

Exploring Student Difficulties in Algebra: Insights from a Four-Item Diagnostic Assessment

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Abstract

This study examines undergraduate students' understanding of four foundational algebraic topics: fundamental algebraic manipulation, systems of linear equations, inequalities, and quadratic functions, using a mid-term diagnostic assessment. Four exam questions, each aligned with a key algebra domain, were analyzed to identify performance patterns and common misconceptions. Error analysis was used to evaluate student responses and interpret the conceptual difficulties underlying incorrect answers. The findings reveal persistent misconceptions consistent with recent literature in algebra education. In fundamental algebra, students frequently miscombine like terms, indicating an incomplete understanding of symbolic structures. For systems of linear equations, many struggled to select and apply elimination or substitution effectively, reflecting difficulties with multi-step reasoning. Inequality errors were dominated by incorrect sign handling when manipulating negative values. In quadratic functions, students demonstrated weak representational fluency, particularly in identifying the vertex, determining intercepts, and sketching parabolas. The study highlights the need for instructional strategies that emphasize conceptual reasoning, multiple representations, and structured error-reflection. Recommendations include integrating formative assessments, strengthening the selection of methods, and enhancing graphical-symbolic connections, particularly for quadratic functions. These findings provide actionable insights for improving algebra proficiency in tertiary mathematics courses.

Keywords: student misconceptions; error analysis; fundamental algebra; systems of linear equations; inequalities; quadratic functions

Introduction

Algebra serves as a foundational component of mathematical proficiency, underpinning students' ability to reason symbolically, analyze quantitative relationships, and solve real-world problems. Core topics, including fundamental algebraic manipulation, systems of equations, linear and quadratic functions, and the representation of inequalities and intervals, are central to secondary and tertiary mathematics curricula. However, AL-Rababaha & Yew (2020) discuss common misconceptions in algebra, such as expressions, linear equations, and functions, which they argue persistently impair student learning. Therefore, mastery of these concepts is essential not only for progression into advanced mathematics but also for success in fields such as economics, engineering, data science, and finance.

Nevertheless, research has consistently reported that many learners experience difficulties in transitioning from procedural computation to conceptual understanding in these areas, often resulting in fragmented knowledge and persistent misconceptions. In line with that, Daud and Ayub (2019) conducted an error analysis in algebraic expressions among Malaysian secondary students and found frequent transformation and process-skill errors. This indicates that students' persistent errors in algebraic manipulation, are in distribution and combining like terms. In higher education contexts, assessment data provide valuable insights into students' conceptual grasp and problem-solving approaches. Midterm examinations, in particular, function as diagnostic tools that capture students' early performance and reveal learning gaps that may impede later achievement.

Despite continuous emphasis on algebraic competencies in tertiary-level mathematics courses, many students continue to demonstrate limited proficiency in core algebra topics. Error-analysis studies show systematic difficulties in algebraic manipulation, equation-solving, and conceptual understanding (Daud & Ayub, 2019; Pramesti & Retnawati, 2019). In the Malaysian context, for instance, students show weaknesses in connecting quadratic equations, inequalities, and their graphical representations (Muhammad Fuad Tiew et al., 2023). These limitations often manifest in errors involving symbolic manipulation, misunderstanding of functions, and difficulties interpreting mathematical relationships through inequalities and interval notation. Instructors frequently observe that even after classroom instruction, students struggle to apply these concepts in structured assessment tasks, indicating a disparity between taught content and internalized understanding.

However, empirical studies focusing on students' actual performance on specific exam items remain limited, particularly in the context of higher education in Malaysia. There is a need to analyze how students respond to targeted questions that assess key algebraic concepts, as such analysis can reveal detailed patterns of reasoning and error types. Without this evidence, efforts to enhance teaching strategies risk being misaligned with students' actual learning needs. This study aims to examine students' algebraic understanding through an analysis of four midterm examination questions that assess core topics: (1) fundamentals of algebraic manipulation, (2) systems of linear equations, (3) linear and quadratic functions,

and (4) inequalities with interval notation. The study seeks to provide empirical evidence on common difficulties and conceptual gaps by analyzing students' performance and error patterns across these questions.

Hence, this study is guided by the following research objectives:

1. To assess students' performance on mid-term examination questions related to fundamental algebraic manipulation, systems of linear equations, inequalities, and quadratic functions.
2. To identify and categorize the types of errors and misconceptions demonstrated by students when solving algebra-related problems.
3. To analyze students' conceptual understanding of foundational algebra topics based on the patterns of errors observed in their responses.
4. To propose instructional strategies and interventions that can address identified misconceptions and enhance students' algebra proficiency.

Literature Review

Algebra remains a cornerstone of secondary and tertiary mathematics education, underpinning later study in calculus, statistics, engineering, and data-driven disciplines. Contemporary research continues to show that weaknesses in foundational algebra hinder students' progression and contribute to attrition in STEM pathways (Kieran, 2007; Kilpatrick et al., 2001). Students who lack fluency in symbolic manipulation, functional reasoning, and equation-solving often face persistent difficulties in subsequent courses (Sfard, 1991). Recent investigations reaffirm this trend and emphasize persistent gaps in students' procedural fluency and conceptual understanding, which remain visible in routine classroom assessments and examinations. As a result, understanding students' performance and common misconceptions in core algebra topics remains a priority in mathematics education research.

Fundamental algebraic manipulation, distribution, simplification, and handling of exponents remain a frequent source of error. Past studies employ systematic error-analysis methods to classify student mistakes (procedural vs. conceptual) and show that many errors previously described in older literature persist, often because students apply arithmetic intuitions to symbolic contexts without conceptual grounding (MacGregor & Stacey, 1997; Star & Stylianides, 2013). Recent error-analysis work using student exam scripts and diagnostic protocols reports recurrent sign errors, incorrect distribution, and combination-of-like-terms mistakes patterns that support targeted remediation strategies.

Systems of linear equations require coordination of multiple representational forms (algebraic, graphical, numeric). Contemporary research highlights that while many students can apply algorithmic solution methods (e.g., elimination or substitution), they often lack a deep understanding of what solutions represent (a unique solution, infinitely many solutions, or no solution) and the geometric meaning of these cases. Recent classroom-based studies and midterm/exam analyses indicate that misinterpretations

frequently arise when students face nonstandard or context-based system problems, reinforcing the diagnostic value of well-constructed exam items (Mathaba et al., 2024).

Understanding functions, especially the jump from linear to quadratic behavior, continues to be identified as a major conceptual hurdle. The literature has difficulties in interpreting graphs, connecting algebraic expressions to shape and transformations, and using functional language (e.g., mapping, domain/codomain). Intervention studies using dynamic geometry or CAS tools (e.g., GeoGebra) have shown promise in improving students' representational fluency for quadratics and in helping students connect symbolic, numerical, and graphical perspectives. These recent findings strengthen the case for including function-based items in midterms that require translation among representations (Muhammad Fuad Tiew et al., 2023).

Inequalities and interval notation present both symbolic and representational challenges. Recent empirical work documents frequent errors such as failing to reverse inequality signs when multiplying by negative numbers, misreading compound inequalities, and difficulties translating solutions into interval notation or number-line representations. Such misconceptions often derive from weak number-line reasoning or insufficient attention to the logical structure of compound inequalities. These studies reiterate that targeted assessment items, such as midterm questions combining symbolic solution and interval representation, are diagnostically powerful (Putri & Juandi, 2022).

Assessment-focused research emphasizes that midterm and formative exam items are valuable diagnostic instruments, not merely summative measures. Recent studies using midterm exam scripts and item-level error coding provide granular evidence on the types of misconceptions students hold and how those misconceptions cluster across topics (procedural vs. conceptual errors). This line of work shows that midterm question analysis can inform immediate instructional adjustments and targeted remediation, especially when instructors combine quantitative score analysis with qualitative error coding of student work (Mathaba et al., 2024).

Although international studies have proliferated, regionally situated research remains important. Several recent studies, including Malaysian and Southeast Asian contexts, have examined students' understanding of functions and algebraic expressions. They reported similar patterns of difficulty, confirming the cross-cultural persistence of these learning obstacles and the benefit of locally grounded diagnostic assessment. Together, the recent literature supports the methodological choice of analyzing four midterm questions across the core algebra topics to reveal persistent error patterns and to guide pedagogical interventions (Muhammad Fuad Tiew et al., 2023).

Fundamental Algebraic Manipulation

Research consistently shows that difficulties in algebra often begin with weaknesses in basic manipulation of symbols, expressions, and operations. Students incorrectly apply rules, particularly related to distribution, exponents, and combining like terms (Booth, 2011). According to MacGregor and Stacey

(1997), these errors arise from both insufficient conceptual grounding and overreliance on memorized procedures. Students may treat algebraic expressions using the same rules as arithmetic, leading to transformation errors and inappropriate simplifications. Such findings support the need to closely examine student work to uncover misconceptions behind correct procedures (Star & Stylianides, 2013). Recent literature consistently confirms that algebraic misconceptions remain despite curricular reforms and increased emphasis on problem-based learning. For example, Al-Rababaha and Yew (2020) found that misconceptions in combining like terms, manipulating expressions, and conceptualizing variables were among the strongest predictors of student errors. Similar findings were reported by Daud and Ayub (2019), who identified procedural errors such as misapplying operational rules, transforming expressions incorrectly, and treating algebraic terms as unrelated numerical values.

Systems of Linear Equations

Solving systems of equations requires the coordination of symbolic reasoning, problem representation, and procedural fluency. Prior studies observed that students often struggle to select and apply appropriate solving methods, such as substitution or elimination (Chiu, 2001). Research by Knuth (2000) found that students frequently misinterpret the meaning of solutions, especially when the system represents parallel or dependent lines. These misunderstandings indicate that students may possess procedural strategies but lack conceptual understanding of what solutions represent. Analysis of student responses on exam items provides valuable insights into whether students can integrate conceptual and procedural knowledge.

Functions, Linear Relationships, and Quadratic Behavior

The concept of function is recognized as one of the most challenging ideas in school and university mathematics (Dubinsky & Harel, 1992). Students often struggle to understand functions as mappings, interpret graphs, and connect algebraic forms to graphical behavior. Studies show that while students may handle linear functions procedurally, quadratic functions introduce additional complexity, such as interpreting the vertex, symmetry, and transformation properties (Zaslavsky et al., 2002). Additionally, students often treat graphs as mere pictures rather than representations of relationships between variables (Leinhardt et al., 1990). Exam questions involving function analysis, therefore, reveal valuable information about students' representational fluency and conceptual understanding.

Students often struggle to select and apply appropriate methods for systems of equations. Pramesti and Retnawati (2019) observed that even high-performing students commit errors when applying substitution or elimination due to a lack of conceptual grounding. International studies by García Fajardo et al. (2025) confirm that students struggle with graph-sketching, determining intercepts, and identifying maximum/minimum points.

Inequalities and Interval Notation

Inequalities require reasoning about magnitude, symbolic manipulation, and the direction of relationships between numbers. Students frequently display misconceptions about inequality symbols, mixing them up or failing to reverse the symbol when multiplying by a negative number (Clement, 1982). Representing inequalities through interval notation introduces further difficulty because it combines symbolic reasoning with visual-spatial interpretation on the number line (Schwarz, 2009). These conceptual hurdles make inequality problems useful diagnostic tools for evaluating students' understanding of algebraic relationships beyond simple computation.

In the domain of inequalities, sign errors remain the most common difficulty. Students often fail to reverse inequality symbols when multiplying or dividing by negative values, a finding echoed across multiple studies in Southeast Asia (Muhammad Fuad Tiew et al., 2023). These errors suggest a lack of meta-conceptual understanding of inequality relationships compared to equations.

Assessment, Error Analysis, and Diagnostic Value

Assessment data, especially written student work, is a rich source of evidence for identifying common misconceptions and learning gaps (Brookhart, 2013). Error analysis has emerged as a reliable method for revealing the cognitive roots of mathematics misunderstandings (Radatz, 1980). As Hiebert and Grouws (2007) argue, analyzing the strategies and errors students use provides deeper insights than scores alone. In the context of algebra, error analysis helps classify mistakes, including conceptual errors, procedural errors, and symbol manipulation errors, each of which requires a different instructional intervention (Riccomini, 2005). Midterm examinations, therefore, serve not only as evaluative tools but also as diagnostic instruments that inform future instruction.

Methodology

This study employed a quantitative descriptive research design with qualitative error analysis. The quantitative component was used to determine students' performance levels in four algebra topics, while the qualitative component was used to identify and categorize errors and misconceptions in students' written responses. This dual approach allows for a more comprehensive interpretation of students' mathematical understanding beyond numerical scores. The sample consisted of $N = 103$ undergraduate students enrolled in a foundational mathematics course at a public higher education institution in Malaysia. The participants were selected using purposive sampling, as the study specifically targeted students who had completed instruction on fundamental algebra, systems of linear equations, inequalities, and quadratic functions before the mid-term examination.

Purposive sampling was deemed appropriate because the objective of the study was not general population estimation but an in-depth analysis of error patterns in a specific group of learners exposed to the same curriculum and assessment. The student is between 19 and 22 years old and has completed pre-university or equivalent mathematics before enrolment. Therefore, this demographic profile reflects a typical cohort of non-mathematics major students taking introductory quantitative courses at the tertiary level.

The instrument used in this study consisted of a four-item mid-term examination. The questions were designed to assess both procedural fluency and conceptual understanding. Each item represents a core algebraic domain:

1. Fundamental algebraic manipulation

- Simplify this equation $(2x^2 + 3x + 1) + (x^2 - 5x + 4)$.
- Find the product of this equation $(x + 2)(x + 3)$.
- Factor this equation $x^2 + 7x + 10$.
- If $f(x) = 2x^3 - 5x + 4$, find $f(2)$

2. Systems of linear equations

- Use either the elimination or substitution method to solve these linear equations.

$$\begin{aligned} x + y + z &= 6 \\ 2x - y + z &= 3 \\ x + 2y - z &= 4 \end{aligned}$$

- Use the quadratic formula to solve $2x^2 - 3x - 5 = 0$

- Let $f(x) = 2x + 3$, $g(x) = x^2 - 1$

- Find $(f \circ g)(x) = f(g(x))$
- Find $(g \circ f)(x) = g(f(x))$

3. Inequalities and interval notation

- Solve the inequality $x^2 - 5x + 6 > 0$
- Solve the inequality $2x - 5 < 9$
- Solve the inequality $2 < x + 3 \leq 7$

4. Quadratic functions

Given the quadratic function $f(x) = 3x^2 + 2x - 1$

- Find the vertex of the parabola.
- Find the x-intercept (if any) of the parabola.
- Sketch the parabola.

Data analysis involved two stages of quantitative analysis and qualitative error analysis. In quantitative analysis, students' performance was analyzed using frequency of correct and incorrect answers, percentage of correct responses for each question, ND comparison of performance across the four algebra topics. Whilst qualitative analysis was categorized into conceptual errors (misunderstanding of concepts), procedural errors (incorrect application of rules/steps), computational errors (arithmetic mistakes), and representational errors (graphing and notation issues). The classification was guided by established error analysis frameworks in mathematics education research (Radatz, 1980; Kieran, 2007; Mathaba et al., 2024).

Content validity of the mid-term questions was ensured through expert review by two previous mathematics lecturers. The questions were aligned with course learning outcomes and syllabus specifications. Reliability of analysis was supported through consistent coding procedures and repeated checking of student scripts.

Results

The mid-term exam consisted of four questions designed to assess students' understanding of foundational algebra, systems of linear equations, inequalities, and quadratic functions. Students' written responses were analyzed using error analysis methods to identify misconceptions. The findings were compared with recent empirical literature to situate results within existing research.

Question 1: Fundamental Algebra

One of the errors that stood out was that students were misapplying multiplication rules to the addition of algebraic terms. Instead of combining coefficients, they multiply both the coefficients and the variable, producing an incorrect exponent. This type of misconception is widely documented in the literature as a foundational algebra error (Ancheta & Subia, 2020; AL-Rababaha et al., 2020). Students display confusion between numerical operations and algebraic operations, treating variables as independent objects rather than terms with like components (Fitria, 2023; Stemele, 2024).

Parallel with Mathaba et al. (2024), who report that learners often resort to surface-level pattern recognition, leading to procedural errors rather than conceptual understanding. The recurrence of this misconception in the present study indicates that students may lack a strong foundational grasp of symbolic manipulation, consistent with Ndemo and Ndemo (2023). This finding is consistent with studies that reveal persistent misconceptions in algebraic manipulation, including difficulty understanding variables, expressions, and symbolic structure (Ancheta & Subia, 2020; AL-Rababaha et al., 2020).

Question 2: Linear Equations

Students showed difficulty selecting and applying solution strategies when solving systems of three linear equations. Common errors included:

- Misapplying elimination steps
- Incorrect substitution leading to inconsistent equations

- Confusion processing composite functions ($f(g(x))$)

These findings support earlier research demonstrating that solving multivariable systems poses significant cognitive challenges (Thomas & Mahmud, 2021; Joshi et al., 2023). Learners often struggle to maintain accuracy across multiple steps, leading to compounding errors. Studies by Kanwal and Farooq (2021) disclose that such mistakes arise from a weak conceptual understanding of equality and variable relationships. The present results also align with McNichols et al. (2023), who found that students frequently make systematic, predictable errors when solving systems of equations, such as failing to align coefficients or incorrectly isolating variables.

The observed error categories reflect findings from diagnostic studies that describe that many learners misapply elimination/substitution strategies and confuse inequality notation (Kanwal & Farooq, 2021; Fitria, 2023). Moreover, confusion with composite functions aligns with international findings that demonstrate that students have difficulty interpreting nested functions and often treat $f(g(x))$ as $f \times g(x)$ or perform operations in the wrong order (Kenney, 2024; Otero et al., 2025). Overall, the present results reinforce the literature that solving systems of equations requires more than procedural proficiency; it requires structured conceptual reasoning, which many students have not yet developed.

Question 3: Inequalities

Students demonstrated difficulty manipulating inequalities involving negative values, particularly when multiplying or dividing both sides by a negative number. Many students failed to reverse the inequality sign or incorrectly interpreted the direction of the relationship.

These findings align with prior research indicating that misconceptions in inequalities remain highly persistent (Khasawneh et al., 2022). Learners often struggle to conceptualize inequality as a relationship rather than an equation (Fitria, 2023). Kenney (2024) observed similar misunderstandings in interval notation and inequality representation, even in students preparing for tertiary study. Students' errors in the present study suggest that they may rely on memorized procedures without internalizing the conceptual meaning of inequality operations. This aligns with Ndemo and Ndemo's (2023) assertion that procedural fluency does not necessarily translate into conceptual mastery.

Question 4: Quadratic Functions

Based on the assessment, students struggled to:

- Correctly determine the vertex
- Identify x- and y-intercepts
- Sketch the parabola accurately

This pattern is similar to findings by Rahman (2021), who reported that Malaysian students often misplace the vertex or miscalculate turning points due to a weak understanding of completing the square and transformation rules. Students also showed difficulty connecting algebraic forms with graphical features, a common finding in the literature (Thomas & Mahmud, 2021; Stemele, 2024).

Inconsistencies in graph sketching suggest that learners rely on memorized formulas (e.g., vertex formula) without understanding how the coefficients influence the shape and orientation of the graph. This aligns with international empirical findings that students often struggle to grasp the function transformations (Ndemo & Ndemo, 2023; Joshi et al., 2023). The results highlight the need for instructional strategies that emphasise visualization, multiple representations, and conceptual reasoning in quadratic functions. Similar patterns have been observed in previous research, where learners commonly misinterpret graphs, fail to relate algebraic and graphical representations, and demonstrate limited conceptual understanding of quadratic transformations (Rahman, 2021; Thomas & Mahmud, 2021; Stemele, 2024).

Overall, a pattern emerges across all four questions where students rely heavily on procedural rules and lack conceptual understanding of algebraic ideas. This misconception is not a domestic issue but a global challenge where errors persist across multiple algebra topics. These findings strongly support the empirical literature, which acknowledges that algebraic misconceptions are systematic, predictable, and rooted in deeper cognitive misunderstandings (Mathaba et al., 2024; Fitria, 2023). Furthermore, the recurrence of misconceptions across topics (algebra, systems, inequalities, quadratics) suggests that students' errors are interconnected rather than isolated. This supports the argument for integrated diagnostic assessments and error-focused teaching approaches (Kanwal & Farooq, 2021; Khasawneh et al., 2022).

Conclusion

This study examined students' conceptual and procedural understanding across four core algebra domains—fundamental algebra, linear equations, inequalities, and quadratic functions—using a mid-term diagnostic assessment. The findings indicate that students continue to experience persistent misconceptions that align closely with recent findings in algebra education research. Errors such as mis manipulating algebraic expressions (e.g., treating $3x + 2x$ as $6x^2$), difficulties selecting and applying appropriate methods for solving systems of equations, sign misinterpretation when working with inequalities, and weak representational fluency in quadratic functions reflect gaps in foundational reasoning as well as symbolic manipulation.

Overall, the results reinforce the argument that algebraic proficiency remains a challenge even at the tertiary level, echoing broader concerns in the literature that students often rely on superficial rules or rote procedures rather than conceptual understanding. The persistent nature of these difficulties suggests that strengthening algebra instruction requires deeper attention to cognitive processes, representational fluency, and error-analysis-based teaching strategies. This research adds empirical evidence supporting the need for systematic diagnostic assessments in mathematics courses, particularly in programs where algebra forms the foundation for quantitative reasoning, finance, economics, and other STEM-related coursework.

Practical Implications

The findings of this study provide important implications for policymakers, organizational leaders, human resource practitioners, and employees regarding the effective implementation of outcome-based flexible work arrangements (OBFWA). As organizations continue to adapt to evolving workforce expectations and digital work environments, the successful adoption of OBFWA requires a shift from traditional time-based performance management to a results-oriented approach that prioritizes employee autonomy, accountability, and performance outcomes.

Implications for Policymakers

The findings suggest that policymakers should develop comprehensive guidelines and frameworks that support the implementation of flexible work arrangements while ensuring employee well-being and organizational productivity. Government agencies and labor authorities can establish standardized policies that define employee rights, performance expectations, and employer responsibilities under flexible work arrangements. Such frameworks can reduce ambiguity and promote consistency across industries. Additionally, policymakers should encourage organizations to invest in digital infrastructure and employee development programs that enhance employees' ability to work effectively in flexible environments. Previous studies have shown that supportive regulatory frameworks facilitate the successful adoption of flexible work practices and improve employee outcomes (Allen et al., 2021; International Labor Organization [ILO], 2024).

Implications for Institutional Leaders and Senior Management

For organizational leaders, the findings highlight the importance of fostering a results-oriented organizational culture. Leaders should focus on establishing clear performance indicators, measurable outcomes, and transparent accountability mechanisms rather than monitoring employee attendance or physical presence. The transition to OBFWA requires leaders to develop trust-based management practices that empower employees while maintaining organizational performance standards. Furthermore, senior management should ensure that managers receive adequate training in remote leadership, performance coaching, and virtual team management to effectively supervise flexible workforces. Research indicates that leadership support plays a critical role in employee engagement, productivity, and successful flexible work implementation (Contreras et al., 2020; Kniffin et al., 2021).

Implications for Human Resource Management

The study underscores the need for HR practitioners to redesign performance management systems to align with outcome-based work principles. Traditional evaluation systems that emphasize hours worked should be replaced with performance metrics that assess goal achievement, quality of work, innovation, and contribution to organizational objectives. HR departments should also establish clear communication protocols, provide continuous feedback mechanisms, and implement employee well-being initiatives to mitigate potential challenges such as work-life boundary blurring and social isolation. In addition, HR

professionals should develop competency-building programs that strengthen employees' self-management, digital collaboration, and time-management skills. These initiatives can enhance employee readiness for flexible work arrangements and contribute to sustainable organizational performance (Wang et al., 2021; Choudhury et al., 2022).

Implications for Employees

The findings suggest that employees play an active role in ensuring the success of OBFWA. Employees should develop competencies related to self-discipline, time management, digital communication, and outcome-oriented work practices. Organizations can support these efforts by providing training and resources that enable employees to effectively manage work responsibilities while maintaining work-life balance. Increased employee autonomy has been associated with higher job satisfaction, motivation, and organizational commitment when supported by appropriate structures and resources (Gajendran & Harrison, 2007; Allen et al., 2021).

Implications for Organizational Performance and Sustainability

The study demonstrates that the successful implementation of OBFWA has the potential to improve organizational effectiveness by enhancing employee productivity, engagement, and retention. Organizations that adopt outcome-based management practices may benefit from reduced operational costs, improved talent attraction, and increased workforce resilience. However, these benefits can only be realized when organizations establish supportive leadership practices, robust performance management systems, and a culture of trust and accountability. Consequently, stakeholders should view OBFWA not merely as a workplace flexibility initiative but as a strategic organizational transformation that requires coordinated efforts across multiple levels of the organization.

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