines**

Online collaborative tasks often lose effectiveness when roles, timelines, and quality expectations are not clearly defined (Harasim, 2012; Chang & Brickman, 2018). In this research, open-ended deadlines in asynchronous discussions frequently led to procrastination and rushed submissions. To address this, tasks were scaffolded with short-term goals such as weekly targets and partial drafts which kept groups focused and enabled timely feedback from peers and instructors. When intermediate checkpoints were introduced, groups began submitting draft responses earlier in the cycle, enabling peer

feedback before final submission. This iterative feedback loop improved the conceptual accuracy of explanations, particularly in complex Biology topics such as metabolic pathways and genetic processes. Segmenting tasks into smaller manageable stages with clear deadlines fostered a sense of ongoing progress and reduced last-minute stress. Moreover, these checkpoints helped reduce the effects of culturally influenced indirect communication styles by explicitly prompting contributions at multiple points rather than concentrating input at the final stage. This structure supported more consistent and confident engagement throughout the collaborative process.

### **Design Principle 7: Proactively Address Accessibility and Technical Issues**

Connectivity challenges and device limitations significantly impact participation in OCL (Gaad, 2022; Hackett et al., 2024). While Discord's multi-device access and voice channels support real-time interaction, some students in this research experienced issues such as unstable internet and high data usage, leading to missed updates and reduced engagement. In response, brief text-based summaries were consistently posted after each live discussion. Students who experienced disconnection were able to respond to these summaries, ensuring their perspectives were still incorporated into group outputs. Additionally, simplified troubleshooting guides shared in a dedicated channel reduced repeated technical disruptions across later cycles. Anticipating these technical barriers and implementing inclusive alternatives helped ensure more equitable participation. By proactively addressing accessibility issues, educators can create more resilient and supportive digital learning environments.

## 5.4 Implications of Research

### Theoretical Implications

This research confirms and extends key principles of OCL theories by demonstrating the critical role of structured interaction and dialogic engagement in achieving meaningful learning outcomes (Harasim, 2012). In particular, the findings highlight how social constructivist elements facilitate collaborative knowledge-building within digital environments. The results also contribute to the refinement of the CoI framework by emphasising the delicate balance needed to sustain cognitive, social, and teaching presence in practice (Garrison et al., 2000).

More significantly, the research advances AT by illustrating how contradictions within the learning environment can act as catalysts for iterative pedagogical refinement (Engeström, 2001). By analysing the interaction among tools, rules, division of labour, and community, the research highlights the dynamic and situated nature of mediated learning activities. For example, tensions emerged between Malaysian cultural norms that emphasise respect for authority and Discord's participatory ethos, indicating that the "community" and "rules" components of the Activity System must be examined through a culturally responsive lens. The identification and resolution of such contradictions enrich AT's conceptualisation of expansive learning and demonstrate its relevance for analysing complex and culturally embedded educational contexts. Furthermore, these cultural tensions reveal how hierarchical values and indirect communication styles can either constrain or enable OCL, offering a more detailed understanding of how cultural context shapes the functioning of each element within the activity system.

## **Practical Implications**

The findings suggest several strategies for educators and instructional designers seeking to facilitate OCL in accelerated academic settings. First, the careful selection and organisation of digital platforms is essential for supporting effective collaboration. A channel-based structure as available in platforms like Discord enables the segmentation of discussions, minimises off-topic distractions, and promotes transparency in task delegation. Second, incorporating a balanced combination of synchronous and asynchronous activities addresses diverse learner needs while reducing connectivity-related issues. Lecturers may consider scheduling brief real-time check-ins to maintain motivation and provide immediate feedback, complemented by asynchronous periods that allow for deeper reflection and extended group work.

Effective collaboration also depends on clear role distribution and appropriate group sizing. While larger groups offer a wider range of perspectives, they may increase the risk of free-riding unless roles and accountability mechanisms are clearly established. In contrast, smaller groups can foster more focused and supportive engagement but may limit the diversity of ideas or place disproportionate burdens on more active members. These findings highlight the value of rotating leadership roles, incorporating mini-deadlines, and establishing explicit participation norms to ensure equitable engagement. In the Malaysian context, particular attention should be given to balancing cultural deference to lecturers with opportunities for student-led inquiry, so that respect for authority does not translate into passivity but instead supports constructive and culturally responsive dialogue.

Finally, lecturer facilitation should be carefully calibrated to strike a balance between guidance and learner autonomy. Timely expert input and positive reinforcement help sustain motivation and ensure academic accuracy, whereas overly directive approaches may inhibit

student initiative and reduce opportunities for inquiry-driven learning. An awareness of the tension between hierarchical respect and the need for open discourse can assist educators in selecting facilitation strategies, such as using open-ended questions and small-group breakouts to promote more inclusive and student-centred collaboration.

### **Policy Implications**

At the institutional level, this research highlights the need for explicit policies that acknowledge the pedagogical value of third-party communication platforms such as Discord. Clear institutional guidelines including data protection measures and usage protocols can provide both lecturers and students with a structured framework for integrating these tools into formal teaching and learning environments. Equally important are investments in technological infrastructure such as reliable internet access and device-loan programmes to minimise digital inequalities and ensure equitable participation.

The findings highlight the need for curriculum and assessment reform. Integrating formative assessments and portfolio-based evaluations can promote collaborative problem-solving and sustained engagement. Aligning assessments with collaborative tasks on approved digital platforms validates peer-led learning and encourages active participation. Educators should receive professional development on balancing structured facilitation with learner autonomy, ensuring alignment between pedagogy and digital tool affordances. Additionally, culturally responsive orientation sessions can help lecturers and students navigate hierarchical dynamics while fostering shared leadership and collaborative inquiry. These measures support the effective integration of digital collaboration into formal education systems.

For institutional scalability, implementation should extend beyond isolated classroom innovation toward coordinated programme-level adoption. Professional development initiatives should be structured in phases. It may begin with foundational digital pedagogy workshops and followed by discipline-specific training on designing collaborative tasks aligned with national matriculation learning outcomes. Such training should not focus solely on technical platform use but also on the facilitation strategies.

At a broader systemic level, nationwide implementation requires infrastructure standardisation and coordinated policy alignment across matriculation colleges. This includes ensuring stable high-speed internet access, institutional Wi-Fi coverage in residential facilities, and technical support units capable of assisting lecturers in managing digital collaborative platforms. Without parallel investment in infrastructure and instructional capacity-building, scalable adoption may widen existing inequities between urban and rural institutions. Furthermore, policy frameworks should recognise collaborative digital engagement as a legitimate and assessable component of academic performance. Clear rubrics that capture individual contribution, peer interaction quality, and reflective reasoning can institutionalise collaborative competencies as part of matriculation graduate attributes. Embedding such expectations within national assessment guidelines would support sustainable integration rather than temporary experimentation.

Taken together, these measures position Discord-mediated OCL not merely as a classroom-level innovation but as a scalable pedagogical model adaptable across matriculation institutions nationwide, provided that professional development, infrastructural readiness, and assessment alignment are addressed systematically.

## 5.5 Limitations of Research

The principal limitations of this research arise from both its methodological framework and the practical challenges encountered during data collection and analysis. First, the single case design and relatively small sample of 30 Biology matriculation students limit the broader transferability of findings as contextual factors unique to an exam-oriented Malaysian matriculation setting may not represent other educational environments. Additionally, while DBR and qualitative methods such as focus group interviews, reflective journals, and online observations provided in-depth and contextually rich insights, they restricted the scope for quantitative verification.

Technical issues with Discord such as inconsistent notifications and high data consumption occasionally disrupted synchronous discussions, particularly for participants with limited internet connectivity. These challenges reduced the volume and consistency of interaction data. In addition, the demanding schedules of participants increased the likelihood of missing or fragmented observational data which may have limited the ability to fully capture group dynamics. Consequently, while the findings provide valuable insights into Discord-mediated OCL, they should be interpreted with caution in terms of their generalisability and applicability to other academic settings. Furthermore, the specific cultural context of Malaysian matriculation students which involves strong hierarchical respect and indirect communication styles may differ significantly from other educational environments and therefore limits the direct transferability of these findings.

## 5.6 Directions for Future Research

Future research should address sampling limitations by investigating Discord-mediated OCL across a broader range of educational contexts and with larger and more diverse participant populations. A broader scope would improve the generalisability of findings and provide deeper insights into the applicability of OCL in different settings. Employing mixed-method or longitudinal research designs that incorporate both design-based and quantitative approaches can strengthen the evidence base and capture the development of collaborative learning processes over time. Technical and logistical challenges including high data consumption, inconsistent connectivity, and limited participant availability indicate the need to explore alternative digital platforms or hybrid models that accommodate varying levels of access and scheduling flexibility.

Several important themes warrant further investigation. These include the relationship between lecturer facilitation and learner autonomy, the balance between synchronous and asynchronous communication in sustaining engagement, and the impact of group size on collaborative dynamics such as free-riding and idea saturation. Examining these aspects across diverse curricular contexts may provide a clearer understanding of how institutional structures and expectations shape collaborative learning experiences. Additionally, further exploration of cultural norms especially in hierarchical or group-oriented societies could provide valuable insights into how students adapt to digital environments that emphasize equal participation and shared authority. Greater focus on student-led interactions especially peer-only discussions may also reveal how independent collaboration influences content understanding and academic accuracy. Research in these areas can inform the development of more effective and inclusive digital collaboration practices and contribute meaningfully to the evolving field of online pedagogy.

## 5.7 Conclusion

This research demonstrates the feasibility and effectiveness of implementing OCL using Discord within a Biology matriculation programme. Through the integration of AT and the application of DBR approach, the research identifies both the pedagogical potential and the operational challenges of repurposing a gaming-oriented platform for formal educational use. The findings show that Discord's structured channels and synchronous access support efficient resource sharing and promote collaborative engagement. However, limitations such as high data consumption, inconsistent internet connectivity, and unequal participation also emerged. Group size significantly influenced task execution, creativity, and individual accountability. Meanwhile, lecturer–student and student–student interactions offered essential scaffolding and support, though at times also constrained learner autonomy and initiative.

To address these challenges, several context-sensitive design principles were developed including flexible scheduling, rotating leadership roles, intermediate deadlines, and the use of low-bandwidth materials. These strategies highlight the importance of balanced facilitation and clearly defined communication protocols. By situating these findings within the AT framework, the research illustrates how contradictions within an activity system can serve as drivers for expansive learning and continuous refinement of instructional design. In particular, cultural tensions rooted in hierarchical norms and indirect communication styles in the Malaysian context surfaced as focal contradictions, informing iterative changes in task structure, facilitation methods, and group configuration.

Overall, this research offers a deeper understanding of technology-enhanced collaborative learning in an accelerated exam-oriented educational setting. It provides empirically grounded recommendations for platform selection, group management, and

facilitation practices that are relevant to educators, administrators, and policymakers aiming to implement equitable and effective OCL approaches at the pre-university level. Future research could extend these insights by testing the proposed design principles across different academic disciplines, exploring blended or hybrid models, and employing mixed-methods approaches with larger and more diverse participant samples. Such efforts would contribute to the development of inclusive, adaptive, and pedagogically sound digital learning ecosystems.

## REFERENCES

- Abdullah, Z., Ayub, S. F., Hamzah, N. Z. S., Saifullah, S. S., & Rahim, N. S. (2025). *Persepsi Pelajar Terhadap Persekitaran Virtual Realiti ( VR ) Students ' Perceptions of the Virtual Reality ( VR ) Environment through GeoVR-Xplorer at Kelantan Matriculation College. 1(3), 55–71. <https://doi.org/10.70148/rise.13>.*
- Abdullah, A. H., Sultan, U., Abidin, Z., & History, A. (2025). *Continuing Professional Development (CPD) Models for Islamic Education Teachers in Malaysia and Indonesia. 2(1), 44–57.*
- Abdussyukur, N. F., Mohd Saat, N., & Alias, N. (2021). Teaching and Learning Practices in Chemistry Practical Work of Malaysian Matriculation Programme : a Needs Analysis. *Malaysian Online Journal of Educational Sciences, 9(October), 13–26. <https://ejournal.um.edu.my/index.php/MOJES/article/view/32981>*
- Abuhassna, H., Busalim, A., Yahaya, N., Aman, M., Megat, Z., Binti, A., & Latif, A. (2023). *S TUDY F ROM H OME ! T HE A NTECEDENTS AND C ONSEQUENCES OF C OLLABORATIVE L EARNING ON. 22, 71–95.*
- Adler, K., Salanterä, S., & Zumstein-Shaha, M. (2019). Focus Group Interviews in Child, Youth, and Parent Research: An Integrative Literature Review. *International Journal of Qualitative Methods, 18. <https://doi.org/10.1177/1609406919887274>*
- Afify, M. K. (2019). The influence of group size in the asynchronous online discussions on the development of critical thinking skills, and on improving students' performance in

online discussion forum. *International Journal of Emerging Technologies in Learning*, 14(5), 132–152. <https://doi.org/10.3991/ijet.v14i05.9351>

Ahmed, N. H., Andersion, J., & Martínez, A. G. (2025). *Innovative Blended Learning Approaches to Enhance Student Engagement in University*. 1(1), 1–21.

Al Mulhim, E. N., & Eldokhny, A. A. (2020). The impact of collaborative group size on students' achievement and product quality in project-based learning environments. *International Journal of Emerging Technologies in Learning*, 15(10), 157–174. <https://doi.org/10.3991/ijet.v15i10.12913>

Alghamdi, R. (2026). *Bridging learning gaps through Discord: peer-to-peer learning*. 19(1), 49–65. <https://doi.org/10.1108/LTHE-12-2024-0001>

Alias, N. R., Rahimi, M., Rosman, M., Nur, N., Nik, I., Idayu, A., Shukry, M., Razlan, N. M., Alimin, N. A., Rosman, M., Rosli, N., & Shukry, M. (2024). *INVESTIGATING FACTORS AFFECTING THE ADOPTION OF BYOD IN EDUCATIONAL SECTORS: A STRUCTURED*. 682–697. <https://doi.org/10.55573/JISED.096656>

Almodiel, M. C. (2022). Analyzing Online Learners' Knowledge Construction in Asynchronous Discussion Forums Using Interaction Analysis Model. *International Journal in Information Technology in Governance, Education and Business*, 4(1), 1–11. <https://doi.org/10.32664/ijitgeb.v4i1.93>

Alsayer, A. A. (2023). Learners' Experiences in an Online Learning Environment: An

Analysis of the Impact of International Collaboration. *SAGE Open*, 13(4), 1–15.  
<https://doi.org/10.1177/21582440231208524>

Altowairiki, N. (2021). Online Collaborative Learning: Analyzing the Process through Living the Experience. *International Journal of Technology in Education*, 413–427.  
<https://doi.org/10.46328/ijte.95>

An, Y. H., Chandresekaran, M. K., Kan, M. Y., & Fu, Y. (2018). The muir framework: Cross-linking mooc resources to enhance discussion forums. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 11057 LNCS, 208–219. [https://doi.org/10.1007/978-3-030-00066-0\\_18](https://doi.org/10.1007/978-3-030-00066-0_18)

Arifianto, M. L., & Izzudin, I. F. (2021a). From gaming to learning: Assessing the gamification of discord in the realm of education. *Proceedings - 2021 7th International Conference on Education and Technology, ICET 2021*, 95–99.  
<https://doi.org/10.1109/ICET53279.2021.9575079>

Arifianto, M. L., & Izzudin, I. F. (2021b). Students' Acceptance of Discord as an Alternative Online Learning Media. *International Journal of Emerging Technologies in Learning*, 16(20), 179–195. <https://doi.org/10.3991/ijet.v16i20.22917>

Ashcraft, D., Treadwell, T., & Kumar, V. K. (2008). Collaborative Online Learning: A Constructivist Example. *Journal of Online Learning and Teaching*, 4(1), 109–117.

- Ayob, M. A., Hadi, N. A., Pahroraji, M. E. H. M., Ismail, B., & Saaid, M. N. F. (2022). Promoting ‘Discord’ as a Platform for Learning Engagement during Covid-19 Pandemic.’ *Asian Journal of University Education*, 18(3), 663–673. <https://doi.org/10.24191/ajue.v18i3.18953>
- Babinská, K., & Pleschová, G. (2024). Learning from peers’ diverse knowledge and experience. Findings from internationalising a course for medical students. *Innovations in Education and Teaching International*, 61(5), 848–861. <https://doi.org/10.1080/14703297.2023.2254295>
- Bach, A., & Thiel, F. (2024). Collaborative online learning in higher education—quality of digital interaction and associations with individual and group-related factors. *Frontiers in Education*, 9(November), 1–12. <https://doi.org/10.3389/feduc.2024.1356271>
- Barab, S., & Squire, K. (2004). Design-Based Research: Putting a Stake in the Ground. *Journal of the Learning Sciences*, 13(1), 1–14. [https://doi.org/10.1207/s15327809jls1301\\_1](https://doi.org/10.1207/s15327809jls1301_1)
- Barham, K. A. (2023). The Use of Reflective Journals in the Development of Teaching Skills and Teacher Education in the Occupied West Bank. *Journal of Education in Muslim Societies*, 5(1), 26–46. <https://doi.org/10.2979/jems.5.1.03>
- Bayne, G. A., & Inan, F. A. (2024). *International Review of Research in Open and Distributed Learning Student Mental Fatigue Survey Development of the Online Course Overload Indicator and the Student Mental Fatigue Survey The purpose of this*

*study is to develop and examine the psychometric .*

Beram, S., Dahari, M., Huei, L. Q., Ghazali, S. M., & Abdullah, I. F. (2024). *PENGUKURAN SIKAP, MINAT DAN KEYAKINAN DIRI DALAM KALANGAN PELAJAR EKONOMI KOLEJ MATRIKULASI PERAK*. 22, 37–62.

Berezi, I. U. (2025). *Virtual Learning Environment: Redefining Higher Educational Delivery for Efficiency and Accessibility*. 1(1), 451–467.

Bergdahl, N., Bond, M., Sjöberg, J., Dougherty, M., & Oxley, E. (2024). Unpacking student engagement in higher education learning analytics : a systematic review. *International Journal of Educational Technology in Higher Education*.  
<https://doi.org/10.1186/s41239-024-00493-y>

Berrezueta-Guzman, S., Parmacli, I., Krusche, S., & ... (2024). Interactive Learning in Computer Science Education Supported by a Discord Chatbot. *ArXiv Preprint ArXiv ...*, 4–9. <https://arxiv.org/abs/2407.19266>

Biasutti, M. (2017). A comparative analysis of forums and wikis as tools for online collaborative learning. *Computers and Education*, 111, 158–171.  
<https://doi.org/10.1016/j.compedu.2017.04.006>

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member Checking. *Qualitative Health Research*, 26(13), 1802–1811.  
<https://doi.org/10.1177/1049732316654870>

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Burke, R. A., Jirout, J. J., & Bell, B. A. (2024). Understanding cognitive engagement in virtual discussion boards. *Active Learning in Higher Education*, 26(1), 157–176. <https://doi.org/10.1177/14697874241230991>
- Butarbutar, R., Ruing, F. H., Basri, N., Tuharea, V. U., & Leba, S. M. R. (2023). Unpacking Online Collaborative Learning in Teaching EFL Speaking: Insights from Three Rural Area Case Studies. *Qualitative Report*, 28(12), 3379–3401. <https://doi.org/10.46743/2160-3715/2023.6165>
- Butler, D., Leahy, M., Charania, A., Gedara, P. M., Keane, T., Laferrière, T., Nakamura, K., Ueda, H., & Bocconi, S. (2024). Aligning Digital Educational Policies with the New Realities of Schooling. *Technology, Knowledge and Learning*, 29(4), 1831–1849. <https://doi.org/10.1007/s10758-024-09776-9>
- Buzy, T., Elizabeth, M., & Scheepers, I. (2024). *Acta Educationis Generalis A Systematic Literature Review of Synchronous E-Learning Challenges in Higher Education Institutions in Developing Nations during the COVID-19 Pandemic Acta Educationis Generalis*. 14(3), 0–2. <https://doi.org/10.2478/atd-2024-0023>
- Carcary, M. (2021). The Research Audit Trail: Methodological Guidance for Application in Practice. *Electronic Journal of Business Research Methods*, 18(2). <https://doi.org/10.34190/JBRM.18.2.008>

- Chang, Y., & Brickman, P. (2018). When group work doesn't work: Insights from students. *CBE Life Sciences Education, 17*(3), 1–17. <https://doi.org/10.1187/cbe.17-09-0199>
- Chatterjee, R., & Correia, A. P. (2020). Online Students' Attitudes Toward Collaborative Learning and Sense of Community. *American Journal of Distance Education, 34*(1), 53–68. <https://doi.org/10.1080/08923647.2020.1703479>
- Cherbonnier, A., Hémon, B., Michinov, N., Jamet, E., & Michinov, E. (2024). Collaborative Skills Training Using Digital Tools: A Systematic Literature Review. *International Journal of Human-Computer Interaction, 0*(0), 1–19. <https://doi.org/10.1080/10447318.2024.2348227>
- Chowdhury, T. (2021). *The other side of black screen: Rethinking interaction in synchronous remote learning for collaborative programming.*
- Chuang, T., & Ratan, R. (2022). Discord Use and Intent. *Journal of Student Research, 11*(3), 1–8. <https://doi.org/10.47611/jsrhs.v11i3.3795>
- CohenMiller, A., & Izenkova, Z. (2022). Motherhood in Academia during the COVID-19 Pandemic: An International Online Photovoice Study Addressing Issues of Equity and Inclusion in Higher Education. *Innovative Higher Education, 47*(5), 813–835. <https://doi.org/10.1007/s10755-022-09605-w>
- Cong-Lem, N. (2022). Vygotsky's, Leontiev's and Engeström's Cultural-Historical (Activity) Theories: Overview, Clarifications and Implications. *Integrative*

*Psychological and Behavioral Science*, 56(4), 1091–1112.  
<https://doi.org/10.1007/s12124-022-09703-6>

Craig, C., & Kay, R. (2023). Examining the Discord Application in Higher Education: A Systematic Review of the Literature. *Journal of Digital Life and Learning*, 2(2), 52–66. <https://doi.org/10.51357/jdll.v2i2.205>

Crapciu, S., & Blaga, L. (2025). *Analysis of Students ' Perception of the Concept of a Social e-Learning Platform as a Learning Support : The Study of the History of Communism in Romania. 2008.* <https://doi.org/10.2478/picbe-2025-0402>

Creswell, J. W., & Poth, C. N. (2018). Designing Qualitative Research Using Interview Data. In *The SAGE Handbook of Qualitative Research Design*. <https://doi.org/10.4135/9781529770278.n41>

Crotty, M. (1998). *The foundations of social research*. Routledge.  
<https://doi.org/10.4324/9781003115700>

Daniels, H. (2008). *Vygotsky and Research*. Routledge.  
<https://doi.org/10.4324/9780203891797>

Daniels, N., Gillen, P., Casson, K., & Wilson, I. (2019). STEER: Factors to Consider When Designing Online Focus Groups Using Audiovisual Technology in Health Research. *International Journal of Qualitative Methods*, 18.  
<https://doi.org/10.1177/1609406919885786>

- Dayana, Y. E., Andre, O. M., & Andrade-Arenas, L. (2021). Design of the Discord application as an E-learning tool at the University of Sciences and Humanities. *Proceedings of the LACCEI International Multi-Conference for Engineering, Education and Technology, 2021-July*(July 2020), 29–31. <https://doi.org/10.18687/LACCEI2021.1.1.9>
- de Nooijer, J., Schneider, F., & Verstegen, D. M. L. (2021). Optimizing collaborative learning in online courses. *Clinical Teacher, 18*(1), 19–23. <https://doi.org/10.1111/tct.13243>
- Diem, T., Nguyen, T., Hoai, P., & Le, H. (2025). *Activity Theory in Education Research on the Use of Digital Tools in Language Teaching and Learning. 07*(10), 1372–1395.
- Dillenbourg, P. (2007). What do you mean by collaborative learning? What do you mean by “collaborative learning”? *Collaborative Learning: Cognitive and Computational Approaches, 1*(March), 1–19. <https://telearn.archives-ouvertes.fr/hal-00190240>
- Donelan, H., & Kear, K. (2024). Online group projects in higher education: persistent challenges and implications for practice. In *Journal of Computing in Higher Education* (Vol. 36, Issue 2). Springer US. <https://doi.org/10.1007/s12528-023-09360-7>
- Engeström. (2000). Activity theory as a framework for analyzing and redesigning. *Ergonomics, 43*(7), 960–974.

- Engeström, Y. (1987). *Learning by Expanding*. Cambridge University Press.  
<https://doi.org/10.1017/CBO9781139814744>
- Engeström, Y. (2001). Expansive Learning at Work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14(1), 133–156.  
<https://doi.org/10.1080/13639080020028747>
- Engeström, Y. (2009). The Future of Activity Theory: A Rough Draft. In *Learning and Expanding with Activity Theory* (pp. 303–328). Cambridge University Press.  
<https://doi.org/10.1017/CBO9780511809989.020>
- Farah, F. A., & Eagle, W. E. (2021). Applicability of the Discord platform in the advancement of learning in the Introductory to Engineering Design course. *2021 First-Year Engineering Experience*. <https://doi.org/10.18260/1-2--38370>
- Fenwick, T. (2010). Re-thinking the “thing.” *Journal of Workplace Learning*, 22(1/2), 104–116. <https://doi.org/10.1108/13665621011012898>
- Fernandez, C. J., Ramesh, R., & Manivannan, A. S. R. (2022). Synchronous learning and asynchronous learning during COVID-19 pandemic: a case study in India. *Asian Association of Open Universities Journal*, 17(1), 1–14.  
<https://doi.org/10.1108/AAOUJ-02-2021-0027>

- Foot, K. A. (2014). Cultural-Historical Activity Theory: Exploring a Theory to Inform Practice and Research. *Journal of Human Behavior in the Social Environment*, 24(3), 329–347. <https://doi.org/10.1080/10911359.2013.831011>
- Gaad, A. L. V. (2022). The Effects of Online Collaborative Learning (OCL) on Student Achievement and Engagement. *IAFOR Journal of Education*, 10(3), 31–48. <https://doi.org/10.22492/ije.10.3.02>
- Gao, F., Wang, C., Xie, H., & Hong, J. (2024). Social Interaction and Online Learning Efficiency for Middle School Students: The Mediating Role of Social Presence and Learning Engagement. *Behavioral Sciences*, 14(10). <https://doi.org/10.3390/bs14100896>
- Garrison, D. R. (2000). *Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education*. 2, 87–105.
- Garrison, D. R. (2009). Communities of Inquiry in Online Learning. In *Encyclopedia of Distance Learning, Second Edition* (pp. 352–355). IGI Global. <https://doi.org/10.4018/978-1-60566-198-8.ch052>
- Garrison, D. R. (2011). Communities of Inquiry in Online Learning. *Encyclopedia of Distance Learning, Second Edition, January 2009*, 352–355. <https://doi.org/10.4018/978-1-60566-198-8.ch052>

- Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education*, 2(2–3), 87–105. [https://doi.org/10.1016/S1096-7516\(00\)00016-6](https://doi.org/10.1016/S1096-7516(00)00016-6)
- Gasmi, A. A. (2022). Through the Lens of Students: How Online Discussion Forums Affect Students' Learning. *International Journal of Technology in Education*, 5(4), 669–684. <https://doi.org/10.46328/ijte.291>
- Ghazali, N. E. (2024). Engaging Learners using Discord Application During Signals and Systems Online Class. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 33(2), 244–253. <https://doi.org/10.37934/araset.33.2.244253>
- Gill, M., Pak, S., Lam, Y., Sharma, T., Arora, A., Siddiqui, M., Adeniyi, A. M., Brassett, C., Noel, G., Wingate, R., Mcwatt, S., Stearns, D., Garcia, P., & Anette, S. (2025). *Evaluating group dynamics through peer assessment during a global student collaboration of interprofessional healthcare education : A longitudinal study across 33 universities. March*, 436–447. <https://doi.org/10.1002/ase.70026>
- Gillies, R. (2016). Cooperative Learning: Review of Research and Practice. *Australian Journal of Teacher Education*, 41(3), 39–54. <https://doi.org/10.14221/ajte.2016v41n3.3>

- Gogus, A. (2023). Adaptation of an Activity Theory Framework for Effective Online Learning Experiences: Bringing Cognitive Presence, Teaching Presence, and Social Presence to Online Courses. *Online Learning Journal*, 27(2), 265–287. <https://doi.org/10.24059/olj.v27i2.3073>
- González, C., & Ponce, D. (2024). An observational study of teachers' and students' behaviors in synchronous online classrooms. *Journal of Applied Research in Higher Education*, 17(2), 687–705. <https://doi.org/10.1108/JARHE-07-2023-0277>
- Govindan, S., & Hussin, S. A. (2024). Internet Usage Pattern among Students and Working Groups: A Comparative Analysis between Rural and Urban Areas in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 14(12). <https://doi.org/10.6007/IJARBSS/v14-i12/23711>
- Grothaus, C. (2022). Collaborative Online Learning across Cultures: the Role of Teaching and Social Presence. *Qualitative Research in Education*, 11(3), 298–326. <https://doi.org/10.17583/qre.10474>
- Guba, E., & Lincoln, Y. (1994). Guba & Lincoln 1994.pdf. *Handbook of Qualitative Research*, 105–117. <https://doi.org/http://www.uncg.edu/hdf/facultystaff/Tudge/Guba%20&%20Lincoln%201994.pdf>

- Hackett, S., Dawson, M., Janssen, J., & van Tartwijk, J. (2024). Defining Collaborative Online International Learning (COIL) and Distinguishing it from Virtual Exchange. *TechTrends*, 68(6), 1078–1094. <https://doi.org/10.1007/s11528-024-01000-w>
- Han, F., & Ellis, R. A. (2021). Patterns of student collaborative learning in blended course designs based on their learning orientations: a student approaches to learning perspective. *International Journal of Educational Technology in Higher Education*, 18(1). <https://doi.org/10.1186/s41239-021-00303-9>
- Harasim, L. (2012). Learning theory and online technologies. *Learning Theory and Online Technologies*, 1–192. <https://doi.org/10.4324/9780203846933>
- Haugland, M. J., Rosenberg, I., & Aasekjær, K. (2022). Collaborative learning in small groups in an online course – a case study. *BMC Medical Education*, 22(1), 1–10. <https://doi.org/10.1186/s12909-022-03232-x>
- Heinrich, E., Thomas, H., & Kahu, E. R. (2022). An exploration of course and cohort communication spaces in Discord, Teams, and Moodle. *Australasian Journal of Educational Technology*, 38(6), 107–120. <https://doi.org/10.14742/ajet.7633>
- Hew, K. F., Jia, C., Gonda, D. E., & Bai, S. (2020). Transitioning to the “new normal” of learning in unpredictable times: pedagogical practices and learning performance in fully online flipped classrooms. *International Journal of Educational Technology in Higher Education*, 17(1). <https://doi.org/10.1186/s41239-020-00234-x>

- Hinkes, C. (2021). Key aspects to consider when conducting synchronous text-based online focus groups – a research note. *International Journal of Social Research Methodology*, 24(6), 753–759. <https://doi.org/10.1080/13645579.2020.1801277>
- Hisham, N. F. S. M., & Salim, S. A. (2023). *Study on the Adoption of Online Collaborative Learning from the Perspective of Sociability Quality*. 4(1), 600–612.
- Holland, D., & Lave, J. (2019). *Social Practice Theory and the Historical Production of Persons*. 2, 235–248. [https://doi.org/10.1007/978-981-13-6826-4\\_15](https://doi.org/10.1007/978-981-13-6826-4_15)
- Horvitz, B. S., DeCamp, W., Mitchell, R. G., Kowalske, M., & Singleton, C. (2024). Developing an observation protocol for online STEM courses. *PLOS ONE*, 19(1), e0297359. <https://doi.org/10.1371/journal.pone.0297359>
- Hui, L. M., Terng, H. F., Heng, L. T., Chee, L. K., & Qiaoqiao, L. (2025). *Application of WhatsApp as an Alternative Online Distance Learning Platform in Learning Mandarin as a Foreign Language*. 1(1), 77–91.
- Ishak, M. F. F., Sa'don, N. F., & Abdullah, Y. L. P. K. (2024). *Bridging the gap : Teachers ' grasp and execution of technology-enhanced flipped classrooms*. 1(2), 64–74.
- Ishfaq, A., Sultan, N., & Healy, B. (2025). *TURN-TAKING , POLITENESS , AND IDENTITY : A CONVERSATIONAL STUDY OF SPEAK YOUR HEART Afshan Ishfaq Lecturer , Department of English , Green International University , Lahore*. 8(3), 1567–1581.

- Ismail, H., Mamat, A., Ibrahim, H., & Mokhtar, N. A. (2025). *Social Media Use among Secondary School Students in Malaysia : Age and Gender Trends and Multi-Platform Engagement*. 13(7), 152–168. <https://doi.org/10.4236/jss.2025.137008>
- Jannah, E. I., Wahyuni, S., Aini, N., Jokhio, A. A., & Sciences, L. (2024). *APPLICATION IN EDUCATION : CONTRIBUTIONS AND THE*. 11(January 2024), 877–896.
- Johnson, D. W., & Johnson, R. T. (1999). What makes cooperative learning work? *Cooperative Learning*, 23–36. <https://files.eric.ed.gov/fulltext/ED437841.pdf>
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development*, 47(1), 61–79. <https://doi.org/10.1007/BF02299477>
- Kalaian, S. A., Kasim, R. M., & Nims, J. K. (2018). Effectiveness of small-group learning pedagogies in engineering and technology education: A meta-analysis. *Journal of Technology Education*, 29(2), 20–35. <https://doi.org/10.21061/jte.v29i2.a.2>
- Kalmar, E., Aarts, T., Bosman, E., Ford, C., de Kluijver, L., Beets, J., Veldkamp, L., Timmers, P., Besseling, D., Koopman, J., Fan, C., Berrevoets, E., Trotsenburg, M., Maton, L., van Remundt, J., Sari, E., Omar, L. W., Beinema, E., Winkel, R., & van der Sanden, M. (2022). The COVID-19 paradox of online collaborative education: when you cannot physically meet, you need more social interactions. *Heliyon*, 8(1), e08823. <https://doi.org/10.1016/j.heliyon.2022.e08823>

- Kamal, M., & Abdillah, M. N. (2024). *Innovative Pedagogical Approaches in 21st Century Education : A Study on Collaborative Learning Models*. 1(8), 1113–1120.
- Kamarudin, N. A., Wahab, R. A., Hishamuddin, N. S., Haqem, A., Ghani, A., & Affifudin, A. H. (2023). *Teammates as a Digital Evaluation Tool : An Action Research Approach to Mitigate Free Riding Issue*. 44(4), 1821–1834.
- Kaptelinin, V. ., & Nardi, B. A. (2006). *Acting with Technology: Activity Theory and Interaction Design*. MIT Press.
- Knight, R., & Knight, R. (2024). Professional Development in Education Teacher educators as knowledge brokers : reframing knowledge co-construction with school partners co-construction with school partners ABSTRACT. *Professional Development in Education*, 00(00), 1–16. <https://doi.org/10.1080/19415257.2024.2360461>
- Krishnan, S. K., Yaacob, A., & Veloo, A. (2019). The Relationship between ESL Matriculation Students“ Malaysian University English Test (MUET) Results and their Academic Achievement. *International Journal of English Language and Translation Studies*, 07(03), 11–18.
- Kristian, W., Ferdianto, Sukmaningsih, R. D. W., & Ohyver, M. (2023). Analysis of Student’s Interest Using Discord Application as an Alternative Media Learning. *Proceedings of 2023 International Conference on Information Management and Technology*, *ICIMTech* 2023, 813–818. <https://doi.org/10.1109/ICIMTech59029.2023.10277963>

- Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research*. Sage Publications, Inc.
- Kumi-Yeboah, A., Kim, Y., Sallar, A. M., & Kiramba, L. K. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning Journal*, 24(4), 42–63. <https://doi.org/10.24059/olj.v24i4.2323>
- Kwiatkowska, W., & Wiśniewska-Nogaj, L. (2022). Digital Skills and Online Collaborative Learning: The Study Report. *Electronic Journal of E-Learning*, 20(5), 510–522. <https://doi.org/10.34190/ejel.20.5.2412>
- Lagat, K. T., & Concepcion, G. L. (2022). Students' Social Interaction, Collaborative Learning, and Perceived Learning in an Online Learning Environment. *International Journal of Social Science Research and Review*, 5(1), 24–33. <https://doi.org/10.47814/ijssrr.v5i1.130>
- Lauricella, S., Craig, C., & Kay, R. (2024). Examining the Benefits and Challenges of Using Discord in Online Higher Education Classrooms. *Journal of Educational Informatics*, 4(2), 20–31. <https://doi.org/10.51357/jei.v4i2.225>
- Li, H. (2025). *Impact of collaborative learning on student engagement in college English programs : mediating effect of peer support and moderating role of group size*. April, 1–11. <https://doi.org/10.3389/fpsyg.2025.1525192>

- Lin, Y. L., & Wang, W. T. (2024). Enhancing students' online collaborative PBL learning performance in the context of coauthoring-based technologies: A case of wiki technologies. *Education and Information Technologies*, 29(2), 2303–2328. <https://doi.org/10.1007/s10639-023-11907-1>
- Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. *International Journal of Intercultural Relations*, 9(4), 438–439. [https://doi.org/10.1016/0147-1767\(85\)90062-8](https://doi.org/10.1016/0147-1767(85)90062-8)
- Loh, E. (2025). *MALAYSIAN ONLINE JOURNAL OF EDUCATIONAL SCIENCES ROLE OF COLLABORATIVE INTERACTIONS BETWEEN MEMBERS OF A KNOWLEDGE COMMUNITY IN A TRIALOGICAL ENVIRONMENT Trialogical Approach to Learning*. 13(April), 1–10.
- Lukashe, M., Chigbu, B. I., & Umejiesi, I. (2024). Synchronous online learning and career readiness in higher education: student perceptions, challenges, and solutions. *Frontiers in Education*, 9(October), 1–15. <https://doi.org/10.3389/feduc.2024.1449363>
- Madzlan, N. A. (2023). *The effectiveness of asynchronous online role-play on ESL learners' willingness to communicate*. 10(2), 299–306. <https://doi.org/10.20448/jeelr.v10i2.4604>
- Mahdzir, M., Fatma, N., Nik, A., Mastan, Z. P., & Yuet, L. M. (2023). *Challenges in Discord Application Among Quantity Surveying Students*. 2023(April).

- Maneepakhathorn, R. (2023). An Exploratory Study of Reflective Dialogue Journal Writing of EFL Graduate Students in the English as a Foreign Language Context. *REFlections*, 30(1), 38–58. <https://doi.org/10.61508/refl.v30i1.264474>
- Mansour, N. (2024). Students' and facilitators' experiences with synchronous and asynchronous online dialogic discussions and e-facilitation in understanding the Nature of Science. In *Education and Information Technologies* (Vol. 29, Issue 12). Springer US. <https://doi.org/10.1007/s10639-024-12473-w>
- Mariana, R. R., & Nurjanah, N. (2023). *Teacher Digital Literacy and Instructional Innovation in Southeast Asia : Comparative Insights from Global Educational Systems*. 3, 129–144.
- Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning Journal*, 22(1), 205–222. <https://doi.org/10.24059/olj.v22i1.1092>
- Martin, F., Sun, T., Turk, M., & Ritzhaupt, A. D. (2021). A Meta-Analysis on the Effects of Synchronous Online Learning on Cognitive and Affective Educational Outcomes. *International Review of Research in Open and Distributed Learning*, 22(3), 205–242. <https://doi.org/10.19173/IRRODL.V22I3.5263>
- Maruf, A. Al, & Islam, S. (2025). *TRANSFORMATIVE APPLICATIONS OF AI IN EMERGING TECHNOLOGY SECTORS: A COMPREHENSIVE META-ANALYTICAL REVIEW OF USE CASES IN HEALTHCARE, RETAIL, AND CYBERSECURITY*.

- McCarron, G. P., Olesova, L., & Calkins, B. (2021). An exploratory examination of student-led, asynchronous collaborative online discussions in fostering higher-order cognitive skills and ethical leadership learning. *Online Learning Journal*, 25(4), 79–100. <https://doi.org/10.24059/olj.v25i4.2895>
- McKenney, S., & Reeves, T. C. (2018). *Conducting Educational Design Research*. Routledge. <https://doi.org/10.4324/9781315105642>
- Mei, F., Ma, Q., Tang, J., & Zou, B. (2024). Exploring collaborative writing among large groups in online distance learning through a public forum and private chat tool. *ReCALL*, 37, 43–61. <https://doi.org/10.1017/S0958344024000211>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation* (4th ed.). Jossey-Bass.
- Miao, J., & Ma, L. (2022). Students' online interaction, self-regulation, and learning engagement in higher education: The importance of social presence to online learning. *Frontiers in Psychology*, 13(October), 1–9. <https://doi.org/10.3389/fpsyg.2022.815220>
- Miettinen, R. (1999). The riddle of things: Activity theory and actor-network theory as approaches to studying innovations. *Mind, Culture, and Activity*, 6(3), 170–195. <https://doi.org/10.1080/10749039909524725>
- Ministry of Education, M. (2013). *Malaysia Education Blueprint 2013-2025: Annual Report 2013*.

- Ministry of Higher Education Malaysia. (2024). *Malaysia Higher Education Blueprint 2026–2035: Executive Summary*.
- Minwuyelet, M., Kibret, M., & Melesse, S. (2024). Heliyon Effect of using multimedia and dynamic classroom integrated instruction on grade 11 students ' biology academic achievement. *Heliyon*, *10*(18), e37315. <https://doi.org/10.1016/j.heliyon.2024.e37315>
- Mnkandla, E., & Minnaar, A. (2017). The use of social media in E-Learning: A metasynthesis. *International Review of Research in Open and Distributed Learning*, *18*(5), 227–248. <https://doi.org/10.19173/irrodl.v18i5.3014>
- Mohamad, S. N. A., Zamri, M. T., Abdullah, Z., Abu Samah, N., Mohd Zaid, N., & Abdul Razak, M. R. (2024). *Developing Visual Design Creativity through Online Collaborative Learning : Insights from Activity Theory*. *12*(1), 206–223.
- Morgan, D. (1997). *Focus Groups as Qualitative Research*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412984287>
- Mukhtar, S., Razak, A. Z. A., Setiyowati, N., & Adni, M. A. (2025). *Educational leadership innovation : a recent comprehensive structured review*. *19*(4), 2342–2350. <https://doi.org/10.11591/edulearn.v19i4.23239>
- Müller, R. (2023). Ethics and trust implications of governance. In *Research Handbook on the Governance of Projects* (pp. 184–194). Edward Elgar Publishing. <https://doi.org/10.4337/9781802208078.00023>

- Musliadi, M. (2024). Enhancing speaking agility : unveiling Indonesian lecturers ' hybrid teaching experiences in oral communication skills. *Language Learning in Higher Education*, 14(2), 401–433. <https://doi.org/10.1515/cercles-2024-0018>
- Nalani, A., Gómez, C., & Garrod, A. (2021). Constructive Disequilibrium and Transformative Pedagogy. *Journal of the Scholarship of Teaching and Learning*, 21(4). <https://doi.org/10.14434/josotl.v21i4.32705>
- Nazir, N. A., Hafizah, N., Harith, M., & Samad, S. A. (2023). *Preliminary Findings of Structural Quality Requirements in Malaysia Public Preschools from Multiple Stakeholders' Perspectives*. 27–33.
- Nobrega, S., Ghaziri, M. El, Giacobbe, L., Rice, S., Punnett, L., & Edwards, K. (2021). Feasibility of Virtual Focus Groups in Program Impact Evaluation. *International Journal of Qualitative Methods*, 20. <https://doi.org/10.1177/16094069211019896>
- Nohuddin, P. N. E., AbdKadir, Z., & Noordin, N. A. (2025). A Framework for Bridging the Digital Divide: Improving Connectivity and Opportunities in Rural Malaysia. In *Technology for Societal Transformation* (pp. 215–233). Springer Nature Singapore. [https://doi.org/10.1007/978-981-96-1721-0\\_14](https://doi.org/10.1007/978-981-96-1721-0_14)
- O'Connor, C., & Joffe, H. (2020). Intercoder Reliability in Qualitative Research: Debates and Practical Guidelines. *International Journal of Qualitative Methods*, 19. <https://doi.org/10.1177/1609406919899220>

- Oates, A., & Johnson, D. (2025). *ChatGPT in the Classroom : Evaluating its Role in Fostering Critical Evaluation Skills*. 1793–1824.
- Olmos-Vega, F. M., Stalmeijer, R. E., Varpio, L., & Kahlke, R. (2023). A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher*, 45(3), 241–251. <https://doi.org/10.1080/0142159X.2022.2057287>
- Ong, S. G. T., & Quek, G. C. L. (2023). Enhancing teacher–student interactions and student online engagement in an online learning environment. *Learning Environments Research*, 26(3), 681–707. <https://doi.org/10.1007/s10984-022-09447-5>
- Oyarzun, B., & Martin, F. (2023). A Systematic Review of Research on Online Learner Collaboration from 2012–21: Collaboration Technologies, Design, Facilitation, and Outcomes. *Online Learning Journal*, 27(1), 71–106. <https://doi.org/10.24059/olj.v27i1.3407>
- Ozekes, E. C. (2025). *Group Size 's Impact on Co -Creation Behaviour in Online Brand Communities*.
- Ozkara, B. O., & Cakir, H. (2020). Comparison of Collaborative and Individual Learning in Online Learning. *Turkish Online Journal of Educational Technology - TOJET*, 19(4), 66–74.

- Ozverir, I., Mokhtari, L., & Ozverir, A. (2021). A Systematic Analysis of Design-based Research in Technology-enhanced Language Learning (TELL). *Hayef: Journal of Education*, 18(3), 323–352. <https://doi.org/10.5152/hayef.2021.21038>
- Park, M.-H., Riley, J. G., & Branch, J. M. (2020). Developing self-awareness using mindfulness meditation with preservice teachers: reflections on practice. *Journal of Early Childhood Teacher Education*, 41(2), 183–196. <https://doi.org/10.1080/10901027.2019.1695692>
- Patton, M. Q. (2015). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice (4th ed.)*. Sage Publications, Inc.
- Pawan, F., Li, B., & Harris, A. (2023). *Culturally and Linguistically Responsive Online Teacher Learning and Professional Development*. 27(4), 171–200.
- Perrotta, K. A., & Bohan, C. H. (2020). Reflective Study of Online Faculty Teaching Experiences in Higher Education. *Journal of Effective Teaching in Higher Education*, 3(1), 50–66. <https://doi.org/10.36021/jethe.v3i1.9>
- Peter, J. A., & Ogunlade, O. O. (2024). 2024) 215-222 Peter and Ogunlade. *ASEAN Journal of Educational Research and Technology*, 3(3), 215–222.
- Poudel, A. P. (2021). Computer Supported Collaborative Learning for Developing Higher Order Thinking Skill in ELT. *International Journal of Multidisciplinary Perspectives in Higher Education*, 5(1), 34–51. <https://doi.org/10.32674/jimphe.v5i1.2536>

- Pullenayegem, J., De Silva, R., & Jayatilleke, G. (2021). Contradictions in learner interactions in a blended-learning writing course: An activity theory analysis. *Journal of Learning for Development*, 8(2), 327–345.
- Putri, M. R. (2020). Reflection on Technology-Enhanced Learning in Research Based Teaching Method Implementation. *Humaniora*, 11(1), 45. <https://doi.org/10.21512/humaniora.v11i1.6363>
- Ramli, H., Ibrahim, N., Prasetyaningrum, P. T., Abdul, M., & Saedon, M. (2024). *Graphic Design and Education : A Systematic Review on The Evolution , Diverse Aspects , Innovations in Teaching Methods , and Interconnected Changes in Design*. 11(2), 42–54.
- Reyer Van der Vlies, Vincent-Lancrin, S., & OECD. (2020). Digital strategies in education across OECD countries: Exploring education policies on digital technologies. *OECD Publishing, Paris, No 226*, 1–45. [www.oecd.org/edu/workingpapers](http://www.oecd.org/edu/workingpapers)
- Robinson, H. A., Kilgore, W., & Warren, S. J. (2017). Care, communication, learner support: Designing meaningful online collaborative learning. *Online Learning Journal*, 21(4), 29–51. <https://doi.org/10.24059/olj.v21i4.1240>
- Roschelle, J., & Teasley, S. (1995). Computer Supported Collaborative Learning. *Computer Supported Collaborative Learning*, January. <https://doi.org/10.1007/978-3-642-85098-1>

- Roslan, M., Nor, M., & Zubaidi, A. (2026). *Digital reading platforms in literary learning: cultural understanding and engagement in Indonesian and Malay texts*. 2(1), 33–50.
- Roychowdhury, H., Gerrits, R., Hull, K., Stowe, S., & Jensen, M. (2020). Benefits and Challenges of Assigned Out-of-Class Group Work in The Community College Setting. *HAPS Educator*, 24(3), 23–33. <https://doi.org/10.21692/haps.2020.020>
- Said, M. N. H. M., Tahir, L. M., Ali, M. F., Noor, N. M., Atan, N. A., & Abdullah, Z. (2014). Using activity theory as analytical framework for evaluating contextual online collaborative learning. *International Journal of Emerging Technologies in Learning*, 9(5), 54–59. <https://doi.org/10.3991/ijet.v9i5.3972>
- Salehudin, M., Zurqoni, Z., Robingatin, R., Syobah, S. N., Janah, F., Rorimpandey, W. H. F., & Subakti, H. (2023). Mobile Learning With Discord Application as Creative Teaching. *TEM Journal*, 12(3), 1697–1705. <https://doi.org/10.18421/TEM123-51>
- Samri, M. Z., & Jumaat, N. F. (2024). Online Collaborative Learning Approach for Malay Language Learning and Its Impact on Students' Achievement/ Pendekatan Pembelajaran Kolaboratif dalam Talian bagi Pembelajaran Bahasa Melayu dan Kesannya ke atas Pencapaian Pelajar. *Sains Humanika*, 16(2), 85–91. <https://doi.org/10.11113/sh.v16n2.2139>
- Saqr, M., Nouri, J., & Jormanainen, I. (2019). *A Learning Analytics Study of the Effect of Group Size on Social Dynamics and Performance in Online Collaborative Learning* (pp. 466–479). [https://doi.org/10.1007/978-3-030-29736-7\\_35](https://doi.org/10.1007/978-3-030-29736-7_35)

- Sari, N. M., Yin, K. Y., & Mustapha, Z. Z. (2024). *THE EFFECT OF ONLINE COLLABORATIVE LEARNING ON COGNITIVE AND AFFECTIVE ASPECTS OF PRE-UNIVERSITY*. 4(1), 104–116. <https://doi.org/10.5281/zenodo.10938184>
- Schilling, H., Hirschberger, S., & Kauffeld, S. (2024). A focus group study of students' expectations of digital onboarding tools in higher education. *Frontiers in Education*, 9. <https://doi.org/10.3389/feduc.2024.1287387>
- Selvanathan, B., & Narayanan, S. (2024). *Chatgpt in Higher Education Malaysia : An Opportunity or Threat to The Education System?* 13(3), 965–979. <https://doi.org/10.6007/IJARPED/v13-i3/21455>
- Sharma, K., Nguyen, A., & Hong, Y. (2024). Self-regulation and shared regulation in collaborative learning in adaptive digital learning environments: A systematic review of empirical studies. *British Journal of Educational Technology*, 55(4), 1398–1436. <https://doi.org/10.1111/bjet.13459>
- Sichterman, B., Noroozi, O., Boetje, J., Ginkel, S. Van, & Versendaal, J. (2025). Supporting peer learning with artificial intelligence : A systematic literature review A systematic literature review. *Innovations in Education and Teaching International*, 62(5), 1648–1664. <https://doi.org/10.1080/14703297.2025.2530118>
- Siemens, G., Onderwijsdagen, S., Age, D., Design, E., Downes, S., & Verhagen, P. (2019). Connectivism : a new learning theory? *Journal of Instructional Technology and Distance Learning*, 2(1), 1–5. <http://elearning.surf.nl/e-learning/english/3793>

- Silseth, K., & Furberg, A. (2024). Bridging group work and whole-class activities through responsive teaching in science education. *European Journal of Psychology of Education, 39*(3), 2155–2176. <https://doi.org/10.1007/s10212-023-00770-w>
- Slavin, R. E. (2014). Cooperative Learning and Academic Achievement: Why Does Groupwork Work?. [Aprendizaje cooperativo y rendimiento académico: ¿por qué funciona el trabajo en grupo?]. *Anales de Psicología, 30*(3). <https://doi.org/10.6018/analesps.30.3.201201>
- Smith, E. E., Kahlke, R., & Judd, T. (2020). Not just digital natives: Integrating technologies in professional education contexts. *Australasian Journal of Educational Technology, 36*(3), 1–14. <https://doi.org/10.14742/ajet.5689>
- Spall, S. (1998). Peer Debriefing in Qualitative Research: Emerging Operational Models. *Qualitative Inquiry, 4*(2), 280–292. <https://doi.org/10.1177/107780049800400208>
- Stake, E. (1995). The Art of Case Study Research. *Evaluation, 2*(2), 231–235. <https://doi.org/10.1177/135638909600200211>
- Syafii, A., Purwati, O., Munir, A., & Suhartono, S. (2024). *AI-Powered Pedagogy : Elevating Student Engagement through Integrated Feedback. 04*(04), 721–739.
- Taşdemir, H., & Gümüşok, F. (2023). Self-Evaluation as a Form of Reflective Practice in the Practicum. *Dil Eğitimi ve Araştırmaları Dergisi, 9*(2), 515–534. <https://doi.org/10.31464/jlere.1252480>

- Termizi, S. A., Hamid, A. H. A., Fahmie, A., & Razak, A. (2025). *Jurnal kepemimpinan pendidikan* |. 33–52.
- The Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*, 32(1), 5–8.  
<https://doi.org/10.3102/0013189X032001005>
- Tracy, S. J. (2010). Qualitative Quality: Eight “Big-Tent” Criteria for Excellent Qualitative Research. *Qualitative Inquiry*, 16(10), 837–851.  
<https://doi.org/10.1177/1077800410383121>
- Tuan, T. N., Bakar, A., & Quah, W. B. (2023). *Lecturer Competence and Student Satisfaction: A Roadmap for Quality Education*. 12(4), 957–967.  
<https://doi.org/10.6007/IJARPED/v12-i4/18970>
- van de Pol, J., Mercer, N., & Volman, M. (2019). Scaffolding Student Understanding in Small-Group Work: Students’ Uptake of Teacher Support in Subsequent Small-Group Interaction. *Journal of the Learning Sciences*, 28(2), 206–239.  
<https://doi.org/10.1080/10508406.2018.1522258>
- Vladoiu, M., & Constantinescu, Z. (2020). Learning during COVID-19 pandemic: Online education community, based on discord. *Proceedings - RoEduNet IEEE International Conference*, 2020-Decem(February).  
<https://doi.org/10.1109/RoEduNet51892.2020.9324863>

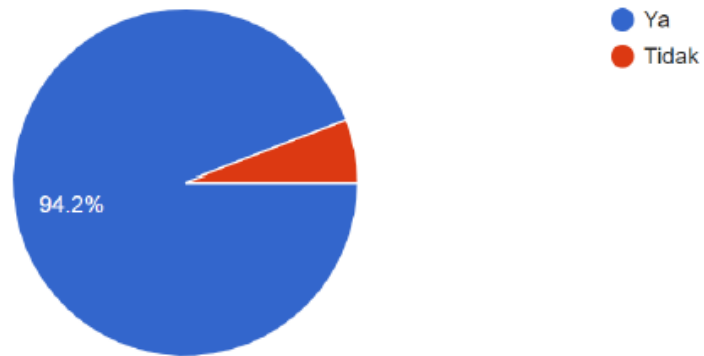
- Vygotsky, L. S. (1978). *Mind and Society: The Development of Higher Psychological Processes*. In A. Kozulin, B. Gindis, V. S. Ageyev, & S. M. Miller (Eds.), *University of Texas Press Slavic series* (Vol. 1). Harvard University Press.  
<https://doi.org/10.1017/CBO9780511840975>
- Wan, Y., Li, R., Li, W., & Du, H. (2025). *Impact Pathways of AI-Supported Instruction on Learning Behaviors , Competence Development , and Academic Achievement in Engineering Education*. 1–27.
- Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5–23. <https://doi.org/10.1007/BF02504682>
- Wang, M., Jiang, L., & Luo, H. (2023). Dyads or quads? Impact of group size and learning context on collaborative learning. *Frontiers in Psychology*, 14(May), 1–11.  
<https://doi.org/10.3389/fpsyg.2023.1168208>
- Wang, Y., Lai, Y., & Huang, X. (2024). *Innovations in Online Learning Analytics : A Review of Recent Research and Emerging Trends*. October, 166761–166775.
- Wiles, A. M., & Simmons, S. L. (2022). Establishment of an Engaged and Active Learning Community in the Biology Classroom and Lab with Discord. *Journal of Microbiology & Biology Education*, 23(1). <https://doi.org/10.1128/jmbe.00334-21>

- Xie, L., & Zhang, H. (2025). *Research Hotspots and Trends in the Digital Transformation of Global Vocational Education*. 2(4), 1–10.
- Xie, Y., Huang, Y., Luo, W., Bai, Y., Qiu, Y., & Ouyang, Z. (2022). Design and effects of the teacher-student interaction model in the online learning spaces. *Journal of Computing in Higher Education*, 35(1), 69–90. <https://doi.org/10.1007/s12528-022-09348-9>
- Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). Sage Publications, Inc.
- Yin, T. T., Hanif, H., Kong, V., Soon, L., Yao, H., & Jing, A. L. (2025). *Students' Perspectives on the Application of Flipped Learning in Learning the Development of Education in Malaysia : Philosophy and Policies*. 14(4), 1315–1327.
- Yusoff, S. R. M., & Zin, N. A. M. (2012). Activity Theory to Guide Online Collaborative Learning Instructional Design. *International Journal of Systems and Service-Oriented Engineering*, 3(2), 15–29. <https://doi.org/10.4018/jssoe.2012040102>
- Zainal, A. Z., & Zainuddin, S. Z. (2020). Technology adoption in Malaysian schools: An analysis of national ICT in education policy initiatives. *Digital Education Review*.
- Zainudin, Z., Baharuddin, N., Hussin, H., Hee, W. F., Kalid, A. B., & Ibrahim, N. (2025). *Digitalization of Education in Malaysia : Roles , Issues , Challenges , Recommendations , Ethics and Future Trends*. 1, 13–21.

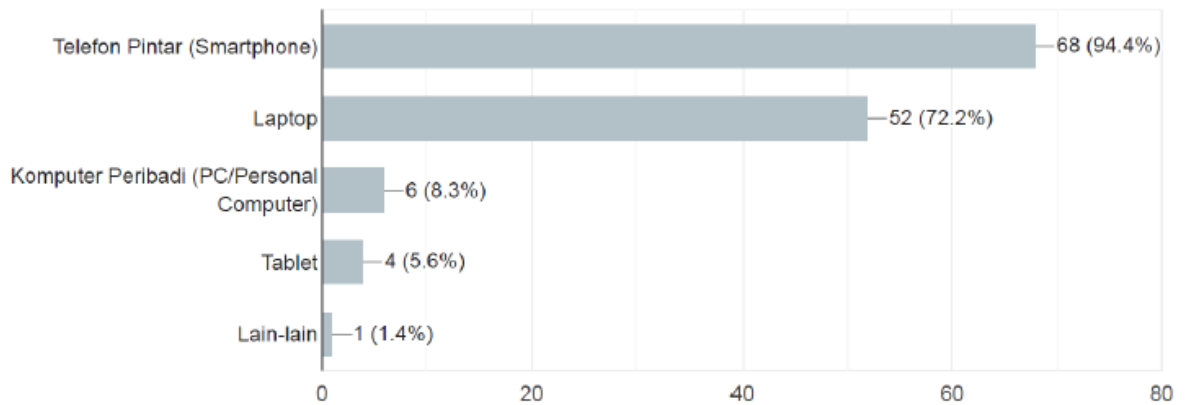
Zerkouk, M., Mihoubi, M., & Chikhaoui, B. (2025). *A Comprehensive Review of AI-based Intelligent Tutoring Systems : Applications and Challenges.*

## APPENDIX A

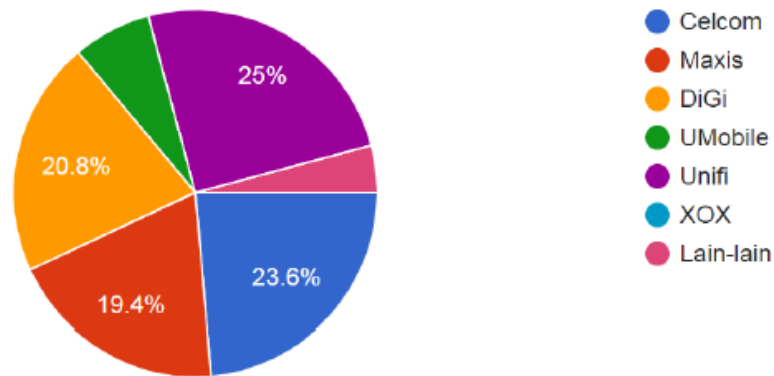
### Digital Learning Survey Results (Students)



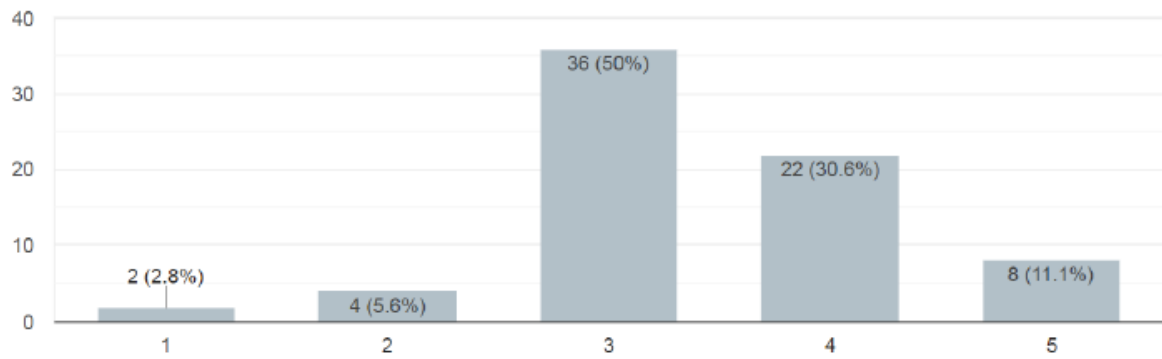
Gambar Rajah 3: Peranti Personal Pelajar



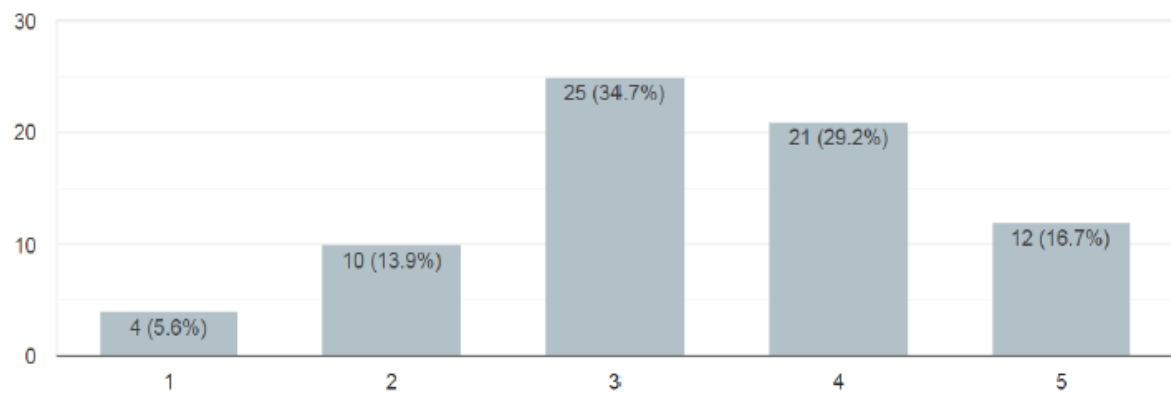
Gambar Rajah 5: Jenis Peranti untuk Akses Internet



Gambar Rajah 6: Pembekal Khidmat Internet



Gambar Rajah 7: Kadar Kelajuan Internet



Gambar Rajah 8: Kepuasan Perkhidmatan Internet

Digital Learning Survey Instrument (Lecturers)

## KMSw Digital Learning Survey

This survey aims to collect information about digital learning environment at Kolej Matrikulasi Sarawak

1. Name

---

2. Gender

*Mark only one oval.*

Male

Female

3. Age range

*Mark only one oval.*

20-30

30-40

40-50

50-60

4. Subject

⌵ Dropdown

*Mark only one oval.*

- BIOLOGY
- CHEMISTRY
- PHYSICS
- MATHEMATICS
- SCIENCE COMPUTER
- ENGLISH
- CO-CURRICULUM
- GENERAL STUDIES
- ISLAMIC/MORAL STUDIES

Digital Literacy Skill

5. From scale 1 (inexperience) to 5 (expert), please rate your personal digital literacy skills

*Mark only one oval.*

1   2   3   4   5

---

Inex      Expert

6. From scale 1 (never) to 5 (frequent), please rate your frequency of using digital learning in teaching/learning process

*Mark only one oval.*

1   2   3   4   5

---

Nev.      Frequent

10. What kind of device do you use to access digital learning platform? [Please tick the box(es). If other, please state]

*Check all that apply.*

- Personal Computer (PC)  
 Laptop  
 Tablet  
 Smartphone  
 Other: \_\_\_\_\_

11. From scale 1 (Very poor) to 5 (Very good), please rate the facilities provided by your organization for digital learning

*Mark only one oval.*

1 2 3 4 5  
Very      Very Good

12. From scale 1 (Very poor) to 5 (Very fast), please rate internet speed for teaching/learning at your organization

*Mark only one oval.*

1 2 3 4 5  
Very      Very Fast

13. From scale 1 (Not satisfied) to 5 (Very satisfied), please rate your satisfaction towards internet connectivity in your classroom for digital learning

*Mark only one oval.*

1 2 3 4 5  
Not      Very satisfied

Experience of using digital learning tools

14. Which digital learning application/software/tools you have been using for your teaching/learning process? [Please tick the box(es). If others, please state]

*Check all that apply.*

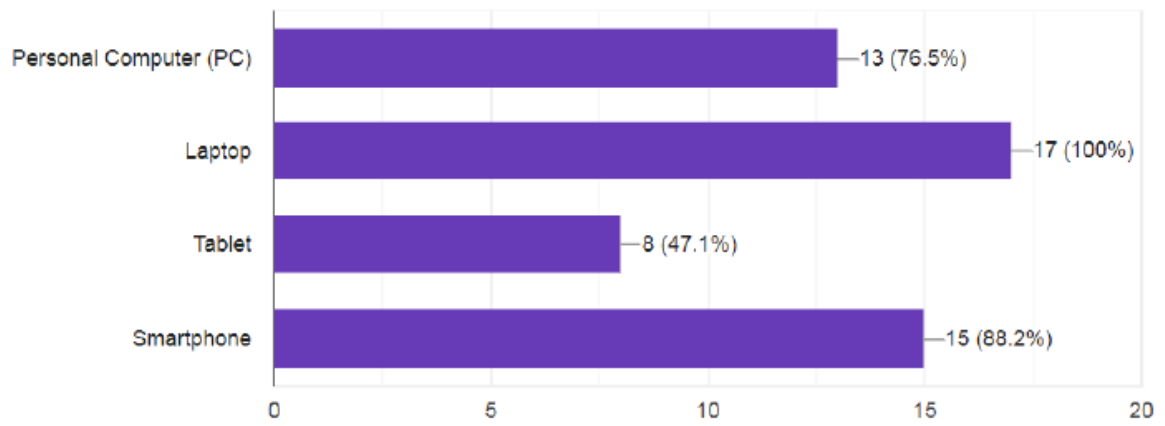
- Google Classroom
- Microsoft Teams
- OneNote
- Apple Educator
- YouTube
- Ted-Ed
- Quizziz
- Kahoot
- Prezi
- Padlet
- Microsoft Word
- Microsoft Powerpoint
- Open Broadcaster Software (OBS)
- Whatsapp
- Telegram
- Moodle (Portal e-Learning)
- Google Meet
- ZoomUs
- Discord
- Other: \_\_\_\_\_

---

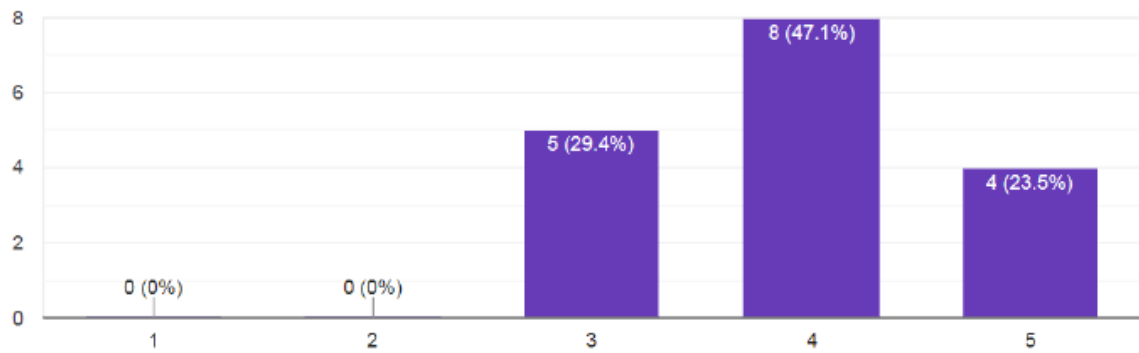
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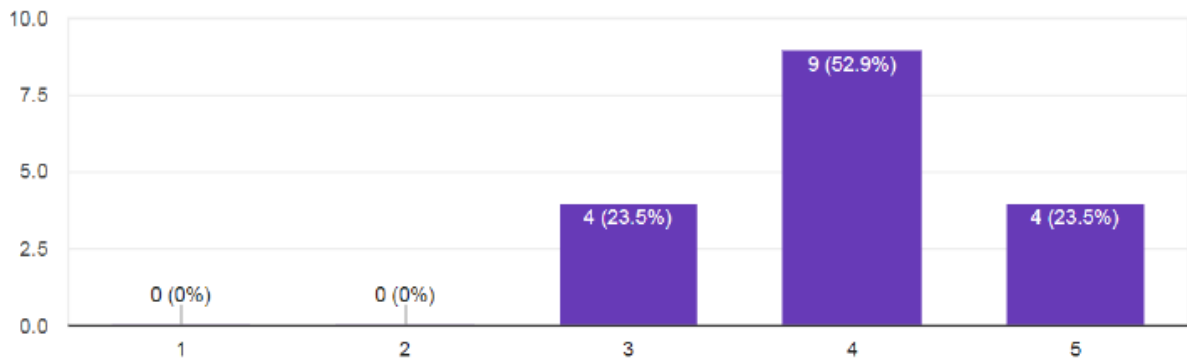
*Digital Learning Survey Results (Lecturers)*



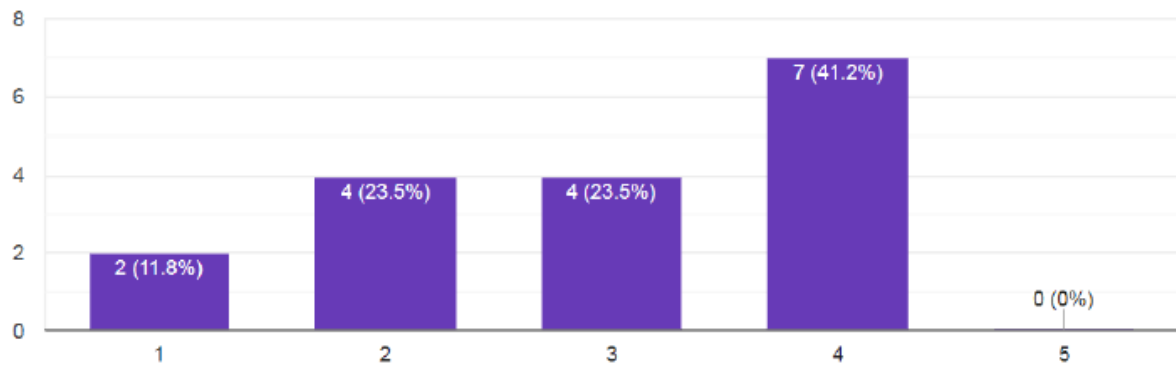
Gambar Rajah 10: Jenis Peranti Personal Pensyarah



Gambar Rajah 11: Kemahiran Literasi Digital Pensyarah



Gambar Rajah 15: Fasiliti Internet Premis



Gambar Rajah 16: Kadar Kelajuan Internet Premis

Antara aplikasi/platfrom pembelajaran digital yang telah digunakan oleh para pensyarah di Kolej Matrikulasi [REDACTED] adalah seperti berikut:

- Whatsapp (94.1%)
- Youtube (94.1%)
- Google Classroom (88.2%)
- Google Meet (76.5%)
- Kahoot (82.4%)
- ZoomUs (64.7%)
- Microsoft Teams (58.8%)
- Telegram (41.2%)
- Open Broadcaster Software/OBS (41.2%)
- Microsoft OneNote (35.3%)
- Moodle (35.3%)
- Padlet (29.4%)
- Quizziz (29.4%)
- Prezi (23.5%)
- Ted-Ed (17.5%)
- Webex (5.9%)

## APPENDIX B

### Expert Evaluator Appointment Letters & Sample Feedback

*Expert 1:*

Fakulti Sains Kognitif dan Pembangunan Manusia  
Faculty of Cognitive Sciences and Human Development



UNIMAS/NC-16/03-16 Jld. 2 [64]

21 Mac 2023

Mohd Noor Hafizee Bin Zulkaflee  
Jurulatih Utama *Digital Classroom*  
Unit Matematik, Jabatan Matematik  
Kolej Matrikulasi Sarawak

*Tuan*

#### **Permohonan Perkhidmatan Sebagai Jurulatih Utama Bagi Tujuan Penyelidikan Tesis PhD**

Dengan hormatnya perkara di atas adalah dirujuk.

Adalah dimaklumkan bahawa pelajar yang tersebut di bawah merupakan pelajar Doktor Falsafah, Fakulti Sains Kognitif dan Pembangunan Manusia di Universiti Malaysia Sarawak yang perlu menjalankan penyelidikan sebagai syarat untuk bergraduasi. Untuk menjayakan kajian tersebut, pelajar memerlukan seorang Jurulatih Utama *Digital Classroom* Bahagian Matrikulasi KPM untuk terlibat dalam proses saringan alat teknologi pembelajaran atas talian bagi tujuan penyelidikan tersebut.

Maklumat lanjut pelajar dan tajuk kajian adalah seperti berikut:-

Nama Pelajar	:	Awang Najib Bin Awang Mohamad
No. Pelajar	:	20010073
No. Telefon/E mel	:	010 4091988 / <a href="mailto:20010073@siswa.unimas.my">20010073@siswa.unimas.my</a>
Tajuk Kajian	:	<i>A Design-Based Research: Activity Theory as Analytical Framework to Examine Online Collaborative Learning Among Matriculation Students</i>
Nama Penyelia/	:	Prof Madya Dr Zaimuariffudin Shukri bin Nordin /
Penyelia Bersama	:	Encik Mohd Hafizan bin Hashim
No HP/Emel	:	016 8600364 / <a href="mailto:nzaim@unimas.my">nzaim@unimas.my</a>
Penyelia	:	

Sehubungan itu, pihak fakulti berbesar hati melantik Tuan sebagai pakar teknologi pendidikan bagi terlibat dalam proses saringan reka bentuk pembelajaran atas talian dalam penyelidikan pelajar. Bersama-sama ini, dilampirkan borang penilaian untuk tujuan rujukan Tuan nanti.

Besarlah harapan kami kiranya pihak Tuan dapat memberikan kerjasama kepada pelajar ini untuk membolehkan pelajar mendapat maklumat yang diperlukan. Pihak fakulti menjamin bahawa segala maklumat yang diperoleh hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Di atas kerjasama yang diberikan, kami dahului dengan ucapan ribuan terima kasih.

*Expert 2:*

Fakulti Sains Kognitif dan Pembangunan Manusia  
Faculty of Cognitive Sciences and Human Development



UNIMAS/NC-16/03-16 Jld. 2 [65]

21 Mac 2023

Hajah Sallehattun Binti Salleh  
Pensyarah Kanan  
Unit Biologi, Jabatan Sains  
Kolej Matrikulasi Pahang

*Puan Hajah*

**Permohonan Perkhidmatan Sebagai Pakar Subjek Biologi Bagi Tujuan Penyelidikan Tesis PhD**

Dengan hormatnya perkara di atas adalah dirujuk.

Adalah dimaklumkan bahawa pelajar yang tersebut di bawah merupakan pelajar Doktor Falsafah, Fakulti Sains Kognitif dan Pembangunan Manusia di Universiti Malaysia Sarawak yang perlu menjalankan penyelidikan sebagai syarat untuk bergraduat. Untuk menjayakan kajian tersebut, pelajar memerlukan seorang pakar/*subject-matter expert* subjek Biologi bagi menilai pembinaan tugas subjek Biologi yang akan digunakan semasa fasa pengumpulan data penyelidikan tersebut.

Maklumat lanjut pelajar dan tajuk kajian adalah seperti berikut:-

Nama Pelajar	:	Awang Najib Bin Awang Mohamad
No. Pelajar	:	20010073
No. Telefon/E mel	:	010 4091988 / <a href="mailto:20010073@siswa.unimas.my">20010073@siswa.unimas.my</a>
Tajuk Kajian	:	<i>A Design-Based Research: Activity Theory as Analytical Framework to Examine Online Collaborative Learning Among Matriculation Students</i>
Nama Penyelia/	:	Prof Madya Dr Zaimuariffudin Shukri bin Nordin/
Penyelia Bersama	:	Encik Mohd Hafizan bin Hashim
No HP/Emel	:	016 8600364 / <a href="mailto:nzaim@unimas.my">nzaim@unimas.my</a>
Penyelia	:	

Sehubungan itu, pihak fakulti berbesar hati melantik Puan sebagai Pakar Subjek Biologi bagi menentukan kesahan dan kebolehpercayaan tugas subjek Biologi yang akan digunakan dalam penyelidikan pelajar. Bersama-sama ini, dilampirkan borang penilaian tugas untuk tujuan rujukan Puan nanti.

Besarlah harapan kami kiranya pihak Puan dapat memberikan kerjasama kepada pelajar ini untuk membolehkan pelajar mendapat maklumat yang diperlukan. Pihak fakulti menjamin bahawa segala maklumat yang diperolehi hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Di atas kerjasama yang diberikan, kami dahului dengan ucapan ribuan terima kasih

*Expert 3:*

Fakulti Sains Kognitif dan Pembangunan Manusia  
Faculty of Cognitive Sciences and Human Development



UNIMAS/NC-16/03-16 Jld. 2 [63]

21 Mac 2023

Prof Madya Dr Fitri Suraya binti Mohamad Hapni Joblie  
Pensyarah  
Fakulti Sains Kognitif & Pembangunan Manusia  
Universiti Malaysia Sarawak [UNIMAS]

*YBhg Prof Madya Dr Fitri Suraya*

**Permohonan Perkhidmatan Sebagai Pakar Penilaian Instrumen & Protokol Temu Bual  
Penyelidikan Tesis PhD**

Dengan hormatnya perkara di atas adalah dirujuk.

Adalah dimaklumkan bahawa pelajar yang tersebut di bawah merupakan pelajar Doktor Falsafah, Fakulti Sains Kognitif dan Pembangunan Manusia di Universiti Malaysia Sarawak yang perlu menjalankan penyelidikan sebagai syarat untuk bergraduasi. Untuk menjayakan kajian tersebut, pelajar memerlukan dua orang pakar bagi menilai instrumen dan protokol temu bual yang akan digunakan semasa fasa data pengumpulan data penyelidikan tersebut.

Maklumat lanjut pelajar dan tajuk kajian adalah seperti berikut:-

Nama Pelajar	:	Awang Najib Bin Awang Mohamad
No. Pelajar	:	20010073
No. Telefon/E mel	:	010 4091988 / <a href="mailto:20010073@siswa.unimas.my">20010073@siswa.unimas.my</a>
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Nama Penyelia/	:	Prof Madya Dr Zaimuariffudin Shukri bin Nordin /
Penyelia Bersama	:	Encik Mohd Hafizan bin Hashim
No HP/Emel	:	016 8600364 / <a href="mailto:nzaim@unimas.my">nzaim@unimas.my</a>
Penyelia	:	

Sehubungan itu, pihak fakulti berbesar hati melantik Prof Madya Dr sebagai **Pakar Penilai** instrumen dan protokol temu bual bagi menentukan kesahan dan kebolehpercayaan data yang akan digunakan dalam penyelidikan pelajar. Bersama-sama ini, dilampirkan borang penilaian untuk tindakan Prof Madya Dr.

Besarlah harapan kami kiranya pihak Prof Madya Dr dapat memberikan kerjasama kepada pelajar ini untuk membolehkan pelajar mendapat maklumat yang diperlukan. Pihak fakulti menjamin bahawa segala maklumat yang diperoleh hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Di atas kerjasama yang diberikan, kami dahului dengan ucapan ribuan terima kasih

*Expert 4:*

Fakulti Sains Kognitif dan Pembangunan Manusia  
Faculty of Cognitive Sciences and Human Development



UNIMAS/NC-16/03-16 Jld. 2 [62]

21 Mac 2023

Encik Chuah Kee Man  
Pensyarah  
Fakulti Bahasa dan Komunikasi  
Universiti Malaysia Sarawak [UNIMAS]

*Tuan*

**Permohonan Perkhidmatan Sebagai Pakar Penilaian Instrumen & Protokol Temu Bual Penyelidikan Tesis PhD**

Dengan hormatnya perkara di atas adalah dirujuk.

Adalah dimaklumkan bahawa pelajar yang tersebut di bawah merupakan pelajar Doktor Falsafah, Fakulti Sains Kognitif dan Pembangunan Manusia di Universiti Malaysia Sarawak yang perlu menjalankan penyelidikan sebagai syarat untuk bergraduasi. Untuk menjayakan kajian tersebut, pelajar memerlukan dua orang pakar bagi menilai instrumen dan protokol temu bual yang akan digunakan semasa fasa data pengumpulan data penyelidikan tersebut.

Maklumat lanjut pelajar dan tajuk kajian adalah seperti berikut:-


Nama Pelajar	:	Awang Najib Bin Awang Mohamad
No. Pelajar	:	20010073
No. Telefon/E mel	:	010 4091988 / <a href="mailto:20010073@siswa.unimas.my">20010073@siswa.unimas.my</a>
Tajuk Kajian	:	<i>A Design-Based Research: Activity Theory as Analytical Framework to Examine Online Collaborative Learning Among Matriculation Students</i>
Nama Penyelia/	:	Prof Madya Dr Zaimuariffudin Shukri bin Nordin/
Penyelia Bersama	:	Encik Mohd Hafizan bin Hashim
No HP/Emel	:	016 8600364 / <a href="mailto:nzaim@unimas.my">nzaim@unimas.my</a>
Penyelia	:	

Sehubungan itu, pihak fakulti berbesar hati melantik Tuan sebagai **Pakar Penilai** instrumen dan protokol temu bual bagi menentukan kesahan dan kebolehpercayaan data yang akan digunakan dalam penyelidikan pelajar. Bersama-sama ini, dilampirkan borang penilaian untuk tindakan Tuan.

Besarlah harapan kami kiranya pihak Tuan dapat memberikan kerjasama kepada pelajar ini untuk membolehkan pelajar mendapat maklumat yang diperlukan. Pihak fakulti menjamin bahawa segala maklumat yang diperolehi hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Di atas kerjasama yang diberikan, kami dahului dengan ucapan ribuan terima kasih.

## Sample of Expert Feedback

 Outlook

---

**RE: Request for Expert Review of Interview Protocol for PhD Research**

---

From Fitri Suraya binti Mohamad Hapni Joblie <mfitri@unimas.my>

Date Wed 2023-03-29 8:32 AM

To AWANG NAJIB BIN AWANG MOHAMAD <20010073@siswa.unimas.my>

Assalamualaikum wbt

Dear Awang Najib

Thank you for the trust and opportunity.

I append a link to your instrument, with comments within.

URL:  [PhD - Awang Najib - OCL Interview Protocol - Reviewed.docx](#)

All the best.



**Fitri Suraya Mohamad**  
*PhD (Education) London*

*Associate Professor*  
Dept of Cognitive Sciences  
Faculty of Cognitive Sciences and Human Development  
Universiti Malaysia Sarawak (UNIMAS)  
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<http://www.unimas.my>



TOP 2% IN ASIA  
QS  
ASIAN  
UNIVERSITY  
RANKINGS  
out of 11,900 university



## Sample of Expert Feedback

	<p>6. Can you specify which online learning course subject(s) you previously enrolled <del>in</del> <u>in</u>?</p> <p><i>Bolehkah anda nyatakan subjek kursus pembelajaran dalam talian yang pernah anda ikuti?</i></p> <p><i>Please list all online learning courses you have attended in the past five years.</i></p> <p>_____</p> <p>_____</p>	<p>Do you need to know when-<del>and what level of learning, and what learning level</del> for this item?</p> <p>Frequency, <del>and</del> recency, might play a role.</p>
	<p>7. Can you specify the technology tool(s) <del>that you have used previously</del> <u>you used</u> for online learning?</p> <p><i>Bolehkah anda nyatakan alat teknologi pembelajaran atas talian yang pernah anda gunakan sebelum ini?</i></p> <p>_____</p> <p>_____</p>	
	<p>I hereby agree to participate in this study. I understand I have the right to <del>withdraw at any point from the study.</del></p> <p><i>Saya dengan ini bersetuju untuk mengambil bahagian dalam kajian ini.</i></p> <p>Signature/ <i>Tandatangan</i> : _____</p> <p>Date/ <i>Tarikh</i> : _____</p>	<p><del>Acceptable</del> Minor addition suggested.</p>

Fitri Suraya binti Mohamad Hapni Joblie  
Formatted: Font: Italic

Construct	Questions	Expert Opinion/Feedback
<p><b>Collaborative Technology Tool: Discord</b></p>	<ol style="list-style-type: none"> <li><del>Can you please</del> <u>Please</u> describe the best aspects of Discord as a technology tool for your online collaborative activity?<sup>2</sup> <i>Cuba anda nyatakan aspek-aspek terbaik Discord sebagai alat teknologi untuk aktiviti kolaboratif atas talian anda?</i></li> <li>Can you please describe the main challenges that you faced when using Discord as a tool for your online collaborative activity? <i>Cuba anda nyatakan halangan-halangan utama yang anda hadapi semasa menggunakan Discord sebagai alat teknologi untuk aktiviti kolaboratif atas talian anda?</i></li> <li>Overall, do you prefer to use Discord for your online collaborative activity? Why? <i>Secara keseluruhan, adakah anda lebih suka menggunakan Discord untuk aktiviti kolaboratif atas talian anda? Mengapa?</i></li> </ol>	<p><u>This assumes that the respondent has used Discord for online learning.</u></p>

Construct	Questions	Expert Opinion/Feedback
<p><b>Synchronous Task Vs. Asynchronous Task</b></p>	<ol style="list-style-type: none"> <li><del>Can you please</del> <u>Please</u> describe the best aspects <del>in-of</del> <u>in</u> synchronous tasks that make you want to participate more actively in online collaborative activity via Discord? <i>Cuba anda nyatakan aspek-aspek terbaik dalam tugas segera yang menyebabkan anda rasa untuk terlibat dengan lebih aktif dalam aktiviti kolaboratif atas talian melalui Discord?</i></li> <li><del>Can you please</del> <u>Please</u> describe the main challenges in synchronous tasks that hinder you <del>to participate from participating</del> <u>more actively</u> in online collaborative activity via Discord? <i>Cuba anda nyatakan halangan-halangan utama dalam tugas segera yang boleh menghalang anda untuk terlibat dengan lebih aktif dalam aktiviti kolaboratif atas talian melalui Discord?</i></li> <li><del>Can you please</del> <u>Please</u> describe the best aspects <del>in-of</del> <u>in</u> asynchronous tasks that make you want to participate more actively in online collaborative activity via Discord? <i>Cuba anda nyatakan aspek-aspek terbaik dalam tugas tidak segera yang menyebabkan anda rasa untuk terlibat dengan lebih aktif dalam aktiviti kolaboratif atas talian melalui Discord?</i></li> <li><del>Can you please describe the main challenges in asynchronous tasks that hinder you to participate</del> <u>Please describe the main challenges in asynchronous tasks that hinder you from participating</u> more actively in online collaborative activity via Discord? <i>Cuba anda nyatakan halangan-halangan utama dalam tugas tidak segera yang boleh menghalang anda untuk terlibat dengan lebih aktif dalam aktiviti kolaboratif atas talian melalui Discord?</i></li> <li>Which type of task would you prefer the most to participate <del>in</del> <u>for</u> online collaborative activity using Discord; synchronous or asynchronous? Why? <i>Tugasan manakah yang anda paling suka untuk sertai bagi aktiviti kolaboratif atas talian dalam Discord; segera atau tidak segera? Mengapa?</i></li> </ol>	<p><u>Maybe you can ask about the types of tasks that have been conducted first, and then use the information to lead to this item.</u></p>

**APPENDIX C**  
Task Instruction Details



## TASK 1: MOLECULES OF LIFE

<b>Learning Outcome:</b>	To understand the structure, types, functions, and interactions of water, carbohydrates, lipids, proteins, and nucleic acids
<b>OCL Platform:</b>	Discord
<b>Channel Type:</b>	Text/Voice
<b>Communication Mode:</b>	Synchronous/Asynchronous
<b>Duration:</b>	8 - 10 Jan 2024
<b>Instructions:</b>	<ol style="list-style-type: none"><li>1. Each group will choose <b>ONE</b> subtopic from Chapter 1: Molecules of Life (water, carbohydrates, lipids, proteins, and nucleic acids)</li><li>2. Discuss and gather information on:<ul style="list-style-type: none"><li>• Key structural components and functions of the chosen molecule.</li><li>• How molecular properties relate to biological roles.</li></ul></li><li>3. After gathering the relevant information, collaborate with group members to create <b>ONE</b> infographic of your chosen molecule.</li><li>4. Please include minimum 3 references (APA style) at any corner of your infographic.</li><li>5. Criteria of evaluation:<ul style="list-style-type: none"><li>• Content accuracy (30%)</li><li>• Visual design &amp; organization (30%)</li><li>• Creativity (20%)</li><li>• Key concepts (20%)</li></ul></li></ol>
<b>Due Date:</b>	10 Jan 2024; 5.00 p.m.
<b>Group Interview:</b>	12 Jan 2024 (Friday); 2.30 p.m.
<b>Declaration:</b>	<i>The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.</i>



## TASK 2: CELL DIVISION

---

**Learning Outcome:** To gain a clear understanding of how disruptions in cell cycle control can lead to cancer cell

---

**OCL Platform:** Discord

---

**Channel Type:** Voice

---

**Communication Mode:** Synchronous

---

**Duration:** 45 minutes

---

**Session schedule:** **Dates:** G1 & G2- 15/01; G3 & G4- 16/01; G5 & G6- 17/01  
**Time:** 4.15-5.00 p.m.

---

**Instructions:** **Preparation**

1. Review Topic 3.1(c) on loss of cell cycle control, focusing on how malfunctions at G<sub>1</sub> and M checkpoints can contribute to cancer
2. Do your individual research real-world examples or case studies (e.g., specific genes or mutations) that illustrate uncontrolled cell proliferation.

**Synchronous Discussion**

1. Please join the voice channel of your respective group on Discord according to the schedule.
2. Your collaborative exploration should cover:
  - How the G<sub>1</sub> and M checkpoints operate under normal conditions, and what happens when they fail
  - Relate checkpoint malfunctions to abnormal cell growth and tumour formation
  - Consider how understanding these checkpoints informs cancer diagnosis and therapy

**Expected Output:**

1. By end of session, create a shared document (flowchart/key takeaways) of how disruptions in cell cycle control can lead to cancer cell.

---

**Group Interview:** 19 Jan 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---



## 3: GENETIC INHERITANCE

---

**Learning Outcome:** To gain understanding of Mendelian and non-Mendelian genetic inheritance

---

**OCL Platform:** Discord

---

**Channel Type:** Text

---

**Communication Mode:** Asynchronous

---

**Duration:** 22 – 30 Jan 2024

---

**Instructions:** In your own group, solve this genetic case scenario. Summarize your reasoning in a final group statement, backing it up with genetic diagrams:

### **Problem Scenario 1**

A mother (Lisa) with blood group A has given birth to a baby who is blood group O. She claims that her fiancé (Dan), who is blood group B, must be the father. However, a distant relative suggests that another man (Carl), who is blood group AB, might be involved

- How can a couple with blood types A and B produce a child with blood type O?
- Could a man with blood group AB be the father of a child with blood group O?
- Based on your Punnett squares for ABO blood group inheritance, which man is most likely the father?
- How do codominance and multiple alleles factor into this situation?

### **Problem Scenario 2**

A family suspects a sex-linked recessive condition (e.g., color blindness or hemophilia) runs in their lineage. Noah, a male family member, is affected. His sister, Amy, appears unaffected, but they share the same parents: their mother (unaffected) and father (affected). Meanwhile, their maternal grandfather also had the condition

- How can you explain Noah's condition using X-linked recessive inheritance?
- If Amy marries a man who is not affected, what is the likelihood of her children inheriting the condition?
- Why might a daughter be unaffected even though her father is affected?
- Could there be any other patterns of inheritance (e.g., autosomal recessive) that explain these observations?

---

**Group Interview:** 1 Feb 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---



## 4: EXP. OF BIOLOGICAL INFORMATION

---

**Learning** To understand and able to explain the molecular mechanisms

**Outcome:** involved in the flow of genetic information

---

**OCL Platform:** Discord

---

**Channel Type:** Text/Voice

---

**Communication** Synchronous/Asynchronous

**Mode:**

---

**Duration:** 13 – 15 Feb 2024

---

**Groups:** **Large Group 1 (S1-S15)**

**Large Group 2 (S16-S30)**

---

**Instructions:** 1. In your large group, produce **THREE** concept maps on these topics:

- DNA Replication
- Transcription
- Translation

2. Divide your roles and work among group members to explain the mechanism, enzymes/proteins involved, and stages of the gene flow.

3. Post your final concept maps in #lobby before 5 p.m. (15 Feb 2024)

---

**Group Interview:** 16 Feb 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---



## 5: MUTATION

---

**Learning Outcome:** To compare between autosomal and sex chromosomal abnormalities and their effects

---

**OCL Platform:** Discord

---

**Channel Type:** Text/Voice

---

**Communication Mode:** Synchronous/Asynchronous

---

**Duration:** 26 – 29 Feb 2024

---

- Instructions:**
1. In your small groups, compare and contrast between
    - Autosomal abnormalities (e.g. Monosomy 21, Down syndrome)
    - Sex chromosomal abnormalities (Klinefelter syndrome, Turner syndrome)
  2. Divide your roles and work among group members to identify the similarities and differences between the two types of chromosomal mutation.
  3. Write a summary of your findings in your own group #text channel.
- 

**Group Interview:** 1 Mac 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---



## 6: RECOMBINANT DNA TECHNOLOGY

---

**Learning Outcome:** To illustrate the steps in gene cloning

---

**OCL Platform:** Discord

---

**Channel Type:** Text/Voice

---

**Communication Mode:** Synchronous/Asynchronous

---

**Duration:** 11 – 13 Mac 2024

- 
- Instructions:**
1. Explain the steps in gene cloning by using plasmid as the vector, following these steps:
    - Isolation of genes
    - Cleave/cut
    - Insertion
    - Transformation and amplification
    - Screening
  2. **A concept check will be conducted by Mdm. S to ensure clarity of your understanding of the content.**
  3. Create a mind map to illustrate the 5 steps of gene cloning.

---

**Group Interview:** 15 Mac 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---



## 7: REPRODUCTION & DEVELOPMENT

---

**Learning Outcome:** To understand the process of human reproductive system

---

**OCL Platform:** Discord

---

**Channel Type:** Text/Voice

---

**Communication Mode:** Synchronous/Asynchronous

---

**Duration:** 25 – 28 Mac 2024

- 
- Instructions:**
1. The topics for each group are as following:
    - Spermatogenesis: G1 & G2
    - Ovarian Cycle: G3 & G4
    - Menstrual Cycle: G5 & G6
  2. In your own group, find and discuss the role of hormones in each mechanism.
  3. Give details on the steps of mechanism and hormones involved.
  4. Write **ONE** collaborative essay based on your discussion.
  5. Post your final writing in your own group #text channel.

---

**Group Interview:** 15 Mac 2024 (Friday); 2.30 p.m.

---

**Declaration:** *The data collected through this activity will be used solely for research purposes in accordance with ethical research guidelines. Participation is voluntary, and all personal information will be kept confidential.*

---

## APPENDIX D

### Interview Protocol & Sample Transcripts

#### Interview Protocol

##### SECTION A: STUDENTS' BACKGROUND SEKSYEN A: LATAR BELAKANG PELAJAR

Please fill in your personal information. Please tick (✓) on the appropriate bracket. Thank you.  
*Sila isi maklumat peribadi anda. Sila tandakan (✓) pada kurungan yang berkenaan. Terima kasih.*

1. Full Name  
*Nama Penuh* \_\_\_\_\_
2. Gender  
*Jantina* Male/ *Lelaki* [     ]  
Female/ *Perempuan* [     ]
3. Age  
*Umur* \_\_\_\_\_
4. Name of College  
*Nama Kolej* \_\_\_\_\_
5. Course  
*Jurusan* \_\_\_\_\_
6. Have you participated in any online learning?  
*Pernahkan anda terlibat dalam pembelajaran dalam talian?*  
  
Yes/ *Ya* [     ]                      No/ *Tidak* [     ]

7. If Yes, can you specify which technology tools you have used for online learning?  
*Jika Ya, bolehkah anda nyatakan teknologi pembelajaran yang pernah digunakan untuk pembelajaran dalam talian?*  
  
\_\_\_\_\_

8. Have you ever participated in any online collaborative learning activity?  
*Pernahkah anda menyertai aktiviti pembelajaran secara kolaboratif dalam talian?*

Yes/ *Ya* [     ]                      No/ *Tidak* [     ]

9. If Yes, can you specify which technology tools you have used for online collaborative learning activity?  
*Jika Ya, boleh nyatakan teknologi pembelajaran yang pernah digunakan untuk aktiviti pembelajaran secara kolaboratif dalam talian?*  
  
\_\_\_\_\_

10. Have you used Discord application for previous online learning?  
*Pernahkah anda menggunakan aplikasi Discord untuk pembelajaran dalam talian sebelum ini?*  
Yes/ *Ya* [     ]                      No/ *Tidak* [     ]

I hereby agree to participate in this study.  
*Saya dengan ini bersetuju untuk mengambil bahagian dalam kajian ini*

Signature/ *Tandatangan*: \_\_\_\_\_

Date/ *Tarikh* : \_\_\_\_\_

**Task 1: Discord as a Tool for OCL**  
***AT Component: Tool (RQ1)***

**Interview Questions:**

1. Can you describe the best aspects of Discord application as a technology tool for your collaboration with other students during online learning?  
*Boleh anda nyatakan aspek-aspek terbaik aplikasi Discord sebagai alat teknologi untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian?*
  
2. Can you describe the main challenges that you faced when using Discord application for your collaboration with other students during online learning?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi dalam menggunakan aplikasi Discord sebagai alat teknologi untuk berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian?*
  
3. Overall, do you prefer to use Discord application over other platforms (e.g., Microsoft Teams, Google Classroom etc.) for collaboration? Why or why not?  
*Secara keseluruhan, adakah anda lebih suka menggunakan aplikasi Discord berbanding platform lain (contohnya Microsoft Teams, Google Classroom)? Mengapa?*

**Task 2: Synchronous Communication**  
**AT Component: Rules (RQ2)**

**Interview Questions:**

1. Can you describe the best aspects in synchronous tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi tugas segera untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in synchronous tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi tugas segera untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*

**Task 3: Asynchronous Communication**  
**AT Component: Rules (RQ2)**

**Interview Questions:**

1. Can you describe the best aspects in asynchronous tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi tugas tak segera untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in asynchronous tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi tugas tak segera untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
3. Which type of task do you prefer more; synchronous or asynchronous, and why?  
*Bentuk tugas manakah yang anda lebih suka sertai; tugas segera atau tak segera? Nyatakan SATU sebab utama pilihan anda.*

**Task 4: Large Group Collaboration**  
**AT Component: Division of Labour (RQ3)**

**Interview Questions:**

1. Can you describe the best aspects in large group size tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi tugas kumpulan saiz besar untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in large group size tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi tugas kumpulan saiz besar untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*

**Task 5: Small Group Collaboration**  
**AT Component: Division of Labour (RQ3)**

**Interview Questions:**

1. Can you describe the best aspects in small group size tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi tugas kumpulan saiz kecil untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in small group size tasks for your collaboration with other students during online learning via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi tugas kumpulan saiz kecil untuk anda berkolaborasi dengan pelajar lain semasa pembelajaran dalam talian melalui aplikasi Discord?*
3. Which type of group do you prefer; large or small, and why?  
*Bentuk tugas manakah yang anda lebih suka sertai—tugas kumpulan saiz besar atau kecil? Nyatakan SATU sebab utama pilihan anda.*

**Task 6: Teacher–Student Interaction**  
***AT Component: Community (RQ4)***

**Interview Questions:**

1. Can you describe the best aspects in teacher-student interaction for your online collaborative learning activity via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi interaksi guru-pelajar untuk aktiviti kolaboratif dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in teacher-student interaction for your online collaborative activity via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi interaksi guru-pelajar untuk aktiviti kolaboratif dalam talian melalui aplikasi Discord?*

**Task 7: Student–Student Interaction**  
***AT Component: Community (RQ4)***

**Interview Questions:**

1. Can you describe the best aspects in student–student peer interaction for your online collaborative activity via Discord?  
*Boleh anda nyatakan aspek-aspek terbaik bagi interaksi pelajar–pelajar untuk aktiviti kolaboratif dalam talian melalui aplikasi Discord?*
2. Can you describe the main challenges in student–student peer interaction for your online collaborative activity via Discord?  
*Boleh anda nyatakan halangan-halangan utama yang anda hadapi bagi interaksi pelajar–pelajar untuk aktiviti kolaboratif dalam talian melalui aplikasi Discord?*
3. Which interaction type do you prefer more; student–student or teacher–student, and why?  
*Bentuk interaksi manakah yang anda lebih suka sertai—interaksi pelajar–pelajar atau guru–pelajar? Nyatakan SATU sebab utama pilihan anda.*

## Sample Interview Transcripts

### **FOCUS GROUP 1 (FG1)**

#### **INTERVIEW TRANSCRIPT**

##### Task 1

*Interviewer: Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.*

S2: Discord can sync in all device at the same time

S3: I think I enjoy using Discord as we can use Emojis and GIF. I like it very much

S5: I think it is easy to use Discord. Plus, there are lots of bots we can install in our server and use them. Most likely I use Discord server during online classes, and to chitchat..haha

S3: Really?

S4: For me, I enjoy using Discord during online learning as we can discuss through videocall with group members. Plus, we can enjoy listening to songs with others who are participating in the call. I just learned about the bots as well. Compare to Google Apps, I prefer Discord as there are many things we can do on the server such as discussion, assignment. If we can submit our works through Discord is even better, compare to submission via Google Classroom. Too many things to be downloaded for online learning. Google Meet, Google Classroom etc.

S5: Yes, I agree

S1: Discord has user-friendly interface. It is easy to learn how to use it. And it is easy to send file, just two taps and file sent.

S2: As a new user, it is quite convenient as all learning materials are systematically arranged, thus saving time to find the things I need. I'm impressed to use Discord first time.

S3: Understand

S4: I agree

S5: Agreed

*Interviewer: Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning.*

S4: Discord consume lots of data. Sometimes, the notification did not appear on my phone.

S2: Agreed. Sometimes, I did miss the information delivered by lecturers

S3: Yes, the waiting time to open Discord on laptop is quite long. Or maybe I am the one who is impatient.

S4: You are the one who are impatient

S5: There are a lot of updates on Discord. It's like, every time I open Discord on laptop, it is always updating

S1: There is this premium version ads thing. The pop-up always come out every time I open it, which is annoying.

S2: What is the advantage of using premium version?

S1: I don't know. Maybe we can expect a larger file upload?

*Interviewer: Overall, do you prefer to use Discord over other platforms (e.g. Microsoft Teams, Google Classroom etc) for you to collaborate with others for learning? Describe ONE main reason why.*

S4: I prefer to use Discord. It is much organized to use Discord for online learning. We just create a specific server for example just for Biology subject. For other subjects, we can create another server, thus it will not be mixed between subjects. The arrangement of servers is organized. Microsoft Teams too tedious..haha. For Whatsapp, too many groups, I have hundreds of Whatsapp group already. When I chat with others, I did not realize and cannot remember about those Whatsapp groups

S3: Em...for now I prefer Discord

S5: Overall, Discord is okay for online learning. More convenient to use for discussion. We just join the server, then directly discuss the assigned tasks. Compare to other platforms, Discord is much better. But for task upload, I prefer Google Classroom.

S2: Ya, I agree. Discord is better for discussion. For task submission, Google Classroom can help us to organize and notify which homework we have not submitted.

S3: There are useful bots for example to convert files to pdf. No need to use CamScanner

S1: Google should buy Discord.

S2: I like the idea

S3: Let's make use of Discord guys

##### Task 2

*Interviewer: Please describe the best aspects of synchronous OCL Task 1 that make you want to participate more actively in online collaborative activity via Discord.*

S1: I like the vibe. Where many people online at the same time, we can share our opinions together, laugh together, cry together. It strengthens the bonds.

S2: The discussion will be more active and fun. If there is a question, there will always be suggested answers.

S3: Yes, it is like very instant responses.

S4: If the OCL is synchronous, there are many data that can be collected. The task can be completed much earlier. However, it depends on the internet connectivity and if most of us have the ideas.

S2: Yes, the internet connection might make the discussion to be put on hold.

S3: If we do the OCL task on Discord, we can use the voice feature though. We can call each other, it is okay not to open the camera. That is why synchronous is fun.

*Interviewer: Please describe the main challenges in synchronous OCL Task 1 that hinder you from participating more actively in online collaborative activity via Discord.*

S5: For me, sometimes it is hard for me to discuss especially in chat. Sometimes we have to wait the others to finish replying, then we can reply. But this will affect the progress of the task, well sometimes.

S3: Yeah, then we got nothing from the discussion.

S4: Agreed. As we are busy replying to others' ideas, we might overlook many other points and opinions as there are too many.

S2: As the chat goes on, we have to type our question again following the discussion flow.

S4: It ends up with less people can contribute.

S2: For synchronous OCL, people tend to discuss out of the topic.

S4: Yes, correct.

##### Task 3

*Interviewer: Please describe the best aspects of asynchronous OCL Task 2 that make you want to participate more actively in online collaborative activity via Discord.*

S5: It is easier for us to find data first then share to our group if it is asynchronous.

S2: We can follow our own schedule. Different individuals will have different ways to arrange their time.

S4: Asynchronous is fun as there is no time limit for us to think for the discussion. Sometimes, the ideas just come out of nowhere, even when we are in the toilet. When there is no pressure, ideas can flow in easily.

S3: If asynchronous, it is easy for me to give my opinion or ideas whenever I want. No pressure since we have time to think.

S2: Yea, I agree with S4. I have many ideas when in the toilet. Haha

*Interviewer: Please describe the main challenges of asynchronous OCL Task 2 that hinder you from participating more actively in online collaborative activity via Discord.*

S1: Very hard to communicate since we do not know whether he/she is online. It feels lonely.

S5: For me, I tend to delay the task if the given due date is still long. It ends up the work will be completed last minute.

S4: There might be some students not contributing at all if the task is asynchronous.

*Interviewer: Which type of task would you prefer the most to participate in for online collaborative activity using Discord; synchronous or asynchronous? Why?*

S4: Hmm, I would say both. Depends on the type of task.

S2: 50 50. Yes, I would see what kind of task will be given.

S4: If the task is difficult, so I think I would prefer long due date and asynchronous.

S3: Actually, it depends. If the work needs to be done quickly, I think it is more suitable as synchronous task. If no rush, then asynchronous is better.

S5: Depends on the task given.

S3: Yes, so it is neutral, I guess?

S1: Synchronous for me. It is much more fun to be able to communicate with others at the same time.

##### Task 4

*Interviewer: Please describe the best aspects in large group size tasks that make you want to participate more actively in online collaborative activity via Discord?*

S3: Learning collaboratively in large group is actually fun as we can get many information from each other, given that all of the members participate actively

S5: Personally, the advantage of working collaboratively for online task is that it makes the work much easier. We can distribute the task evenly, especially a heavy workload task. But, if the task is easy, there will be members who will be passive

S2: Yeah, it will be easier in condition that everyone is online at the same time. But, as the advantage working in large group, there are more ideas coming from different members.

S3: Exactly.

S1: I would describe myself as extrovert, thus I love interacting with many people. I think I would enjoy the online environment with large group size

S3: But, I think introverts may also enjoy working participating using texts in Discord although the group size is large. Much easier to communicate using Discord text compare to discussing face to face.

## **FOCUS GROUP 2 (FG2)**

### **INTERVIEW TRANSCRIPT**

#### **Task 1**

**Interviewer:** Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.

S10: In my opinion, the best aspects of discord as a technology tool is that it is more organised. You don't need to search for it for example, the Discord server for Biology class. You can see the class on the side bar.

S6: In my opinion, Discord can sort out the learning material more easily. We can search for the learning material that we want much faster and easier compare to other technology tools. Not only that, we can join the voice channel in Discord to discuss the homework or assignment together.

S8: As for me, the best aspects of Discord is the way it is arranged accordingly by lecturer. It is much easier for us to pick up such important topic when the exam is around the corner. It takes little effort to search for info that have been pinpointed by friends and lecturer. The voice channel is useful, no need for us to use Google Meet separately.

S7: In my experience, Discord is a good technology application for online study because it can create many channels in one main channel which can help me to classify the learning material by chapters. It gives me the benefit for not wasting my time to get the learning material from previous message in comparison to Telegram or WhatsApp.

S6: Besides, before this I also used the Discord during my secondary school. I join the online learning group in my school which is organised by the students in my school. I join the voice channel in Discord, everyone was studying in that channel. That motivate me to study also. I will join the Discord study channel and calculate the time of study.

S9: I think Discord is the best learning app for education because it has a lot of useful features. It is compatible with all gadgets such as smartphones or laptops. Discord has their own bots such as music bot (Rhythm, Hydra, Groovy), meme bots (Dank Memer, Lol Bots) and lots more!

**Interviewer:** Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning.

S10: As for the challenges, when using discord is sometimes, you won't be able to receive the notification from any channel in the discord. Did you guys experience it too?

S7: Yes, if the message has no tags for us, it will not notify us in general.

S6: Yes, I experienced it too.

S8: Yes, just like when our physic lecturer assigns or updated our new work to be submitted in his list, I don't get any notification which makes me sometime miss the deadline. That is not good.

S7: Another thing that I can complain about Discord is it has so many notifications and I need to mute one by one.

S10: Another challenge that I experience during my time using Discord is the loading time is too long. I need to restart my laptop then I will be able to open it.

S9: The disadvantage of using Discord, when there is no internet connection, we cannot get access to the materials in there. Then, the mic or voice chat always have bugs, when I accidentally turn on my mic it is embarrassing.

S6: Sometimes, the update takes too long.

**Interviewer:** Overall, do you prefer to use Discord over other platforms (e.g. Microsoft Teams, Google Classroom etc) for you to collaborate with others for learning? Describe ONE main reason why.

S6: For me, I prefer another platform such as Google Classroom. They provide functionality to save all files offline. Using Discord, I need to have the strong internet connection.

S7: Overall, I prefer to use Discord over other platforms because it is almost similar with other social platforms that I commonly use such as WhatsApp, WeChat, and Telegram. I feel familiar when using Discord for learning purpose.

S10: If you ask me, I prefer Discord more because you can directly chat/tag/interact with your lecturers through Discord instead of texting them on different platforms or using private chat space such as in Google Classroom. If you use the private chat or comment space, you would not be able to get the response directly.

S9: Overall, I do prefer Discord other than any other apps out there. It really helps my study. The system is not complicated compared to most other apps. For example, Microsoft Teams is really complicated for me to use; I just cannot.

#### **Task 2**

**Interviewer:** Please describe the best aspects of synchronous OCL Task 1 that make you want to participate more actively in online collaborative activity via Discord.

S6: The best part of asynchronous is that we can do the tasks as well as the discussion anywhere, anytime. The (internet) line is not lagging, just chill.

S7: This one (asynchronous) is good as you may not free at the moment, or you have any trouble which need to solve so you cannot join the activity on time. This suits the best for those who are busy.

S6: Agreed!

S8: Asynchronous is useful especially for those who like to manage their time properly and take time to do research on the assigned topics.

S9: Yes, at last! Best aspect for asynchronous, hmm... we can postpone our work. Just joking. Being online at different times doing any task or assignment is very helpful especially for a procrastinator like me, joking! Not only that, you can do the work without having anxiety being online at the same time.

S10: The best aspect of asynchronous tasks is you can take time to think for some ideas because not all the time our brain cannot think of good ideas. For instance, after waking up from a short nap we need to refresh first before thinking.

S9: You are having nap? I think you are studying all the time.

#### **Task 3**

**Interviewer:** Please describe the main challenges of asynchronous OCL Task 2 that hinder you from participating more actively in online collaborative activity via Discord.

S10: The main challenges of asynchronous task is the work we are doing might be incomplete, or it maybe not perfect. This happens as we take advantage of the time and keep procrastinating until the very last minute.

S8: We as human really do like to postpone our work. Then, as a result we feel anxiety and stress because cannot finish the work.

S6: The main challenge of asynchronous is that lazy people will not join the discussion, then they just give excuses not able to participate.

S7: Agreed.

S9: I think the challenges is that when we start to postpone our task, it will be until the very last-minute close to deadlines. Then, the quality is not there. Online at different times, anything can happen, sometimes someone did not online to the very end upon the task completion.

**Interviewer:** Which type of task would you prefer the most to participate in for online collaborative activity using Discord; synchronous or asynchronous? Why?

S7: I prefer synchronous when I truly want to learn something so I cannot wait to know the answer or opinion from other people. Thus, I need the topic to be discuss through synchronous so that I can get feedback quickly.

S10: I prefer synchronous because as matriculation students, we are very tight in terms of time as this is a fact-track program. So, synchronous task is better because you can finish the task immediately and can focus on other things such as the upcoming exam.

S8: Exactly. I also prefer synchronous task because we need to complete the task as soon as possible to avoid stress last minute.

S7: However, I prefer asynchronous when I am tired or I think the discussion will not give benefits to me. I can become inactive if the discussion is conducted through asynchronous. I can hide myself throughout the discussion.

S6: I am neutral. I can accept both ways; synchronous or asynchronous. For me, the only difference between these two is the time. For synchronous, we can collect data on the spot. For asynchronous, we just chill giving and collecting ideas and opinion, maybe we can get more due to the time. So I think combining both are the best.

S9: It depends on the task itself. If the task needs to be completed on the spot, it is better not to postpone it and complete the task on the spot. But of the task is heavy, need lots of data, it will be hard to carry it out synchronous mode. For me, that kind of heavy task asynchronous will be helpful.

S6: I understand.

#### **Task 4**

**Interviewer:** Please describe the best aspects in large group size tasks that make you want to participate more actively in online collaborative activity via Discord?

S6: Easy to divide the work. Like before, we had the video creation task. So, four people create one video. Much easier and we can complete the work faster.

S10: In large group, many members will be able to online at one particular time. So, they can contribute their ideas, although some members are not able to attend the discussion.

**Interviewer:** Can you please describe the main challenges in large group size tasks that hinder you to participate more actively in online collaborative activity via Discord?

S6: Introvert people like me would not dare to speak up in large group. Another thing is that quite difficult for us to standardise the work template since there are too many people in one group. I might do the first part of the task, but then when another person continues, it looks weird to me.

S7: The challenge of working collaboratively in large group size, I think, the members see that some students able to think creatively and discuss, so they will tend to keep silent because they are lazy to think, and for most of the time they are not confident with their answers

S10: I prefer teacher-student interaction. It is much better because teacher is more mature than us. If he/she involves in our discussion, we will be able to tell whether our thoughts are still childish or are we on par of maturity with our teacher. Sometimes our opinion is not outside of the box, or immature opinions. So, teacher-student interaction is better.

S9: Student-student interaction is better because it involves only students' ideas which we can elaborate more on. Not only that, it does not have pressure coming from teacher during the discussion.

S10: If we discuss with our teacher, we can increase our knowledge.

S6: For me, I prefer the participation of teacher in the group discussion. This is because the teacher can help to connect all group members to do the project together. He/she will motivate students to do the task in correct direction. Besides, students also can have more interaction and communication with our teacher.

S8: Agreed.

S10: Agreed.

S6: Sometimes, we just do not have the direction to start the discussion. Teacher can also motivate students to collaborate more. For example, teacher can help with the task division, following the strength of each member. You guys agree?

S10: Totally agreed.

S8: Agreed.

S9: Agreed.

### **FOCUS GROUP 3 (FG3)** **INTERVIEW TRANSCRIPT**

#### **Task 1**

**Interviewer: Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.**

S11: In my opinion, Discord can let us communicate via video, audio, and text. The teacher can post study materials in Discord for reference, and conduct online classes via Discord.

S12: From my point of view, Discord can help us to communicate with our friends. It is the best app for gaming. You can run the Discord background while playing the game.

S13: For me, Discord is a good platform for us because we can use it as a medium (platform) for studying. We can easily discuss with each other. We can study together as live streaming, such as using video call while enjoy listening to music together.

S14: I think Discord is easy to use as students can easily access study materials posted by lecturer.

S15: Yes, we can communicate outside of class hour. This can be helpful for us to ask questions and collaborate on project.

S13: Yup, I admit that much because we can refer to all lecture notes that have been released by our lecturer in the Discord easily.

**Interviewer: Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning.**

S11: (Discord) notification system is not good. Sometimes I saw a notification and I click on it but it did not direct me to that message. I have to find that message by clicking into every channel.

S12: The disadvantage of using Discord is that sometimes if a server has too many channels, it makes me confuse. For example, if I want to find certain notes, I need to open the channel one by one to find it.

S11: I agree

S13: Ohhh, I see even we have a good connection at that time also sometimes it will happen but it still okay for me

**Interviewer: Overall, do you prefer to use Discord over other platforms (e.g. Microsoft Teams, Google Classroom etc) for you to collaborate with others for learning? Describe ONE main reason why.**

S12: Overall, I still prefer to use Discord over other platforms. If we want to join Microsoft Teams or Google Classroom, we need to have link so that we can join the meeting. However, for Discord, we just need to press the (voice) button, we direct enter the meeting channel.

S11: I prefer to use Discord over other platforms. The reason is that, for example Google classroom is not well organised so if the teacher posted the study materials together with the homework, it is hard for me to find the study materials. Every time I have to scroll for a long time to find the thing I want in Google Classroom.

S12: Discord is also better than Microsoft Teams or Google Classroom because it shows notification directly, not through email

S15: For me, I do not prefer to use Discord as it has the notification system's problem. I need to open it very often to prevent skipping important information.

S13: If I compare to Google Classroom and Discord, I think I prefer the most is Discord even it quite not organized well but we can still use it for studying and discuss among each other

S11: I prefer Discord because sometimes the document in WhatsApp if we did not download it, it will be expired and you have to ask the owner to resend it. The materials in Discord retains for a long time until the owner delete it

S12: Agreed

#### **Task 2**

**Interviewer: Please describe the best aspects of synchronous OCL Task 1 that make you want to participate more actively in online collaborative activity via Discord.**

S11: I think the best aspect of synchronous task is we can see the opinion from others and maybe we will have new ideas when reading others' opinions.

S12: The best aspect of synchronous task is that we can finish the task more efficiently since everyone is being online at the same time.

S13: We also can finish our work within that time without the need to postpone it.

S14: I think the best aspect of synchronous task is we can see every group member online and take part in group discussion.

S13: We also can share our idea with each other at that time and can elaborate more and more ideas.

S15: When people participate in synchronous tasks, they are more likely to feel a sense of engagement and involvement. This is because they are actively participating in the conversation and can see the reactions from others which make us more connected in the group.

**Interviewer: Please describe the main challenges in synchronous OCL Task 1 that hinder you from participating more actively in online collaborative activity via Discord.**

S13: Of course, network connection is the problem for me if we want to discuss something.

S11: Use many data then I have to buy data again.

S12: Some people are not providing their opinion since many people is being online at the same time.

S14: Internet connection is the main challenge of being online at the same time.

S12: Agreed.

S13: Yes, I totally agreed. Then, if the internet connection is problematic, it is difficult to finish the task at that time.

#### **Task 3**

**Interviewer: Please describe the best aspects of asynchronous OCL Task 2 that make you want to participate more actively in online collaborative activity via Discord.**

S12: The best aspect of asynchronous tasks is that we can relax ourselves while doing the task.

S11: In my opinion, the best aspect of asynchronous tasks is that you can do that task whenever you want. Maybe that day you feel tired, then maybe you can do it tomorrow.

S13: To be honest, we can delay our work, haha. And continue to finish it whenever the mood is there.

S14: I think the best aspect of asynchronous tasks is we can do it according to our time and schedule.

S15: We can have more flexibility in terms of time. It means that we can control our time to do the work which is more important.

S12: We can focus on more important tasks first.

**Interviewer: Please describe the main challenges of asynchronous OCL Task 2 that hinder you from participating more actively in online collaborative activity via Discord.**

S11: Haha, I always procrastinate if I do asynchronous tasks.

S13: Yes exactly!

S14: Yes I agreed.

S11: The main challenge is I will totally forget that task if the deadline is too long.

S13: I will do it very last minute, if it is for me.

S15: In the end, we cannot finish the task, haha.

**Interviewer: Which type of task would you prefer the most to participate in for online collaborative activity using Discord; synchronous or asynchronous? Why?**

S14: I prefer asynchronous tasks because we can finish the task according to our time, no need rushing and pressure.

S11: I prefer asynchronous because I actually do not like to stick on the time which I must online at that time to complete a task. I will have more ideas and more efficient if I do the work after I have a good rest.

S12: I prefer asynchronous task because I can rest while doing the task. No pressure and no need to rush.

S13: It is actually hard to choose because both of them are okay. For me, all of these depending on our situation which we cannot expect, for example, our mood at that time.

## **FOCUS GROUP 4 (FG4)** **INTERVIEW TRANSCRIPT**

### **Task 1**

**Interviewer:** Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.

S16: What do you guys think?

S19: I think the best aspects of Discord is that if we want to post different materials accordingly, we can name and categorize the materials at the sidebar

S16: Correct, I agree with you S19

S19: It will be easier for us to search for the different materials that we want. The clear categorization in Discord server makes our life easier...haha

S16: Besides, it is easy for us to get access to all of the materials posted

S18: I think the best aspect of Discord is I get to learn and get information in a lot of different study groups, even only in one single channel of Discord

S16: Also, we can add friends, even though we are strangers to each other at first but then we can add friends and get to know each other more

S20: I think using Discord as medium of communication seems relevant as it is an easy application to be used. There are lots of things that can be done such as listening to music, streaming movies, and even video calls. What is more interesting is that it also has different kinds of bots with variety of uses.

S17: Ye, many people can join the discussion so we can get different kinds of information

S18: I also agree with S19, Discord can categorise some materials on the sidebar and makes it easier for us to refer to them

S16: Yep, I strongly agree with you guys

S18: Sometimes if I am bored learning, I can also watch movies with my friends by using Discord even if we are far apart from each other

S16: Discord can be access easily using difference devices but with the same account

S19: Yea, we just have to scan the barcode then we can log into different devices such as PC or laptops with one account

S17: Correct I enjoy those multiple devices access feature

S18: Yes, i agree

S16: Exactly

S20: Absolutely

**Interviewer:** Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning.

S16: For me, Discord is quite difficult to refresh the page, depending on the internet connection. Especially when I try to open it on laptop

S20: I think Discord need a large amount of internet data for it to function normally. A fast internet connection is needed so that Discord can operate at its finest. So, for those who often have weak internet connection, it seems that it would a big challenge for them to use the Discord for online learning.

S18: Based on my experience, sometimes notifications from Discord cannot come out or pop out on my mobile phone and because of this I tend to miss some important information.

S19: I think the main downside of Discord is that sometimes it will be very hard for me to upload the pictures (images) onto Discord if I am opening Discord on my phone and computer at the same time. I have to close one of them in order to upload the pictures, which is very inconvenient for me. Unlike WhatsApp, Telegram or other platforms, only when I use Discord, this kind of problem will happen.

Yes, I also agree with S18. This notification problem happened to me before too. This made me missed some many important announcements.

S17: Yes I also experience the same problem with Discord notifications

S16: Other than that, I feel that it is a little bit difficult to reach out to other person through Discord. Mainly, I think it is due to the internet connection of each individual that could be weak at that time, thus cannot receive my chats. Or it could be because of nowadays people are prone to use apps like WhatsApp to chat rather than on Discord as many of us feels that Discord is only for gaming.

S20: I also agree with S19 as Discord does not operate smoothly with two devices at the same time, it really makes my work troublesome.

S18: Yes I agree

S20: Absolutely agree

**Interviewer:** Overall, do you prefer to use Discord over other platforms (e.g. Microsoft Teams, Google Classroom etc) for you to collaborate with others for learning? Describe ONE main reason why.

S19: I would say no to this question because Discord is a less friendly application for me. It is a great app to get access of the learning materials, but I would not recommend it for discussion purposes. I think other apps such as WhatsApp and Telegram are better for the discussion especially for those who wish to have long and deep discussion.

S17: For me, I prefer to use Discord for online activity because there are many people can join the discussion so we can get many information from different perspectives. Plus, many people know how to use Discord

nowadays so it will make it easier for us to collaborate with our group members

S16: Yes I prefer to use Discord because it is fun to use, got lots of cute stickers and emojis. In terms of our privacy, we can hide our phone numbers from others. I feel that Discord is suitable for collaborative discussion. For me, Discord is suitable for an important and serious discussion in comparison to other platform such as WhatsApp and Telegram. Because the latter are usually used for a casual and personal chat.

S20: For me, I think using Discord as my main medium for online collaborative activity sounds a no for me. It would be a great side-app to be used, but as the main medium it sometimes can be troublesome. There are lots of other platforms such as WhatsApp and Telegram that is more user-friendly, more reasonable to be used. However, Discord can be a communicative platform if it involves a large community, which makes it easier to sort different kind of problems to be discussed.

S18: Yes, I would prefer to use Discord for online collaborative activities. We can discuss and share task information, and also ask task-related questions. In my opinion, although WhatsApp and Telegram are easier to use but I would prefer my online learning activities occur in separate application such as Discord since WhatsApp and Telegram are more towards my personal uses.

### **Task 2**

**Interviewer:** Please describe the best aspects of synchronous OCL Task 1 that make you want to participate more actively in online collaborative activity via Discord.

S16: Through a synchronous task, I can participate on the discussion on time and will not be left behind by the ongoing discussion. I think we can interact more with each other and get quick feedback about something that we are discussing about.

S17: Yes, I agreed. I can give instant feedback to my other members in my group discussion.

S16: Synchronous tasks can help us to engage more in the tasks and be fully involved in it.

S18: The best aspect of synchronous activity is that it can be done online, for example through voice channel on Discord and instant messaging. By this way, we can get faster information exchange.

S19: For me synchronous tasks allow us to have more "compact" conversation because everyone will brainstorm for ideas at the same time.

S20: In terms of synchronous activity, Discord would be a great application for discussion.

S19: I do think that synchronous tasks will push us to have instant discussion as lots of people will have the habit to procrastinate.

S18: The questions given in the task can be answered instantly and the feedback can be received immediately.

**Interviewer:** Please describe the main challenges in synchronous OCL Task 1 that hinder you from participating more actively in online collaborative activity via Discord.

S16: The main challenge is that sometime due to lots of chats being sent at almost the same time, our own chat or ideas can be overlooked by others.

S18: Yes, I strongly agree with you.

S17: Agreed.

S20: I also agree with you. What a great point.

S16: The most painful thing that could happen is when your connection is suddenly lost during the discussion.

S20: Yes, absolutely. It would be very disappointing.

S19: Yes, I totally agree with S16. Sometimes, sending the messages at the same time can cause lagging on our devices. Then it will be very hard for us to sort out and combine all of the ideas.

S20: For me, I think for synchronous activity, it would be easier to be done face-to-face. As there are lots of things that can distract us during the discussion. If we cannot do the discussion face-to-face, then using Discord is reasonable.

### **Task 3**

**Interviewer:** Please describe the best aspects of asynchronous OCL Task 2 that make you want to participate more actively in online collaborative activity via Discord.

S16: Asynchronous activity is convenient because not everyone is available at the same time right? So, it is easier to manage our time when to reply the chats in a discussion through asynchronous activity.

S19: The best thing about asynchronous task is that I can think thoroughly before I express my personal opinion. Sometimes, I need to pause myself to rethink and reconsider the problem/questions from different aspects after listening to others' opinion. Asynchronous task enables me to conclude what others have said and I do not have to worry that the topic will be covered by the new topic in a short time. Hence, better quality discussion can be held.

S17: Asynchronous task is good because everyone can give their opinion at any time.

S18: The best aspect for asynchronous activity is that I can learn at my own pace. As for me, I like to learn by myself as it is more effective. For example, watching videos from YouTube and watching demonstrations for learning.

S16: Other than that, the teacher can monitor the discussion too and will be there to assist the students back to the right path if the discussion is out of topic.

S20: I agree with you. Very straight and rightful path, haha.

S19: And the students will know that they have done well when they receive positive comment from the teacher. This can motivate the students.

S16: Yes.

**Interviewer: Please describe the main challenges when the teacher is involved in your collaborative tasks' discussion via Discord?**

S19: The downside of having teacher around in the discussion is some students are too shy to express themselves in front of the teacher.

S16: When the teacher involves in the discussion, some of the shy students would tend to keep quiet only.

S18: The disadvantage is that students will depend on the teacher for ideas and opinions.

S19: Yes, this has happened to me before especially when my group are all critical thinkers. I feel like my opinion sound childish and unprofessional.

S20: I think if the teacher is involved, the conversation cannot be versatile. It would depends mostly on the teacher to carry the conversation.

#### Task 7

**Interviewer: Please describe the best aspects when only student peers are involved in your collaborative tasks' discussion via Discord?**

S18: The best aspect of it is I can ask questions directly with my peers without being shy.

S20: The conversation would be versatile if there is no teacher around.

S16: When only student peers involve in online collaborative discussion, most of the time they can be more expressive about their opinions. They can understand what each other are talking about from their own perspective.

S19: There will be easier and more comfortable to express my point of view as well as asking questions.

S17: The best aspect is the discussion will be more relaxing and less pressure.

S20: It is easier for student to share their opinion in their own language.

**Interviewer: Please describe the main challenges when only student peers are involved in your online collaborative tasks' discussion via Discord?**

S16: Sometimes, students tend to discuss out of topic during the activity.

S18: Yes, that's the thing. Students tend to do some other unrelated things when the teacher is not around during the discussion.

S17: True, they might be distracted easily during the conversation.

S19: Especially at the start of discussion, we will tend to joke around and do ice-breaking first of the members are not familiar with each other. If the teacher is around, we probably cannot do this part.

**Interviewer: Which type of task would you prefer the most to participate for online collaborative activity using Discord; teacher-student interaction or student-student peers interaction? Describe ONE main reason why.**

S16: I prefer student-student interaction. This is because it will be less tension during the discussion if compared to when there is a teacher involved.

S19: I like student-student peers interaction more as we can discuss things in relax manner and the discussion among students enable them to do self-reflection which helps us to see our weaknesses.

S17: I prefer student-student interaction because I can use mixed language for example English and Bahasa Melayu during the discussion.

S19: That is a good point. We can use our casual language among friends.

S20: I prefer student-student peers interaction as communication would be a lot easier with less pressure.

S18: I would prefer student-student peers interaction as I can be myself when giving my ideas. Moreover, bonds between students can be strengthen as students can help each other and solve critical thinking questions together by collaboration between us.

## **FOCUS GROUP 5 (FG5)** **INTERVIEW TRANSCRIPT**

### Task 1

**Interviewer: Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.**

S22: Hi S23, what is your opinion?

S21: S23, give us your perspective. hehe

S23: As a new Discord user, I think Discord helps me to assort my learning materials. I am more comfortable to communicate with lecturers via Discord

S22: From my perspective, Discord is indeed a great application for online learning as it gives us more privacy by not exposing our personal data such as our phone numbers. Besides, it is great because anyone could easily create a channel and invite people to discuss about certain topics. All of the crucial sources or notes could be access easily as the side task bar is visible. Not just that, we could also re-download the lecture notes again, as long as the admin did not delete it. By that, I could say that Discord is one appropriate medium for to learn collaboratively in online environment

S25: I think Discord is a very good application because it is designed for individuals to communicate via video calls and text chat with people around the world even though they do not have our personal phone number.

S21: From my perspective, Discord is not only about simply chatting and sharing documents with our friends or classmates. The most attractive feature of this application is that we can locate our files and discussion very specifically. If it is group chat in other social platforms such as WhatsApp, we mix up all the things in that one space. However, in Discord, interestingly we can further divide the topics into smaller specific divisions. Take an example, for Chemistry online class, we can further divide the Discord channel to organic chemistry and physical chemistry separately. Hence, we can locate the information that we need easily, regardless of the discussion on a certain concept or the documents related to that particular idea. Comparing to the other platforms, it is easier for us to arrange the shared resources in Discord server.

S22: That is true.

S24: We can simply use Discord to create many sub-channels in which we can manage our conversation and access to previous information easily. We can create many sub-channels for different topics to discuss. This is a very useful way for educational purposes. For instance, a teacher can create sub-channel for different subtopic and upload information based on the topic for better access. In addition, the documents uploaded will not be compressed such as image, video and so on.

S22: I never use the voice feature in Discord but from what I heard Discord calls is great. We could connect with anyone around the globe as long as we know their user ID.

S23: Oh... I see.

S21: Also, Discord can accommodate large number of participants. Unlike the other communication related apps like WhatsApp which will limit the number of participants, Discord allows large number of people to join the same server at the same time. Thus, more people of common interest and motive can discuss the similar topic together. Overall, it is very useful for us in the case of needing a public channel.

S24: Besides, Discord can be installed on our smartphone, tablet, and laptop as well. And we can login to any of it using the same account. I think it is helpful because as long as we have any of the electronic devices at the moment, we can access to the information in the Discord at any time. It will not be restricted to any of the electronic devices only. And most importantly, Discord is free, and we can download it easily.

S22: Waa... excellent.

S21: From another perspective as well, Discord did a great job in syncing the messages. As S24 has mentioned just now, it can be installed in your smart phone, tablet, and computer. At the same time, we can log in the gadgets with the same account, thus allowing us to access to the documents in Discord easily. We do not really have to worry to use other apps for the sake of transferring the file again

S23: I just found out that Discord can display our online activities as well while using the application, such as when we listen to Spotify. The members would know what kind of songs we are listening while using Discord

S22: I agree with S21 and S24. As long as we have any electronic devices, we could access to Discord very easily... Everything is just at the tip of our fingers.

**Interviewer: Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning.**

S22: From my experience, Discord consumes large data usage to use it. Thus, we should have a stable internet connection in order for us to use it smoothly. However, it is okay. It is still a great application for online learning.

S21: In terms of challenges, Discord has problem in notifying the user. Whenever the lecturer or tutor in the group want to notify students, if that group of students are not tagged, no notification will be received. This is a huge issue as the students can miss the important announcements

S24: Students may be afraid of giving the wrong answer and hence they will try to cheat so the ideas given will not be that sincere

S21: We tend to become shy and reluctant in answering. Students will become passive as they afraid of giving wrong answers. In student's mind, teacher is a character that will judge whether we are doing right or wrong, even though for some cases of grey area, there is no correct or wrong way to do it. This mindset causes us to be timid in proposing ideas in front of our teachers or mentors.

S22: The main challenge when teacher involved is the student might be uncomfortable and not being openly expressing their opinion as the might scared their opinion is not valid from their teacher's perspective. Besides, sometimes teachers are too controlling as they are not allowing their student to be creative or giving free opinion.

S25: From my own experience, the main challenge if the teacher involves in our discussion is I am too afraid and shy to give response.

S22: But, overall it depends on the teacher himself, if the teacher is not too strict or friendly I am okay when the teacher is involved in the discussion.

S23: The main challenge when teacher is involved in the task is certain students afraid and feeling worried that their suggestions are wrong. Other than that, since the teacher is present, students tend to keep quiet during the discussion.

#### Task 7

**Interviewer: Please describe the best aspects when only student peers are involved in your collaborative tasks' discussion via Discord?**

S25: If the discussion is only among us, we can argue as much as we can without disturbing and spamming the teacher.

S22: When only students are involved in online collaboration, it could lead to more versatile and open discussion. Students tend to share ideas that are out of the box and somehow can be more creative around their peers. Not just that, it could train leadership and communication skills of the student to handle and organize discussion among themselves.

S21: The environment itself is less stressful and everyone feels easy to give opinions. When we feel less stressful, we can think more and brave enough to give out our opinion. Since it is not restricted, we can propose more creative idea.

S23: The best aspect if only student peers involved in the discussion is student can chat freely, suggesting their ideas. No need to worry about getting correct or wrong answers to discuss. And the discussion conversation will not be too formal.

**Interviewer: Please describe the main challenges when only student peers are involved in your online collaborative tasks' discussion via Discord?**

S25: The main challenge here is when only student peers are involved in the discussion, some group members are more likely to get bullied by the other members since the teacher is not participating in the discussion.

S24: When a group discussion only involves student peers, students can really give their honest opinion regarding a particular topic because there will be no one to judge them.

S22: Nevertheless, when there are only students involve in the discussion, sometimes they could lose focus and talking about unnecessary things. Fighting might somehow occur. Not just that, sometimes they do not take the task seriously as they are too comfortable around their peers.

S23: The main challenge is that it might cause the discussion to be run out of ideas and lead to useless discussion. So, we might spend more time for the discussion to finish the task.

**Interviewer: Which type of task would you prefer the most to participate for online collaborative activity using Discord; teacher-student interaction or student-student peers interaction? Describe ONE main reason why.**

S23: I prefer the task which involved the teacher. Safe, controlled, and efficient discussion.

S25: Me too!!

S22: I would prefer when teacher-student interaction but just to monitor the conversation and prevent any unnecessary things happen during the discussion. Besides, we could also ask for the teacher's opinion and brainstorming together. I have no issues if teacher involved.

S25: Yes, in order to avoid discussing unnecessary things I prefer the involvement of teacher

S21: I prefer student-student interaction. Sometimes when the teacher is involved it seems like an obstacle between students. We have ideas to share but too much to worry in order to give out the ideas even though the teachers said themselves it is okay to say anything even when they are around.

S22: When teacher involves in the discussion, we could train ourselves to be less shy and train our communication skills.

S23: With the presence of teacher, we need to be careful of our attitude and ethics whether it is a normal conversation or just chatting.

S24: I still prefer student-student peers group discussion because what we need during a discussion is nothing but just a honest opinion. Yes, teacher can guide the student for the discussion but not necessarily get involve in the group to see everyone discussing. As long as students can finish on time, that should be fine. A private platform for students only to discuss can eventually come out with some unexpected ideas.

## **FOCUS GROUP 6 (FG6)** **INTERVIEW TRANSCRIPT**

### Task 1

**Interviewer: Please describe the best aspects of Discord as a technology tool which makes you want to actively collaborate with others during online learning.**

S26: Hi everyone. In my opinion, one of the best aspects of Discord is that we can open many channels in a server which allows us to get access to different materials more systematically. We can directly go to the channel we want. For example, we just open the tutorial channel in Biology Discord and can download all tutorials easily.

S30: I agree with you. I think Discord is a good application for online collaborative learning as we can discuss and collaborate together in online environment.

S27: In my opinion, I think the best aspect of discord is we can edit and update our messages. So, when we make any typos, we can quickly fix our mistakes. Besides, any updates for our last message can also be edited and this can save a lot of time.

S26: Yes, that is true. This feature avoids my embarrassment when I send message with typos. Also, I think that Discord only takes a little space from my storage. So, it saves my storage space. Thus, I do not need to clean the storage all the time.

S27: I agree with you too. Discord brings many benefits for our collaborative learning. Various materials are available and we can directly click it to download.

S29: I agree with all of you.

S28: The advantages of Discord in my opinion are it allows users to easily access to the learning material. In comparison to WhatsApp which is also a social online platform, the communication in Discord among a large group of users is much easier and efficient.

S30: Discord also does not use much mobile data. So, it really saves my money as no need to buy mobile data.

S27: Truly agree.

**Interviewer: Please describe the main challenges that you faced when using Discord which makes you feel disturb to collaborate with others in online learning**

S26: The main challenge I faced is that Discord's notifications sometimes do not function well. Sometimes, I do not receive the important messages that lecturer sent in the Discord group.

S30: I totally agree with you S26. Sometimes, Discord does not show notification. So, I am not alert of the assignment or information that has been given

S27: I do agree that the main challenge about using Discord is about the poor notification system. Maybe the developer should improve on that feature.

S28: In my opinion, the disadvantage of Discord is it can be distracting sometime especially for who are trying to focus on the other tasks. While we collaborate on one topic, others might be discussing on other channel or server which I find it quite distracting.

S29: I don't really think that Discord notification system brought any convenience to me as I felt the need to constantly open my laptop to look at the conversations and important messages as there is no message alert. Frequently missing through important contents sometimes.

S26: Oh yes, sometimes I also face this connection problem. But I am not sure whether Discord needs a very stable internet connection to access, or maybe not.

**Interviewer: Overall, do you prefer to use Discord over other platforms (e.g. Microsoft Teams, Google Classroom etc) for you to collaborate with others for learning? Describe ONE main reason why.**

S29: In terms of online collaborative activity, Discord helps me to keep track of what my classmates or groupmates posted on the channels in a tidy sequence.

S26: For me, I would prefer to use Discord for my online collaborative activity as I think it feels more of formal platform. Also, I can easily get materials that I want by just opening the related channels. So, it is quite convenient for me.

S30: I prefer to use Discord for online collaborative activity because I can work and communicate with my own group and can share material easily. That is just my opinion, I guess.

S27: I think I would prefer Discord for my online collaborative because we can chat and discuss with friends directly and quickly. Any files or materials can be sent easily through Discord and also can be downloaded with convenient.

**APPENDIX E**  
Lecturer Reflective Journal Prompts & Entries

*Lecturer Reflective Journal Prompts*

**Reflective Prompts (Used Across Task 1–7):**

1. What were the most effective aspects of student collaboration observed in this task? Which platform features, communication patterns, or group behaviours contributed positively to learning or engagement?

*Apakah aspek paling berkesan dalam kolaborasi pelajar bagi tugas ini? Ciri Discord, corak komunikasi, atau tingkah laku kumpulan yang manakah menyumbang secara positif?*

2. What challenges or limitations did you encounter during this task? Include any technological issues, group dynamics, participation gaps, or pedagogical constraints.

*Apakah cabaran atau kekangan utama yang dihadapi? Nyatakan isu teknologi, dinamika kumpulan, jurang penyertaan, atau kekangan pedagogi jika ada.*

3. What adjustments or strategies would you recommend to improve the next task cycle? What could be improved in terms of group configuration, facilitation style, task design, or use of Discord features?

*Cadangan atau strategi untuk penambahbaikan dalam kitaran seterusnya? Apakah aspek konfigurasi kumpulan, gaya bimbingan, reka bentuk tugas atau penggunaan ciri Discord yang boleh ditambahbaik?*

*Reflective Journal Entries*

<b>Task</b>	<b>Effective Aspects</b>	<b>Challenges</b>	<b>Recommendation</b>
<b>1</b>	The Discord interface was easy to use. Students quickly understood how to use the features. The clearly labelled channels helped them navigate smoothly. They could find materials easily through topic-specific threads. File sharing was simple, and the use of emojis and music bots made the environment more relaxed, which encouraged participation.	Some students missed important messages due to notification issues. A few faced app crashes, slow uploads, and high memory usage. Logging in from multiple devices caused forced logouts. The informal features, like emojis and bots, sometimes distracted students from the task.	Give students a short briefing or guide on how to use the channels properly. Clean up unused threads to reduce confusion. Set clear rules on emoji use during academic tasks. Recommend lighter versions of the app or alternative platforms for students with weak internet.
<b>2</b>	Live sessions helped students complete tasks faster. Interaction was active, and immediate feedback cleared up misunderstandings on the spot. Clear instructions kept students focused. Brainstorming in real-time also improved the quality of group ideas and collaboration.	Unstable internet disrupted participation for some students. Those with poor connectivity often dropped out mid-discussion. A few students felt stressed because the discussions moved too fast. In some groups, only a few students dominated the conversation while others stayed quiet.	Keep voice groups small to make it easier for everyone to speak. Use breakout channels to give quieter students more space. Provide asynchronous alternatives for those who missed the live session. Set clearer pacing or use visual cues to manage turn-taking in discussions.
<b>3</b>	Text-based discussions allowed students to reflect more before responding. Many gave well-organised and thoughtful answers. The flexible format helped students work at their own pace. Archived threads made it easy to refer back to earlier points and track the flow of ideas.	Procrastination was common. Some students delayed their responses, which made the discussion feel disjointed. Participation levels were uneven across groups. A few students didn't check earlier messages and ended up repeating what others had already said.	Set small deadlines for each part of the discussion to keep things moving. Assign a different student each week as moderator to guide the conversation. Post short summaries every few days to help everyone stay updated.
<b>4</b>	Large groups generated a wide range of ideas. The mix of perspectives improved the quality of discussions. Tasks were completed more efficiently because the work could be divided among members. Stronger students often helped guide or support weaker ones during the process.	Some students didn't contribute and relied on others to complete the work. A few remained silent throughout. During peak times, too many messages at once made communication messy. Without clear roles, some tasks were duplicated or left out.	Assign specific roles to each member and rotate them regularly. Use sub-channels to separate parts of the task and organise the workflow. Include checkpoints during the task for group members to reflect and adjust direction. Set up peer accountability measures to ensure fair contribution.

Reflective Journal Entries

<b>Task</b>	<b>Effective Aspects</b>	<b>Challenges</b>	<b>Recommendation</b>
<b>5</b>	Students were more comfortable sharing their opinions in small groups. Roles were easier to assign and understand. Participation was more balanced, and tasks were completed on time. Communication was straightforward and efficient.	The smaller group size sometimes limited the variety of ideas. Some groups relied too much on one strong member, which caused pressure. When no one took the lead, communication slowed down or stopped altogether.	Rotate the facilitator role to encourage leadership. Form groups based on a mix of past performance to increase diversity of ideas. Use prompts with varied sub-questions to push creative thinking. Provide checklists or simple guides to help groups stay organised and independent.
<b>6</b>	Lecturer presence helped keep discussions focused and clear. Misunderstandings were corrected quickly, which improved learning. Students showed better engagement when guided properly. Discussions stayed on topic and aligned with the intended learning outcomes.	Some students were hesitant to speak when the lecturer was present. The formal setting reduced spontaneity and made weaker students anxious. Technical issues, especially in voice channels, also affected participation.	Combine formal guidance with a more relaxed tone when needed. Use simple language and light humour to reduce pressure. Create dedicated channels for open idea sharing without assessment to encourage students to express themselves more freely.
<b>7</b>	Peer-led discussions helped students build stronger connections. The informal tone and use of humour made them more open and comfortable. Students supported each other naturally without needing teacher input. Some groups showed good levels of creative thinking and collaboration.	Discussions sometimes went off-topic. Without a clear leader, some conversations lacked depth. Leadership within groups was uneven. In a few cases, dominant voices took over while others just followed, leading to groupthink.	Provide basic training on how to moderate peer discussions. Use short reflection prompts at the end of tasks to bring focus back to learning goals. Encourage students to challenge ideas respectfully. Teacher can observe quietly and step in only when needed to guide the discussion.



Task 4: Large Group Task					
	Participant	Participation	Interaction	Social	Cognitive
<b>Group 1</b>	S1	Passive	High Reciprocity	High Sociability	Surface Discussion
	S2	Passive	Low Reciprocity	High Sociability	Surface Discussion
	S3	Passive	High Reciprocity	High Sociability	Surface Discussion
	S4	Active	High Reciprocity	High Sociability	Deep Discussion
	S5	Passive	Low Reciprocity	Low Sociability	Surface Discussion
<b>Group 2</b>	S6	Active	High Reciprocity	High Sociability	Deep Discussion
	S7	Passive	Low Reciprocity	High Sociability	Surface Discussion
	S8	Active	Low Reciprocity	High Sociability	Deep Discussion
	S9	Passive	High Reciprocity	High Sociability	Surface Discussion
	S10	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 3</b>	S11	Active	Low Reciprocity	Low Sociability	Deep Discussion
	S12	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S13	Passive	High Reciprocity	High Sociability	Surface Discussion
	S14	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S15	Passive	Low Reciprocity	Low Sociability	Surface Discussion
<b>Group 4</b>	S16	Active	High Reciprocity	High Sociability	Deep Discussion
	S17	Passive	High Reciprocity	High Sociability	Surface Discussion
	S18	Active	High Reciprocity	High Sociability	Surface Discussion
	S19	Active	Low Reciprocity	High Sociability	Surface Discussion
	S20	Passive	High Reciprocity	High Sociability	Surface Discussion
<b>Group 5</b>	S21	Active	High Reciprocity	High Sociability	Deep Discussion
	S22	Active	High Reciprocity	High Sociability	Surface Discussion
	S23	Active	High Reciprocity	High Sociability	Deep Discussion
	S24	Passive	Low Reciprocity	High Sociability	Deep Discussion
	S25	Passive	Low Reciprocity	High Sociability	Surface Discussion
<b>Group 6</b>	S26	Active	Low Reciprocity	High Sociability	Deep Discussion
	S27	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S28	Active	Low Reciprocity	Low Sociability	Deep Discussion
	S29	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S30	Active	High Reciprocity	High Sociability	Surface Discussion

Task 5: Small Group Task					
	Participant	Participation	Interaction	Social	Cognitive
<b>Group 1</b>	S1	Active	High Reciprocity	High Sociability	Deep Discussion
	S2	Active	High Reciprocity	High Sociability	Deep Discussion
	S3	Active	High Reciprocity	High Sociability	Surface Discussion
	S4	Active	High Reciprocity	High Sociability	Deep Discussion
	S5	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 2</b>	S6	Active	High Reciprocity	High Sociability	Deep Discussion
	S7	Active	High Reciprocity	High Sociability	Deep Discussion
	S8	Active	High Reciprocity	High Sociability	Deep Discussion
	S9	Active	High Reciprocity	High Sociability	Deep Discussion
	S10	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 3</b>	S11	Active	High Reciprocity	High Sociability	Deep Discussion
	S12	Active	Low Reciprocity	High Sociability	Deep Discussion
	S13	Active	High Reciprocity	High Sociability	Deep Discussion
	S14	Passive	Low Reciprocity	High Sociability	Surface Discussion
	S15	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 4</b>	S16	Active	High Reciprocity	High Sociability	Deep Discussion
	S17	Active	High Reciprocity	High Sociability	Surface Discussion
	S18	Active	High Reciprocity	High Sociability	Deep Discussion
	S19	Active	High Reciprocity	High Sociability	Deep Discussion
	S20	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 5</b>	S21	Active	High Reciprocity	High Sociability	Deep Discussion
	S22	Active	High Reciprocity	High Sociability	Deep Discussion
	S23	Active	High Reciprocity	High Sociability	Deep Discussion
	S24	Active	High Reciprocity	High Sociability	Deep Discussion
	S25	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 6</b>	S26	Active	High Reciprocity	High Sociability	Deep Discussion
	S27	Active	High Reciprocity	High Sociability	Deep Discussion
	S28	Active	High Reciprocity	High Sociability	Deep Discussion
	S29	Passive	Low Reciprocity	High Sociability	Deep Discussion
	S30	Active	High Reciprocity	High Sociability	Deep Discussion

Task 6: Teacher-Student Interaction					
	Participant	Participation	Interaction	Social	Cognitive
<b>Group 1</b>	S1	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S2	Passive	High Reciprocity	High Sociability	Deep Discussion
	S3	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S4	Active	High Reciprocity	High Sociability	Deep Discussion
	S5	Passive	Low Reciprocity	Low Sociability	Deep Discussion
<b>Group 2</b>	S6	Active	High Reciprocity	High Sociability	Deep Discussion
	S7	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S8	Active	High Reciprocity	Low Sociability	Deep Discussion
	S9	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S10	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 3</b>	S11	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S12	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S13	Active	High Reciprocity	High Sociability	Surface Discussion
	S14	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S15	Passive	Low Reciprocity	Low Sociability	Deep Discussion
<b>Group 4</b>	S16	Active	High Reciprocity	High Sociability	Deep Discussion
	S17	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S18	Active	High Reciprocity	High Sociability	Deep Discussion
	S19	Active	High Reciprocity	Low Sociability	Deep Discussion
	S20	Passive	High Reciprocity	High Sociability	Surface Discussion
<b>Group 5</b>	S21	Active	High Reciprocity	High Sociability	Deep Discussion
	S22	Passive	High Reciprocity	High Sociability	Surface Discussion
	S23	Active	High Reciprocity	High Sociability	Deep Discussion
	S24	Active	High Reciprocity	Low Sociability	Deep Discussion
	S25	Passive	Low Reciprocity	Low Sociability	Deep Discussion
<b>Group 6</b>	S26	Active	High Reciprocity	Low Sociability	Deep Discussion
	S27	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S28	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S29	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S30	Active	Low Reciprocity	High Sociability	Surface Discussion

Task 7: Student-Student Interaction					
	Participant	Participation	Interaction	Social	Cognitive
<b>Group 1</b>	S1	Passive	High Reciprocity	High Sociability	Surface Discussion
	S2	Active	High Reciprocity	High Sociability	Deep Discussion
	S3	Passive	High Reciprocity	High Sociability	Surface Discussion
	S4	Active	High Reciprocity	High Sociability	Deep Discussion
	S5	Active	High Reciprocity	High Sociability	Deep Discussion
<b>Group 2</b>	S6	Active	High Reciprocity	High Sociability	Deep Discussion
	S7	Active	High Reciprocity	High Sociability	Deep Discussion
	S8	Active	High Reciprocity	High Sociability	Deep Discussion
	S9	Active	High Reciprocity	High Sociability	Surface Discussion
	S10	Active	High Reciprocity	Low Sociability	Deep Discussion
<b>Group 3</b>	S11	Active	High Reciprocity	Low Sociability	Deep Discussion
	S12	Active	High Reciprocity	Low Sociability	Deep Discussion
	S13	Active	High Reciprocity	High Sociability	Surface Discussion
	S14	Passive	Low Reciprocity	Low Sociability	Surface Discussion
	S15	Active	Low Reciprocity	High Sociability	Deep Discussion
<b>Group 4</b>	S16	Active	High Reciprocity	High Sociability	Deep Discussion
	S17	Passive	High Reciprocity	High Sociability	Surface Discussion
	S18	Active	High Reciprocity	High Sociability	Surface Discussion
	S19	Active	Low Reciprocity	Low Sociability	Deep Discussion
	S20	Active	High Reciprocity	High Sociability	Surface Discussion
<b>Group 5</b>	S21	Active	High Reciprocity	High Sociability	Deep Discussion
	S22	Active	High Reciprocity	High Sociability	Surface Discussion
	S23	Active	High Reciprocity	High Sociability	Deep Discussion
	S24	Active	High Reciprocity	High Sociability	Deep Discussion
	S25	Passive	Low Reciprocity	High Sociability	Deep Discussion
<b>Group 6</b>	S26	Active	High Reciprocity	High Sociability	Deep Discussion
	S27	Passive	High Reciprocity	High Sociability	Deep Discussion
	S28	Active	High Reciprocity	Low Sociability	Deep Discussion
	S29	Passive	Low Reciprocity	Low Sociability	Deep Discussion
	S30	Passive	Low Reciprocity	High Sociability	Surface Discussion

Online Observation Notes

**Task 2: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	All members actively engaged, initiating and responding often.	S5 gave short replies and didn't continue conversations.	High use of humour and encouragement.	Some discussions focused more on logistics than content.
Group 2	Consistently contributed, balanced interactions.	Strong multi-turn conversations, co-construction of ideas.	Strong group bonding and emotional support.	Deeper analytical discussions.
Group 3	S15 had minimal engagement, only responded when tagged.	Isolated posts, lacked collaboration.	Limited support, mostly task-oriented.	Deep inquiry and collaborative problem-solving.
Group 4	Strong interaction and real-time discussion.	Acknowledged and built on peer responses.	Mostly warm, some neutral participants.	Reflective discussions.
Group 5	S25 responded late with few original contributions.	S25 posted alone, didn't follow up.	Some awareness, but S25 not engaged.	Discussions linked to real-world use.
Group 6	S30 rarely joined in, didn't initiate discussions.	Minimal responses to peers.	Mostly transactional, task-focused.	Stayed surface-level.

**Task 3: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	Only S1 actively initiated discussions, others responded sporadically.	Standalone comments, minimal interaction.	Limited humor and encouragement.	Mainly logistical, not analytical.
Group 2	Frequent engagement by S6–S8; S9–S10 more responsive.	Strong back-and-forth and acknowledgment.	Strong bonding, use of emoticons and humor.	Deep discussions, source citation.
Group 3	No active engagement; responses only when prompted.	No discussion threads; isolated responses.	Task-oriented, minimal connection.	Few clarifications, no deep engagement.
Group 4	Mostly passive; S16 occasionally started discussions.	Some acknowledgment, limited depth.	Some warm interactions, inconsistent.	Some reflections, not consistently analytical.
Group 5	S21 and S23 contributed; others minimal.	Some idea-sharing, lacked follow-up.	Limited connection, mostly academic.	Strong real-world application.
Group 6	S26 contributed occasionally; others as needed.	Independent comments, no interaction.	Transactional, no personal engagement.	Surface-level engagement.

**Task 4: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	S1, S4, S8, S11–S13 actively initiated; others responded.	Some back-and-forth, five posted standalone comments.	Humor and support shown; some task-focused.	S4, S5, S10–S11 deep analysis; others surface clarifications.
Group 2	Balanced engagement by all; S16–S18 initiated, others responded.	Strong acknowledgment, multi-turn discussions.	High social engagement, emoticons, encouragement.	Balanced discourse with reflective real-world connections.

**Task 5: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	All (S1–S5) actively engaged.	Strong reciprocal exchanges, idea building.	Strong bonding, humor and support.	Deep discussions, one surface-level exchange.
Group 2	All (S6–S10) contributed frequently.	High acknowledgment, interactive dialogue.	Camaraderie and encouragement.	In-depth analysis from all.
Group 3	S11–S14 active; S15 minimal.	S11–S13 reciprocal, others limited.	S11, S12 social; others task-focused.	S11–S14 reflective, S15 surface-level.
Group 4	All (S16–S20) highly active.	All acknowledged and extended discussions.	Strong social engagement.	S16–S19 analytical depth.
Group 5	All (S21–S25) consistently active.	Strong reciprocal interactions.	Emotional connection throughout.	Deep conceptual analysis by all.
Group 6	S26–S29 active; S30 less so.	All meaningful with idea building.	Engaging and humorous.	All contributed conceptually.

**Task 6: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	Only S4 active, rest passive.	Only S1 and S4 had reciprocal exchanges.	Some emoticons and support by S1, S2, S4.	Some critical discussion, others surface-level.
Group 2	S6–S8 active, S9–S10 less involved.	Strong interactions, idea building.	Moderate humor and encouragement.	Deep analysis and problem-solving.
Group 3	Only S11 active; others sporadic.	Minimal reciprocity; mostly S11.	Minimal; S12, S13 showed warmth.	Reflective discussions by S11–S14.
Group 4	S16–S17 engaged, others passive.	Average; some expansion of ideas.	Supportive communication by S16–S19.	S16–S18 analytical.
Group 5	S21, S22, S24 active; others minimal.	Strong collaborative exchanges.	Warmth and encouragement shown.	Some analysis; some surface-level.
Group 6	S26, S27 active; rest inactive.	Only S26, S28 reciprocal.	Interpersonal engagement by S26, S28.	S26, S28, S29 analytical; S27 surface-level.

**Task 7: Group Observation Notes**

<b>Group</b>	<b>Participation Level</b>	<b>Reciprocity Level</b>	<b>Social Engagement</b>	<b>Cognitive Depth</b>
Group 1	S1–S3 active, two less involved.	All engaged in multi-turn discussions.	Strong warmth and support.	Some analysis; two surface-level.
Group 2	All members active.	Excellent back-and-forth.	Strong bonding by S6–S9; one less expressive.	Four members deeply engaged.
Group 3	S11–S14 active; S14 passive.	S11–S13 engaged; others minimal.	S11, S12 supportive; others task-focused.	High-level contributions from four members.
Group 4	Most active; S17 less so.	S16–S19 built on peer ideas.	Community bonding shown.	Three participants analytical, two surface-level.
Group 5	All consistently contributed.	Fully collaborative discussions.	Excellent bonding across all.	All showed in-depth discussion.
Group 6	S26, S28, S30 active; two passive.	Most interactive; S29 isolated.	S26, S28, S30 warm; others transactional.	Three engaged critically; S27, S30 surface-level.

## APPENDIX G

### Ethical Approval Letters

#### Educational Research Application System (eRAS 2.0) Approval



KEMENTERIAN PENDIDIKAN MALAYSIA  
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN  
ARAS 1-4, BLOK E8  
KOMPLEKS KERAJAAN PARCEL E  
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN  
62604 PUTRAJAYA

TEL : 0388846591  
FAKS : 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(18676)  
Tarikh : 20 Disember 2023

**AWANG NAJIB BIN AWANG MOHAMAD**  
NO. KP : 880810525457

LOT 2439, LORONG 2, FASA 1, KAMPUNG TANJUNG BUNDONG  
94300 KOTA SAMARAHAN  
SARAWAK

Tuan,

**KELULUSAN BERSYARAT UNTUK MENJALANKAN KAJIAN :  
A DESIGN-BASED RESEARCH: ACTIVITY THEORY AS ANALYTICAL FRAMEWORK TO EXAMINE ONLINE  
COLLABORATIVE LEARNING AMONG SARAWAK MATRICULATION STUDENTS**

Perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan dengan syarat :

**" KELULUSAN INI BERGANTUNG KEPADA KEBENARAN PENGARAH BAHAGIAN MATRIKULASI DAN  
PERTIMBANGAN PENTADBIR KOLEJ MATRIKULASI. PENGLIBATAN, PEMERHATIAN SERTA RAKAMAN VIDEO  
TERHADAP AKTIVITI PENGAJARAN DAN PEMBELAJARAN MURID DI DALAM BILIK DARJAH TIDAK DIBENARKAN.  
NAMA RESPONDEN DALAM PROTOKOL TEMU BUAL TIDAK PERLU DIMASUKKAN KERANA DATA TERSEBUT  
ADALAH SULIT. "**

3. Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **3 Januari 2024** hingga **19 April 2024**

5. Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini. Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

**"BERKHIDMAT UNTUK NEGARA"**

Saya yang menjalankan amanah,

Ketua Penolong Pengarah Kanan  
Sektor Penyelidikan dan Penilaian Dasar  
b.p. Pengarah  
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan  
Kementerian Pendidikan Malaysia

salinan kepada:-

BAHAGIAN MATRIKULASI  
JABATAN PENDIDIKAN SARAWAK

\* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN \*

UNIMAS HREC Approval

Deputy Vice Chancellor's Office  
(Research and Innovation)  
Human Research Ethics Committee  
(Non-Medical)  
Tel: 082 581222/1223  
Fax: 082 665115

**UNIVERSITI MALAYSIA  
SARAWAK**  
94300 Kota Samarahan

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**MEMORANDUM**

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**Reference** : UNIMAS/TNC(PI)/09 – 65/02 ( 80 )

**To** : Awang Najib bin Awang Mohamad  
Faculty of Cognitive Sciences & Human Development

**From** : Chair  
Human Research Ethics Committee (Non-Medical)

**Date** : 12 January 2024

**Subject** : **Research Ethics Approval for Non-Medical Research on Humans**

With reference to the above, I would like to inform you that your application for research ethics clearance was discussed in the 9<sup>th</sup> Human Research Ethics Committee (Non-medical) meeting 5/2023 on 12<sup>th</sup> December 2023. Your application for research ethics has been approved.

Title of project	:	A Design-Based Research: Activity Theory as Analytical Framework to Examine Online Collaborative Learning Among Sarawak Matriculation Students
No. Ethics Approval	:	HREC(NM)/2023 (1)/61
Principal Investigator	:	Awang Najib bin Awang Mohamad (Universiti Malaysia Sarawak)
Co-researcher(s)	:	Associate Professor Dr Zaimuariffudin Shukri bin Nordin (Universiti Malaysia Sarawak)  Mohd Hafizan bin Hashim (Universiti Malaysia Sarawak)

Yours sincerely,



Professor Dr Ting Su Hie

c.c: Deputy Vice Chancellor (Research & Innovation)  
Director, UNIMAS Publisher  
Deputy Dean (Research & Commercialisation), FCSHD

BMKPM Approval



**KEMENTERIAN PENDIDIKAN MALAYSIA  
MINISTRY OF EDUCATION MALAYSIA**

Bahagian Matrikulasi  
Matriculation Division  
Aras 6 & 7, Blok E15, Kompleks E  
Pusat Pentadbiran Kerajaan Persekutuan  
62604 PUTRAJAYA  
MALAYSIA

Tel. : 603-8884 4083  
Faks. : 603-8884 4028  
Laman sesawang: www.moe.gov.my

Ruj. Kami: KPM.600-2/1/4 JLD 14( 66)  
Tarikh: 5 Mei 2025

**Awang Najib bin Awang Mohamad**

**Melalui dan Salinan:**

Dekan  
Fakulti Sains Kognitif dan Pembangunan Sumber Manusia  
Universiti Malaysia Sarawak

Tuan,

**PERMOHONAN MENJALANKAN KAJIAN DI KOLEJ MATRIKULASI  
KEMENTERIAN PENDIDIKAN MALAYSIA**

Dengan hormatnya perkara di atas adalah dirujuk serta surat tuan bertarikh 14 April 2025 adalah berkaitan.

2. Sukacita dimaklumkan bahawa permohonan tuan sebagai pelajar Peringkat Doktor Falsafah dari Fakulti Sains Kognitif dan Pembangunan Sumber Manusia, Universiti Malaysia Sarawak untuk menjalankan penyelidikan bertajuk '**Activity Theory Investigation of Discord-Mediated Online Collaborative Learning Among Malaysian Matriculation Students: A Design-Based Research**' adalah diluluskan secara bersyarat seperti Lampiran.

3. Sehubungan dengan itu, jasa baik tuan dimohon untuk mematuhi syarat dan tempoh kelulusan menjalankan kajian selaras ketetapan Bahagian Perancangan dan Penyelidikan Dasar Pendidikan KPM, iaitu **mulai 14 April 2025 sehingga 30 Oktober 2025**. Tuan boleh menghubungi Pn. Nor Idayu Binti Azmi di talian 03-8884 4267 atau e-mel noridayu.azmi@moe.gov.my bagi pertanyaan berkaitan.

Kerjasama dan perhatian tuan berhubung perkara ini amat dihargai.

Sekian, terima kasih.

**"MALAYSIA MADANI"  
"BERKHIDMAT UNTUK NEGARA"**

Saya yang menjalankan amanah,

**(MOHD KASSIM BIN JAAFAR)**  
Pengarah

Idayu/PermohonanKajian

...2/

(sila nyatakan No. Rujukan Bahagian ini apabila berhubung)



KMSw Approval

Awang Najib Bin Awang Mohamad,  
Lot 2439, Lorong 2, Fasa 1  
Kampung Tanjung Bundong,  
94300 Kota Samarahan,  
Sarawak.

---

Pengarah Kolej Matrikulasi Sarawak,  
Lot 216, Fasa II, Lorong Demak Indah 5A1  
Taman Perindustrian Sejingkat,  
93050 Kuching,  
Sarawak.

26 DISEMBER 2023.

Tuan,

**MEMOHON KEBENARAN UNTUK MENJALANKAN KAJIAN DI KOLEJ MATRIKULASI SARAWAK.**

Dengan segala hormatnya perkara di atas dirujuk.

2. Berhubung perkara di atas, saya memohon untuk menjalankan penyelidikan di Kolej Matrikulasi Sarawak yang bertajuk "*A Design-Based Research: Activity Theory as Analytical Framework to Examine Online Collaborative Learning Among Sarawak Matriculation College*". Kajian saya ini adalah dalam rangka melengkapkan penyelidikan di peringkat Doktor Falsafah, Fakulti Sains Kognitif dan Pengurusan Sumber Manusia, Universiti Malaysia Sarawak (UNIMAS).

3. Bersama-sama ini saya sertakan surat kelulusan bersyarat dari Bahagian Perancangan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia untuk perhatian tuan. Untuk makluman, kaedah pengumpulan data bagi kajian saya hanya melibatkan a)pemerhatian atas talian, b)temu bual kumpulan fokus, dan c)jurnal reflektif.

4. Semua proses pengumpulan data kajian ini adalah berdasarkan tugas atas talian di luar PdP rasmi yang melibatkan para pelajar yang telah bersetuju dengan kebenaran bertulis untuk menyertai kajian ini secara sukarela. Bagi tujuan pelaporan, nama-nama pelajar yang terlibat tidak dimasukkan dan digantikan dengan label tanpa nama.

5. Saya telah memastikan semua syarat-syarat menjalankan kajian daripada Bahagian Perancangan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia telah dipenuhi dengan baik. Kerjasama dan kebenaran untuk menjalankan penyelidikan di Kolej Matrikulasi Sarawak daripada pihak tuan saya dahului dengan ucapan penghargaan dan ribuan terima kasih.

Sekian.  
Yang benar,

.....  
(AWANG NAJIB BIN AWANG MOHAMAD)

No. KP: 880810-52-5457

No. Matrik: 20010073

HP: 010-4091988;

E-mel: 20010073@siswa.unimas.my

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**APPENDIX H**  
Participant Consent Form

**RESEARCH INFORMATION SHEET**

*Title of Study:*

**An Activity Theory Investigation of Discord-Mediated Online Collaborative Learning Among Malaysian Matriculation Students: A Design-Based Research**

*Dear Participant,*

My name is Awang Najib bin Awang Mohamad (Matric No.: 20010073), a doctoral student at the Faculty of Cognitive Sciences and Human Development (FCSHD), Universiti Malaysia Sarawak (UNIMAS). You are invited to take part in a research project titled “An Activity Theory Investigation of Discord-Mediated Online Collaborative Learning Among Malaysian Matriculation Students: A Design-Based Research.” This study seeks to explore students’ experiences with online collaborative learning (OCL) facilitated through technology tools such as Discord.

*Purpose of the Study:* The aim of this research is to better understand how students engage in online collaborative learning. It is hoped that this reflection will help students enhance their learning practices and contribute to the development of more effective OCL instructional strategies tailored to student needs.

*What Participation Involves:* This study will involve the collection of data through the following methods:

- Observation of online interactions
- Document analysis of shared learning materials
- Focus group interviews with student participants

All data collected will be used solely for academic purposes, including inclusion in my doctoral thesis under the supervision of Assoc. Prof. Dr. Zaimuarifuddin Shukri Nordin and Mr. Mohd Hafizan bin Hashim.

*Confidentiality and Voluntary Participation:* All information obtained in this study will be treated with the strictest confidentiality. Participants and institutions will be anonymised using code names in all written reports. Only the researchers involved in this study will have access to the raw data. Your participation is entirely voluntary. Choosing not to participate or withdrawing from the study at any point will not affect your academic standing or grades in any way.

*Contact Information:* If you have any questions or need further clarification, please contact me at 010-4091988 or email [20010073@siswa.unimas.my](mailto:20010073@siswa.unimas.my).

Thank you for your time and consideration.

Sincerely,



Awang Najib bin Awang Mohamad  
PhD Student, FCSHD, UNIMAS.

## **PARTICIPANT CONSENT FORM**

I have received and read a copy of the consent letter for the research entitled:

**Activity Theory Investigation of Discord-Mediated Online Collaborative Learning  
Among Malaysian Matriculation Students: A Design-Based Research.**

I confirm that I have received and read the **Research Information Sheet** outlining the purpose and procedures of the above research study. I understand that:

- My participation is voluntary.
- I may withdraw from the study at any time without penalty or consequence.
- All data collected will remain confidential and used solely for academic research purposes.
- My identity will not be disclosed in any publications or presentations arising from this research.

Please tick (✓) one of the following:

I AGREE to participate in the study described in the letter.

I DO NOT AGREE to participate in the study described in the letter.

Name of Participant : \_\_\_\_\_

Signature : \_\_\_\_\_

Date : \_\_\_\_\_

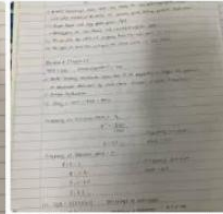
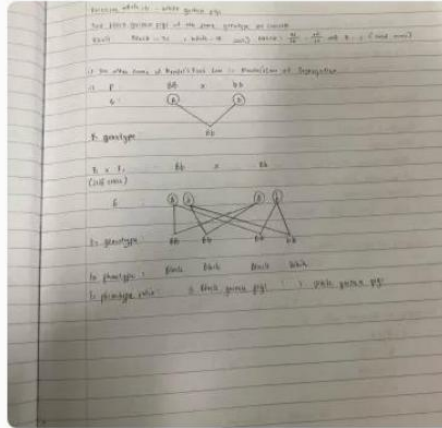
# APPENDIX I

## Samples of Selected Students' Work Output

<p style="text-align: center;"><b>TASK 1</b></p>	<div style="display: flex; justify-content: space-around;"> <div> <h3 style="text-align: center;">CLASSES OF CARBOHYDRATES</h3> <p>An organic molecules that composed of atoms of carbon, hydrogen and oxygen in 1 : 1 : 2 ratio.</p> <p>Carbohydrates have three basic types of molecule and here are the three main types.</p> <p><b>MONOSACCHARIDES</b></p> <p>Monosaccharides are known as simple sugar and the monomers of all disaccharides and polysaccharides, it cannot be broken down further into smaller unit of carbohydrate. Some examples are glucose, fructose and galactose (So et al., 2011)</p> <p><b>DISACCHARIDES</b></p> <p>Disaccharides is formed by joining two monosaccharides units through a condensation reaction. Three examples of disaccharides, maltose, sucrose and lactose.</p> <p><b>POLYSACCHARIDES</b></p> <p>Polysaccharides are long chain of monosaccharides that are bonded together by glycosidic bonds that are formed through condensation.</p> <p><small>Reference So, S., Tang, N. G., Dwyer, G., Macfarlane, D. L., &amp; Wu, W. (2011). <i>Microbiology: a practical approach</i> (6th edn). Oxford: Oxford University Press. Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003. Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003. Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003.</small></p> </div> <div> <h3 style="text-align: center;">WHY WATER &amp; OIL DO NOT MIX TOGETHER?</h3> <p>THIS IS BECAUSE OF THEIR DIFFERENT POLARITIES. WATER IS A POLAR MOLECULE. OIL IS A NON-POLAR MOLECULE. CAUSING THEM UNABLE TO BOND OR FORM ATTRACTION TOWARDS EACH OTHER.</p> <p><b>WHAT'S POLARITY...?</b></p> <p>Polarity results from the uneven partial charge distribution between various atoms in a compound.</p> <ul style="list-style-type: none"> <li>Electronegativity difference</li> <li>Uneven electron distribution</li> <li>Partial positive charge</li> <li>Partial negative charge</li> </ul> <p><b>ISN'T WATER A UNIVERSAL SOLVENT? YES! WATER</b></p> <ul style="list-style-type: none"> <li>ABLE TO DISSOLVE MORE COMPOUND THAN ANY OTHER LIQUID</li> <li>A POLAR MOLECULE</li> <li>HAS A SLIGHTLY POSITIVE CHARGED OXYGEN &amp; SLIGHTLY NEGATIVELY CHARGED HYDROGEN</li> </ul> <p><b>BUT WHY CAN'T WATER BIND WITH OIL? BECAUSE OIL IS A NON-POLAR SUBSTANCE</b></p> <p>CHEMICALLY, OILS ARE MADE OF <b>TRIGLYCERIDES</b></p> <p><b>LONG HYDROCARBON CHAINS</b> (NON-POLAR)</p> <p>MOSTLY INCLUDING HYDROGEN, CARBON AND OXYGEN-CONTAINING BONDS.</p> <p>NON-POLAR MOLECULES ARE UNABLE TO FORM HYDROGEN BOND WITH WATER.</p> <p>THESE OIL BELL FORM ON TOP OF WATER BECAUSE OIL ON TOP OF WATER WHICH BOND WITH WATER.</p> <p><small>Reference Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003. Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003. Principles and Practice of Microbiology, 2nd edn. J. G. Murray, P. Tenenbaum, J. Tenenbaum, &amp; R. Tenenbaum. Philadelphia: Elsevier, 2003.</small></p> </div> </div>									
<p style="text-align: center;"><b>TASK 2</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">MAIN IDEAS /KEY POINT</th> <th style="width: 50%;">EXPLANATION</th> <th style="width: 30%;">NOTES</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <p>(a) Show the stages in cell cycle.</p> </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>Cell cycle is an ordered sequence of events in the life of a cell, from its origin in the division of a parent cell until its own division into two.</li> </ul> <div style="text-align: center;"> <p style="text-align: center;">Cell Cycle</p> </div> </td> <td style="vertical-align: top;"></td> </tr> <tr> <td style="vertical-align: top;"> <p>(b) Explain the stages in cell cycle</p> </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>Stages in cell cycle consist of interphase, the growth period and mitotic (M) phase, the cell division.</li> <li><b>Interphase</b> is the longest phase in the cycle which is cell grow &amp; prepare for cell division. Interphase divided into G<sub>1</sub> phase (first gap), S phase (synthesis) and G<sub>2</sub> phase (second gap).</li> <li><b>Mitotic (M) phase</b> is the shortest part of the cycle that is divided into mitosis and cytokinesis.                             <ul style="list-style-type: none"> <li>Mitosis or karyokinesis is the division of nucleus. It consists of prophase, metaphase, anaphase and telophase. At the end of mitosis, 2 daughter nuclei are formed.</li> <li>Cytokinesis is the division of cytoplasm. At the end of cytokinesis, 2 daughter cells are formed. It usually started at telophase.</li> </ul> </li> </ul> </td> <td style="vertical-align: top;"></td> </tr> </tbody> </table>	MAIN IDEAS /KEY POINT	EXPLANATION	NOTES	<p>(a) Show the stages in cell cycle.</p>	<ul style="list-style-type: none"> <li>Cell cycle is an ordered sequence of events in the life of a cell, from its origin in the division of a parent cell until its own division into two.</li> </ul> <div style="text-align: center;"> <p style="text-align: center;">Cell Cycle</p> </div>		<p>(b) Explain the stages in cell cycle</p>	<ul style="list-style-type: none"> <li>Stages in cell cycle consist of interphase, the growth period and mitotic (M) phase, the cell division.</li> <li><b>Interphase</b> is the longest phase in the cycle which is cell grow &amp; prepare for cell division. Interphase divided into G<sub>1</sub> phase (first gap), S phase (synthesis) and G<sub>2</sub> phase (second gap).</li> <li><b>Mitotic (M) phase</b> is the shortest part of the cycle that is divided into mitosis and cytokinesis.                             <ul style="list-style-type: none"> <li>Mitosis or karyokinesis is the division of nucleus. It consists of prophase, metaphase, anaphase and telophase. At the end of mitosis, 2 daughter nuclei are formed.</li> <li>Cytokinesis is the division of cytoplasm. At the end of cytokinesis, 2 daughter cells are formed. It usually started at telophase.</li> </ul> </li> </ul>	
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B

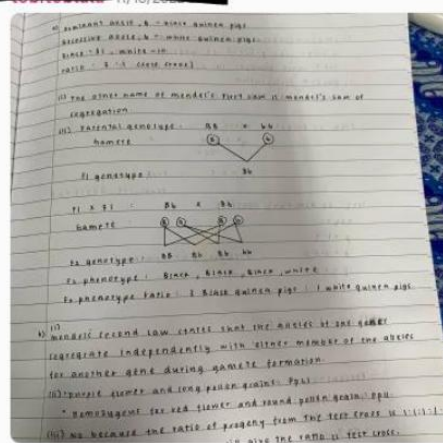
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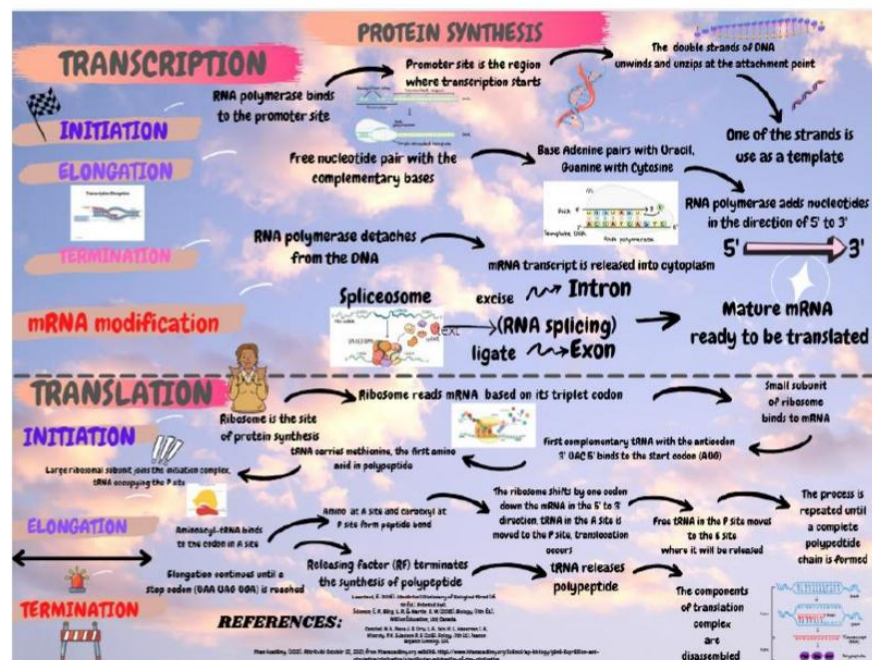
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TASK 3

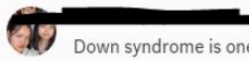
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TASK 4



TASK 5

 Down syndrome is one example of aneuploidy condition where one or more chromosomes are missing/gained in a normal set of chromosomes.

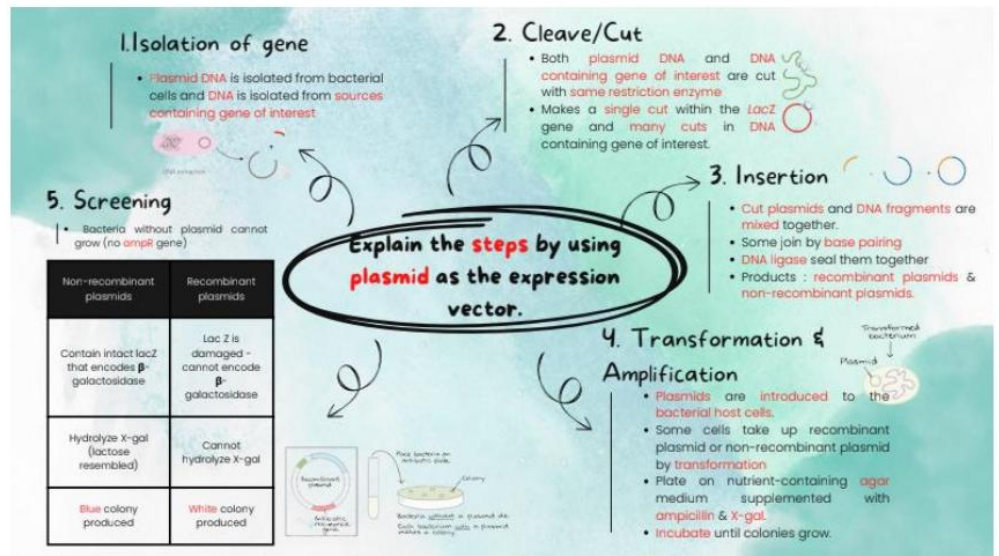
Specifically, Down Syndrome is an aneuploidy condition which occurs in autosomes. An extra chromosome is gained in Chromosome 21. It occurs due to non-disjunction process; either homologous chromosomes failed to separate during Anaphase I, or sister chromatids failed to separate during Anaphase II.

If the non-disjunction occurs during Anaphase I, all gametes produced are abnormal gametes, either gametes with (n+1) or (n-1) in chromosome 21.

If the non-disjunction occurs during Anaphase II, 50% gametes are normal, while 25% gametes are (n+1), and another 25% gametes are (n-1) in chromosome 21.

Examples of characteristics Down Syndrome individuals are growth failure, mental retardation, slanting eyes, heart abnormalities, short stature and reduced resistance to diseases.

**TASK 6**



**TASK 7**



[Redacted text]

There are three hormones which involve in spermatogenesis; Gonadotropin-releasing hormone (GnRH), Follicle-Stimulating hormone (FSH), and Leutinizing hormone (LH). In brain, GnRH from hypothalamus stimulates the anterior pituitary gland to secrete two hormones, FSH and LH. FSH acts on Sertoli cells, which nourish developing sperm within seminiferous tubule. Sertoli cells also secrete inhibin. When the secretion of inhibin increases, it will reduce FSH secretion by negative feedback to anterior pituitary. LH acts on Leydig cells located in the interstitial space between seminiferous tubule, which produces testosterone. Testosterone stimulates the maturation of secondary spermatocytes through meiosis, and differentiation to spermatozoa. Testosterone also maintains the male secondary sex characteristics. Negative feedback mechanism by testosterone on the hypothalamus will reduce the secretion of GnRH. Testosterone also inhibit secretion of FSH and LH by anterior pituitary gland. (ed7ad)

## APPENDIX J

### Samples of Thematic Analysis Matrix (TAM)

*Thematic Analysis Matrix (TAM)*

RQ	Theoretical Framework	Online Observation	Triangulation of Data		Sub-Theme	Final Theme
			Lecturer's Reflective Journal	Focus Group Interview		
Sub-RQ1a: How do features and functionalities of Discord serve as tools in facilitating OCL?	Activity Theory (Tools-related)		<p>The lecturer has observed that Discord's straightforward and intuitive interface significantly encourages student participation in an online learning setting</p>	<p><b>Code: Easy to Use</b>                      -"I think it is easy to use Discord. Plus, there are lots of bots we can install in our server and use them. Most likely I use Discord server during online classes, and to chat." (S5; Focus Group 1)                      -"I think Discord is easy to use as students can easily access study materials posted by lecturer." (S14; Focus Group 3)</p> <p><b>Code: User-friendly Interface</b>                      -"Discord has user-friendly interface. It is easy to learn how to use it. And it is easy to send file, just two taps and file sent." (S1; Focus Group 1)                      -"Plus, Discord interface is more user-friendly, with its ability to keep direct messages (DM) separate, making it easier for us to organize our chats, and not crowded by the group chats like in WhatsApp." (S22; Focus Group 5)</p> <p><b>Code: Convenient Application</b>                      -"As a new user, it is quite convenient as all learning materials are systematically arranged, thus saving time to find the things I need. I'm impressed to use Discord first time." (S2; Focus Group 1)                      -"For me, I would prefer to use Discord for my online collaborative activity as I think it feels more of formal platform. Also, I can easily get materials that I want by just opening the related channels. So, it is quite convenient for me." (S26; Focus Group 6)</p>	<p><b>Ease of Navigation</b></p>	<p><b>Theme 1: Discord Interface Design for OCL</b></p>
				<p><b>Code: Easy to Learn</b>                      -"Discord has user-friendly interface. It is easy to learn how to use it. And it is easy to send file, just two taps and file sent." (S1; Focus Group 1)</p> <p><b>Code: Comfortable to Use</b>                      -"As a new Discord user, I think Discord helps me to assort my learning materials. I am more comfortable to communicate with lecturers via Discord." (S23; Focus Group 5)</p> <p><b>Code: Good Experience</b>                      -"Overall, Discord gives me quite a good experience. I totally understand that an application needs a lot of improvements in order to be flawless. Obviously, the positive side of Discord is more than its downsides. As a result, I will still prefer to use Discord as my learning tool for collaborative learning compared to the other applications." (S21; Focus Group 5)</p>	<p><b>Simplicity of Design</b></p>	
				<p><b>Code: Flexible Application</b>                      -"Undeniably, we need to be flexible while discussing an academic and scientific topic. The flexibility in</p>	<p><b>Customization Options</b></p>	

*Thematic Analysis Matrix (TAM)*

RQ	Theoretical Framework	Online Observation	Triangulation of Data Lecturer's Reflective Journal	Focus Group Interview	Emerging Theme	Final Theme
Sub-RQ2a: How does synchronous communication rule positively influence OCL?	Activity Theory (Rules-related)	<p><b>Group</b></p> <p><b>Group 1</b> All members actively engaged, frequently initiating discussions and responding promptly.</p> <p><b>Group 2</b> Consistently contributed throughout, with balanced interactions.</p> <p><b>Group 3</b> One participant (S15) had minimal engagement, responding only when tagged.</p> <p><b>Group 4</b> Showed strong interaction and real-time discussion contributions.</p> <p><b>Group 5</b> S25 had delayed responses and minimal original contributions.</p> <p><b>Group 6</b> S30 participated infrequently and did not initiate discussions.</p> <p><b>Group</b></p> <p><b>Group 1</b> S5 provided minimal responses without extending discussions.</p> <p><b>Group 2</b> Strong multi-turn conversations, evidence of co-construction of ideas.</p> <p><b>Group 3</b> Most interactions were isolated posts rather than collaborative exchanges.</p> <p><b>Group 4</b> Active acknowledgment and elaboration on peer responses.</p> <p><b>Group 5</b> S25 posted standalone comments without engaging in follow-up discussions.</p> <p><b>Group 6</b> Some participants responded minimally to others' ideas.</p>	<p>-The real-time interaction between students catalysed more dynamic and engaging discussions.</p> <p>-The immediate nature of task completion in a synchronous environment ensured that students could stay on track with their coursework.</p>	<p><b>Code: Direct Interaction</b></p> <p>-“This is because they are actively participating in the conversation and can see the reactions from others which make us more connected in the group.” (S15; Focus Group 3)</p> <p>-“I think the best aspect of synchronous task is that I can ensure every group members are online within that period of time so that we can have an efficient and active interaction.” (S26; Focus Group 6)</p> <p><b>Code: Stay Focused</b></p> <p>-“Also, synchronous task takes less of our time. We only have to focus on one thing in that period of time. Hence, our work will not be getting mixed with unrelated topics.” (S21; Focus Group 5)</p> <p><b>Code: High Participation</b></p> <p>-“When people participate in synchronous tasks, they are more likely to feel a sense of engagement and involvement.” (S15; Focus Group 3)</p> <p>-“Through a synchronous task, I can participate on the discussion on time and will not be left behind by the ongoing discussion.” (S16; Focus Group 4)</p> <p><b>Code: Active Participation</b></p> <p>-“This is because they are actively participating in the conversation and can see the reactions from others which make us more connected in the group.” (S15; Focus Group 3)</p> <p>-“I prefer synchronous because I want all group members to participate in the discussion without missing any details.” (S17; Focus Group 4)</p> <p><b>Code: Keeping Pace</b></p> <p>-“Through a synchronous task, I can participate on the discussion on time and will not be left behind by the ongoing discussion.” (S16; Focus Group 4)</p> <p><b>Code: High Engagement</b></p> <p>-“And through synchronous activity, I can be more engaging and involve in the activity as I can have instant feedback from others.” (S16; Focus Group 4)</p> <p>-“Synchronous discussion can increase group members engagement while doing the</p>	Active Engagement	Theme 1: Effective Communication in Synchronous OCL
					Active Participation	

*Thematic Analysis Matrix (TAM)*

<p><b>Group</b>      <b>Observation Notes (Social Engagement)</b></p> <p><b>Group 1</b>      High use of humour and encouragement.</p> <p><b>Group 2</b>      Showed strong group bonding and emotional connection.</p> <p><b>Group 3</b>      Limited expressions of support, more task-oriented discourse.</p> <p><b>Group 4</b>      Mostly warm interactions but some participants remained neutral.</p> <p><b>Group 5</b>      Good use of personal awareness, but S25 lacked engagement</p> <p><b>Group 6</b>      Discussions were mostly transactional and task-focused.</p>	<p>collaborative group task." (S28; Focus Group 6)</p> <p><b>Code: Fun Learning</b>          -"The discussion will be more active and fun. If there is a question, there will always be suggested answers." (S2; Focus Group 1)          -"We can call each other; it is okay not to open the camera. That is why synchronous is fun." (S3; Focus Group 1)          -"Synchronous for me. It is much more fun to be able to communicate with others at the same time." (S1; Focus Group 1)</p> <p><b>Code: Direct Decision Making</b>          -"If we want to make a decision, we can directly ask everyone to vote for it on the spot." (S24; Focus Group 5)          -"Through synchronous tasks, it can help to facilitate faster decision-making and more efficient online collaboration." (S27; Focus Group 6)</p> <p><b>Code: Fast Information Exchange</b>          -"By this way, we can get faster information exchange." (S18; Focus Group 4)          -"Synchronous work may affect the team members to feel pressure to bounce off their ideas or feedback in a short time." (S28; Focus Group 6)</p> <p><b>Code: Time Saving</b>          -"I really prefer synchronous activity as we could exchange our point of view directly at that time thus the discussion will be more effective and could be done in short period of time." (S22; Focus Group 5)          -"Also, synchronous task takes less of our time. We only have to focus on one thing in that period of time. Hence, our work will not be getting mixed with unrelated topics." (S21; Focus Group 5)</p> <p><b>Code: Avoid Procrastination</b>          -"We also can finish our work within that time without the need to postpone it." (S13; Focus Group 3)          -"Honestly, I prefer synchronous task since we can discuss with our group members together at a particular time to avoid procrastination." (S25; Focus Group 5)</p>	<p><b>Code: Active Discussion</b></p>	<p><b>Efficient Decision-making</b></p>
<p><b>Group</b>      <b>Observation Notes (Cognitive Depth)</b></p> <p><b>Group 1</b>      Some discussions focused on logistics rather than content analysis.</p> <p><b>Group 2</b>      Engaged in deeper analytical discussions.</p> <p><b>Group 3</b>      Showed deep inquiry and collaborative problem-solving.</p> <p><b>Group 4</b>      Engaged in reflective discourse.</p> <p><b>Group 5</b>      Strong discussions with real-world application of concepts.</p> <p><b>Group 6</b>      Some participants remained surface-level in contributions.</p>			

*Thematic Analysis Matrix (TAM)*

RQ	Theoretical Framework	Online Observation	Triangulation of Data	Focus Group Interview	Emerging Theme	Final Theme
<p>Sub-RQ2c: How does asynchronous communication rule positively influence OCL?</p>	<p>Activity Theory (Rules-related)</p>	<p><b>Group</b>  <b>Group 1</b> Only S1 actively initiated discussions, while others responded sporadically.  <b>Group 2</b> Frequent engagement; S6, S7, and S8 initiated discussions, S9 and S10 responded more than initiated.  <b>Group 3</b> No active engagement, all participants responded only when prompted.  <b>Group 4</b> Mostly passive engagement; S16 occasionally started discussions.  <b>Group 5</b> S21 and S23 contributed consistently, but S22, S24, and S25 engaged minimally.  <b>Group 6</b> S26 participated occasionally; the rest contributed only when necessary.</p>	<p><b>Lecturer's Reflective Journal</b>                      -The researcher identified the flexibility in time management as a paramount strength of asynchronous tasks.                      -This flexibility was especially advantageous for those who required additional time for thoughtful engagement with the material.</p>	<p><b>Code: Time Flexibility</b>                      -"We can follow our own schedule. Different individuals will have different ways to arrange their time." (S2; Focus Group 1)                      -"Asynchronous is useful especially for those who like to manage their time properly and take time to do research on the assigned topics." (S8; Focus Group 2)                      -"In my opinion, the best aspect of asynchronous tasks is that you can do that task whenever you want. Maybe that day you feel tired, then maybe you can do it tomorrow." (S11; Focus Group 3)  <b>Code: Long Due Date</b>                      -"If the task is difficult, so I think I would prefer long due date and asynchronous." (S4; Focus Group 1)  <b>Code: Self-paced Learning</b>                      -"The best aspect for asynchronous activity is that I can learn at my own pace. This is because of the convenience of it, for example I can study at my own pace as it takes me sometimes to really understand the problems, discussion, or task materials." (S18; Focus Group 4)                      -"I also prefer asynchronous work because it provides more flexibility to us. Allowing us to discuss at our own speed makes dealing with life and busy study schedules much easier." (S27; Focus Group 6)</p>	<p><b>Time Flexibility</b></p>	<p><b>Theme 1: Enhanced Time Flexibility in Asynchronous OCL</b></p>
		<p><b>Observation Notes (Reciprocity Level)</b>  <b>Group 1</b> Most responses were standalone comments with minimal interaction.  <b>Group 2</b> Active back-and-forth discussions; strong peer acknowledgment.  <b>Group 3</b> Participants posted responses but did not engage in discussion threads.  <b>Group 4</b> Some acknowledgment, but limited in-depth engagement.  <b>Group 5</b> Some idea-sharing but lacked follow-up discussion.  <b>Group 6</b> Mostly independent comments without interactive dialogue.</p>	<p>-The extended time frame afforded by the asynchronous format was more conducive to handling in-depth tasks.                      -This approach supported self-paced learning, enabling students to absorb and understand content at a rate that suited their individual learning styles.</p>	<p><b>Code: Higher Quality Discussion</b>                      -"For asynchronous activity, we can reply and giving our opinions when we have good and mature ideas. Hence, asynchronous discussion gives us more time to think and explore, thus making our sharing becomes more valuable. The discussion might not be as active as synchronous discussion, but the quality is ensured." (S21; Focus Group 5)  <b>Code: Less Pressure</b>                      -"When there is no pressure, ideas can flow in easily." (S4; Focus Group 1)                      -"I prefer asynchronous tasks because we can finish the task according to our time, no need rushing and pressure." (S14; Focus Group 3)                      -"Some of the best aspects of asynchronous task are, it is more flexible and relaxing, and</p>	<p><b>Quality Discussion</b>  <b>Less Pressure</b></p>	<p><b>Theme 2: Quality of Learning in Asynchronous OCL</b></p>

Thematic Analysis Matrix (TAM)

RQ	Theoretical Framework	Triangulation of Data		Emerging Theme	Final Theme	
<p>Sub-RQ3a: How does large group size positively affect the division of labor in OCL?</p>	<p>Activity Theory (Division of Labor-related)</p>	<p><b>Online Observation</b></p> <p><b>Observation Notes (Participation Level)</b></p> <p><b>Group 1</b> S1, S4, S8, S11, S12 and S13 are actively initiated discussions, while others responded sporadically.</p> <p><b>Group 2</b> More balanced engagement, S16, S17, and S18 initiated discussions, while S19 and S20 responded consistently.</p> <p><b>Group</b></p> <p><b>Observation Notes (Reciprocity Level)</b></p> <p><b>Group 1</b> Some learners (S1-S10) engaged in back-and-forth discussions, but five participants only posted standalone comments</p> <p><b>Group 2</b> Strong peer acknowledgment, with many participants engaging in multi-turn conversations. Discussions often built on prior contributions.</p> <p><b>Group</b></p> <p><b>Observation Notes (Social Engagement)</b></p> <p><b>Group 1</b> Many participants showed signs of social bonding through humor and supportive interactions, though some (S12, S13, and S15) remained task-focused</p> <p><b>Group 2</b> Almost all participants demonstrated high social engagement through emoticons, encouragement, and group cohesion.</p> <p><b>Group</b></p> <p><b>Observation Notes (Cognitive Depth)</b></p> <p><b>Group 1</b> S4, S5, S10, and S11 engaged in deeper analytical discussions, while others focused on surface-clarifications</p> <p><b>Group 2</b> More balanced intellectual discussions; about half of participants engaged in deeper, reflective discourse connecting concepts to real-world contexts.</p>	<p><b>Lecturer's Reflective Journal</b></p> <p>-With tasks being distributed among more members, the workload was more manageable</p>	<p><b>Focus Group Interview</b></p> <p><b>Code: Easy work division</b></p> <p>-"Personally, the advantage of working collaboratively for online task is that it makes the work much easier. We can distribute the task evenly, especially a heavy workload task. But, if the task is easy, there will be members who will be passive." (S5; Focus Group 1)</p> <p>-"Easy to divide the work. Like before, we had the video creation task. So, four people create one video. Much easier and we can complete the work faster." (S5; Focus Group 2)</p> <p>-"Best aspect of working collaboratively in large group is we can divide the work much easier. So, the members will not be too stressful and feeling burden while ensuring the quality of work." (S11; Focus Group 3)</p> <p>-"If everyone in a large group does their work, the project can be settled easily." (S15; Focus Group 3)</p> <p><b>Code: Lots of Ideas</b></p> <p>-"A large group size means more brains will think about the tasks, so that means that more ideas could be collected from there. From the different ideas, it can help to stimulate more ideas coming from each individual. Most importantly, we will get to see ideas of others who think about the task from new perspectives." (S16; Focus Group 4)</p> <p>-"I feel that the best aspect for a large group size discussion for OCL via Discord is the fun of communicating and we can get many ideas." (S25; Focus Group 5)</p> <p>-"Overall, I would say that I prefer large group. With a good management, I can make use of more ideas and professions." (S21; Focus Group 5)</p> <p><b>Code: Different Perspectives</b></p> <p>-"If in a large group, I think it is good to share the ideas among each other and we can know and learn from different perspectives." (S13; Focus Group 3)</p> <p>-"In a large group size discussion, we can gather more ideas from every and each of the members. We can have a lot of views from different perspectives." (S24; Focus Group 5)</p>	<p><b>Division of Work</b></p>	<p><b>Theme 1: Effective Division of Labor in Large Group OCL</b></p>
		<p>- One of the primary advantages identified in large groups was the abundance of ideas generated by numerous participants.</p>	<p><b>Idea Generation</b></p>	<p><b>Theme 2: Enhanced Idea Development in Large Group OCL</b></p>		

*Thematic Analysis Matrix (TAM)*

RQ	Theoretical Framework	Online Observation	Triangulation of Data Lecturer's Reflective Journal	Focus Group Interview	Emerging Theme	Final Theme
Sub-RQ4c: How do interactions within student communities positively affect OCL?	Activity Theory (Community-related)	<p><b>Group</b></p> <p><b>Group 1</b></p> <p><b>Group 2</b></p> <p><b>Group 3</b></p> <p><b>Group 4</b></p> <p><b>Group 5</b></p> <p><b>Group 6</b></p>	<p>- The ease and comfort with which students communicated with each other...</p>	<p><b>Code: Easy-going Discussion</b></p> <p>-“Among ourselves, of course can give opinions freely, we can joke around as well, so less pressure.” (S3; Focus Group 1)</p> <p>-“Students can enjoy the discussion without feeling pressure from the teacher.” (S9; Focus Group 2)</p> <p>-“The best aspect is that it is more relaxing when we collaborate with student peers in the task.” (S12; Focus Group 3)</p> <p><b>Code: Less stressful</b></p> <p>-“Among ourselves, of course can give opinions freely, we can joke around as well, so less pressure.” (S3; Focus Group 1)</p> <p>-“Not only that, but it does also not have pressure coming from teacher during the discussion.” (S9; Focus Group 2)</p> <p>-“The best aspect is that it is more relaxing when we collaborate with student peers in the task.” (S12; Focus Group 3)</p> <p><b>Code: Casual Dialogues</b></p> <p>-“I prefer student-student interaction because I can use mixed language for example English and Bahasa Melayu during the discussion.” (S17; Focus Group 4)</p> <p>-“We can use our casual language among friends.” (S19; Focus Group 4)</p> <p><b>Code: Easy Sharing</b></p> <p>-“I can talk about anything during the discussion.” (S6; Focus Group 2)</p> <p>-“If only involve student peers, we can voice out our ideas easily.” (S14; Focus Group 3)</p> <p><b>Code: Informal Interaction</b></p> <p>-“Yes, we can interact with each other informally.” (S3; Focus Group 1)</p> <p>-“I prefer student-student interaction because I can use mixed language for example English and Malay Language during the discussion.” (S17; Focus Group 4)</p> <p>-“No need to worry about getting correct or wrong answers to discuss. And the discussion conversation will not be too formal.” (S23; Focus Group 5)</p> <p><b>Code: Free to Talk</b></p> <p>-“It is free for us to talk, or using some secrets between students that the teacher should not</p>	Communication	Theme 1: Effective Communication in Student-Student OCL Community