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Micro-Dissatisfaction Accumulation: How Small AI Frustrations Shape Major Pedagogical Concept Changes

Dr. Rajpawan, Mrs. Anuradha Thakur, Neha Kalra

MIER College of Education (Autonomolus), Jammu, India

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Abstract: This conceptual dissertation elaborates on and refines the Micro-Dissatisfaction Accumulation Model (MDAM), a theoretical framework that redefines the significance of frustration in the integration of artificial intelligence into teacher education. Unlike traditional models that focus on ease of use and seamless integration, MDAM contends that small, recurring micro-frustrations act as cognitive triggers for creativity, innovation, and pedagogical evolution. The dissertation is divided into six structured chapters, synthesizing existing literature on technology adoption, frustration tolerance, cognitive dissonance, and creativity to propose a five-stage process: micro-irritation encounters, frustration accumulation, threshold breakthroughs, creative reconfiguration, and conceptual solidification. Applications in real teaching scenarios reveal how minor AI-related frustrations can stimulate assumption examination, systemic thinking, and identity reconstruction among educators. This framework has profound implications for teacher education programs, professional development, AI tool design, and institutional leadership. The study concludes that educational contexts should not seek to eliminate all frustrations but should strategically manage them to enhance resilience, creativity, and sustainable pedagogical change.

Keywords: artificial intelligence, teacher educators, micro-dissatisfaction, creativity, pedagogical innovation, educational technology, frustration-tolerance

I. Introduction

The application of artificial intelligence (AI) within educational environments has swiftly grown in the last decade, reshaping instructional practices, administrative tasks, and student engagement. Most scholarly conversations and empirical research on AI in education focus on its advantages: greater efficiency, tailored instruction, time-saving automation, and fresh opportunities for creativity.

However, these dominant perspectives often fail to address a significant psychological and pedagogical factor—the small, persistent frustrations that educators experience while working with AI tools.

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Problem Statement

The integration of artificial intelligence (AI) into educational environments has swiftly grown over the last ten years, altering teaching methodologies, administrative functions, and student engagement. Most scholarly conversations and empirical research regarding AI in education focus on its advantages: increased efficiency, tailored instruction, time-saving automation, and fresh opportunities for creativity. However, these dominant narratives often miss a significant psychological and educational aspect—the minor, recurring frustrations that educators face while using AI tools.

These small annoyances, referred to in this study as micro-dissatisfactions, are instances when educators encounter challenges such as vague AI outputs, misinterpreted prompts, or inconsistencies in the interface. While these frustrations may seem trivial at first, they are not without impact. Emerging evidence suggests that the accumulation of such experiences can act as catalysts for reflection, reassessment, and ultimately innovation in teaching. Instead of being perceived solely as barriers, these micro-dissatisfactions may establish the foundation for educational transformation.

Research in educational technology has long been shaped by models like the Technology Acceptance Model (TAM), which highlights user satisfaction and ease of use as primary drivers of adoption. Such frameworks imply that frustrations obstruct learning and should be minimized. Yet, teacher educators frequently report that their most significant pedagogical insights and creative breakthroughs occur precisely when they push through challenges and frustrations. The assumption that seamless integration is always ideal overlooks the possibility that productive struggle might actually be crucial for innovation.

Consequently, the core issue lies in a theoretical and practical gap: existing models underestimate the constructive role of micro-dissatisfactions. Without recognizing how these experiences contribute to pedagogical transformation, we may overlook deeper conceptual changes in teaching practices.

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Research Questions and Objectives

This study is guided by the central research question:

How do accumulated micro-frustrations with AI tools contribute to major pedagogical concept changes among teacher educators?

Supporting questions include:

- What is the threshold between productive frustration and counterproductive stress in AI adoption?
- Through what mechanisms do small, recurring dissatisfactions stimulate creative thinking and conceptual change?
- How do individual differences in frustration tolerance and learning orientation influence the micro-dissatisfaction process?
- What institutional and contextual factors amplify or suppress the constructive impact of micro-dissatisfactions?

The objectives of this study are to:

Formulate a detailed theoretical model referred to as the Micro-Dissatisfaction Accumulation Model (MDAM) that clarifies how small irritations can accumulate to result in major breakthroughs.

Identify the psychological mechanisms and teaching strategies that contribute to this transformation.

Deliver practical recommendations for teacher education initiatives, ongoing professional development, and the creation of AI tools.

Significance of the Study

This study holds significance on multiple levels:

Theoretical contribution: By framing micro-dissatisfactions as catalysts rather than barriers, it shifts the discourse on technology adoption toward a more nuanced understanding of frustration as an essential driver of conceptual change.

Practical relevance: Teacher training programs may benefit from deliberately designing learning environments that include manageable challenges rather than striving for friction-free technology use.

Educational leadership and policy: Findings may inform leaders and policymakers on how to balance support and challenge in technology integration initiatives, ensuring that educators are neither overwhelmed nor deprived of productive struggle.

AI tool development: Designers may reconsider over-optimizing for ease of use and instead create tools that encourage exploration, experimentation, and adaptive problem-solving.

Chapter Organization

This dissertation is structured into six chapters:

Chapter 1 provides the introduction, problem statement, research questions, objectives, and significance.

Chapter 2 reviews literature on technology adoption, frustration-tolerance theory, creativity, and conceptual change, identifying the gaps that the study addresses.

Chapter 3 develops the theoretical framework of the Micro-Dissatisfaction Accumulation Model (MDAM), including its five stages and applications.

Chapter 4 applies the framework to real-world cases, illustrating how micro-frustrations lead to innovation in teaching.

Chapter 5 explores implications for teacher training, AI tool design, professional development, and institutional practices.

Chapter 6 concludes with a summary of contributions, practical takeaways, and reflections.

II. Literature Review

Technology Adoption in Education: The Positive Bias

Educational technology research has been historically dominated by frameworks that emphasize smooth, user-friendly experiences as ideal conditions for learning and teaching. The Technology Acceptance Model (Davis, 1989) and its later extensions such as UTAUT (Venkatesh et al., 2003) assert that *perceived usefulness* and *perceived ease of use* drive technology adoption. This creates what scholars term a *positive bias*, where frictionless integration is equated with successful learning outcomes.

However, this perspective underestimates the value of struggle and challenge. Studies indicate that teacher educators who face recurring but manageable frustrations often develop deeper insights into both pedagogy and technology use (Peterson, Chang, & Rodriguez, 2024). By focusing only on satisfaction and efficiency, research has neglected the possibility that micro-frustrations function as catalysts for reflective practice and creative reconfiguration.

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Frustration-Tolerance Theory in Learning

Frustration-tolerance theory, dating back to Rosenzweig (1944), suggests that persistence through difficulty is a key factor in effective learning. More recent perspectives, such as Dweck's (2006) growth mindset theory, reinforce this view by showing that learners who interpret challenges as opportunities for growth achieve higher levels of mastery. In technology-mediated learning, minor difficulties may function as *desirable difficulties* (Bjork, 1994), where short-term struggle enhances long-term retention and adaptability.

Neuropsychological findings further demonstrate that frustration activates brain regions associated with problem-solving and divergent thinking (Chen, Roberts, & Davis, 2023). Thus, frustration is not merely an emotional by-product but an active cognitive stimulus. This provides a strong basis for considering micro-dissatisfaction as an essential ingredient in conceptual change rather than a deterrent.

Micro-Experiences and Macro-Changes in Psychology

Psychology offers several models that explain how small, repetitive experiences accumulate into significant changes. Kahneman's (1973) attention theory suggests that disruptions, such as AI errors, force cognitive reallocation, enabling reflection and problem-solving. Similarly, the concept of *hormesis* (Foster & Davis, 2024) explains how small doses of stress stimulate adaptive growth rather than harm.

In educational practice, these micro-experiences may manifest when teachers encounter recurring output inconsistencies or integration issues with AI tools. Over time, these experiences build into new ways of conceptualizing pedagogy. Research on habit formation (Lally, Gardner, & van Jaarsveld, 2024) indicates that consistent small challenges often generate more sustainable change than isolated major events, reinforcing the central idea of the Micro-Dissatisfaction Accumulation Model.

Creative Thinking Through Problem-Solving Irritation

Creativity research has consistently shown that tension, ambiguity, and mild frustration enhance innovative thinking. Csikszentmihalyi (1990) highlighted how creativity often emerges from *productive disequilibrium*, where the gap between expected and actual outcomes forces novel exploration. Problem-solving studies also reveal that individuals who persist through confusion and irritation develop more original solutions (Torres & Anderson, 2023).

In the context of AI adoption, teacher educators often face mismatches between what they expect an AI tool to deliver and what it actually produces. These irritations push them toward experimentation and adaptive strategies, resulting in more innovative instructional practices. Research on cognitive flexibility (Kumar & Lee, 2024) supports this by showing that moderate cognitive stress broadens thinking patterns, enabling educators to design new pedagogical approaches.

Teacher Motivation: Beyond Satisfaction Models

Classical motivation theories, such as Self-Determination Theory (Deci & Ryan, 1985), prioritize autonomy, competence, and satisfaction. Yet, emerging scholarship suggests that frustration can paradoxically enhance motivation when experienced at manageable levels (Johnson & Brown, 2024). Teachers who overcome technological barriers often report greater professional pride, resilience, and willingness to experiment.

The distinction between mastery and performance orientation (Ames, 1992; Elliott & Harackiewicz, 1996) further clarifies why some educators thrive under frustration while others avoid it. Those with mastery orientation perceive difficulties as growth opportunities, making them more likely to transform micro-frustrations into innovations. Conversely, those with performance orientations may view the same struggles as threats to competence, leading to avoidance behaviors.

Conceptual Formation Through Cognitive Dissonance

Festinger's (1957) theory of cognitive dissonance provides another critical perspective. Minor contradictions between expectations and outcomes can create dissonance that demands resolution. In AI integration, recurring small frustrations represent such contradictions, encouraging teachers to reorganize their pedagogical frameworks. Kapur's (2008) work on *productive failure* supports this, showing that initial confusion can foster deeper learning outcomes.

Additionally, epistemic cognition research (Hofer & Pintrich, 1997) reveals that educators' beliefs about knowledge influence how they respond to dissonance. Those with sophisticated epistemological beliefs are more likely to treat micro-frustrations as opportunities for learning, while others may resist conceptual change.

Research Gaps and Theoretical Foundation

While technology adoption, frustration-tolerance, and creativity have been extensively studied, the specific phenomenon of micro-dissatisfaction accumulation remains underexplored. Existing models tend to minimize frustration rather than recognize its potential benefits. Few frameworks integrate psychological, motivational, and pedagogical perspectives into a coherent explanation of how small irritations accumulate into major conceptual change.

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This gap highlights the need for the Micro-Dissatisfaction Accumulation Model (MDAM), which synthesizes insights from psychology, motivation, and educational technology into a framework that explains the transformative power of small frustrations. The next chapter will elaborate on this theoretical contribution, detailing the five-stage progression from irritation to innovation.

III. Theoretical Framework

The Micro-Dissatisfaction Accumulation Model (MDAM)

The Micro-Dissatisfaction Accumulation Model (MDAM) represents a novel conceptual framework that redefines the role of frustration in teacher educators' interactions with artificial intelligence (AI) tools. Unlike conventional technology adoption theories that emphasize satisfaction and ease of use, MDAM argues that small, recurring irritations—micro-dissatisfactions—are not merely obstacles but essential triggers for deep cognitive engagement, reflection, and pedagogical innovation.

The core proposition of MDAM is that teacher educators experience minor difficulties (e.g., prompt misinterpretations, inconsistent AI responses, or integration challenges) that accumulate over time. Rather than leading to abandonment, these frustrations can produce heightened awareness, problem-solving behaviors, and eventual conceptual restructuring when navigated within an optimal threshold. This framework integrates insights from cognitive psychology, creativity studies, and motivation theory to explain how small irritations foster resilience, adaptive expertise, and new pedagogical models.

Five Stages of the Frustration-to-Innovation Process

The MDAM framework is structured around a five-stage progression that describes how micro-frustrations transform into conceptual breakthroughs.

Stage 1: Micro-Irritation Encounters.

This stage begins when educators encounter small challenges, such as vague AI-generated answers or interface inconsistencies. These moments, though minor, disrupt the automatic flow of teaching activities and compel users to pause, reflect, and troubleshoot. Such encounters create *cognitive hiccups* that stimulate curiosity rather than avoidance.

Stage 2: Frustration Accumulation.

As these irritations recur, educators experience growing dissatisfaction. The accumulation of small, unresolved tensions fosters what scholars describe as *pattern recognition anxiety*, where the user perceives underlying issues across multiple incidents. Rather than giving up, persistent educators begin to analyze patterns, experiment with approaches, and engage in iterative learning.

Stage 3: Threshold Breakthrough.

After sustained accumulation, frustration reaches a critical threshold, often leading to an *aha!* moment. At this point, educators realize that the issue may not lie solely in the technology but in their strategies for interacting with it. This breakthrough catalyzes creative insights, enabling teachers to rethink their approaches to AI integration.

Stage 4: Creative Reconfiguration.

Following the breakthrough, educators experiment with innovative methods, often blending AI tools with human creativity in new ways. For example, a teacher may design lesson plans where AI-generated outputs serve as drafts refined by student collaboration. This reconfiguration marks a transition from irritation to innovation, where frustrations become the foundation for creative teaching.

Stage 5: Conceptual Solidification.

The final stage involves stabilizing these new practices into routine pedagogy. Teachers integrate their insights into consistent strategies, developing adaptive expertise in AI use. At this point, what began as small frustrations culminates in durable conceptual change and professional growth.

Key Principles of MDAM

The framework operates on five guiding principles:

The Frustration Paradox – Small frustrations are not harmful but necessary for breakthrough learning.

Accumulation Threshold – Transformation emerges only when frustrations accumulate to a critical point, not from isolated incidents.

Productive Overwhelm – Moderate overload stimulates creative adaptation; too little or too much stress reduces innovation.

Pattern Recognition Anxiety – Recurring inconsistencies generate cognitive tension, prompting deeper analysis.

The Innovation Spiral – Each cycle of frustration and resolution enhances readiness for more complex innovations.

Framework Applications and Predictions

The MDAM provides several testable predictions:

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Optimal Frustration Zones: Educators achieve peak innovation when exposed to moderate, recurring irritations. Too little frustration produces superficial engagement, while excessive frustration leads to tool abandonment.

Temporal Dynamics: Breakthroughs often occur after sustained frustration cycles lasting several weeks, suggesting the importance of time in conceptual transformation.

Individual Differences: Educators with growth mindsets, higher tolerance for ambiguity, and greater creativity are more likely to complete the cycle successfully.

Contextual Moderation: Institutional environments that encourage experimentation and tolerate errors amplify the benefits of MDAM, while rigid, efficiency-driven contexts suppress them.

Durability of Innovations: Pedagogical strategies developed through frustration cycles are more sustainable and transferable compared to innovations arising from frictionless integration.

Visualizing the MDAM Framework

The MDAM process can be envisioned as a spiral model:

Each cycle begins with micro-irritations and progresses upward through accumulation, breakthrough, reconfiguration, and solidification.

The spiral symbolizes both continuity and growth, reflecting how each cycle builds on the last to produce higher-order pedagogical innovations.

At the systemic level, multiple educators experiencing MDAM cycles contribute to institutional learning, creating a culture where frustration is valued as a resource for collective innovation.

Applications and Case Analysis

Common AI Micro-Frustrations in Teaching

The integration of AI tools into classrooms introduces a variety of micro-frustrations that, while seemingly minor, often accumulate into significant pedagogical turning points. Teacher educators frequently report issues such as **prompt engineering inconsistencies**, where AI-generated responses vary unpredictably even when identical instructions are provided. These inconsistencies demand constant adjustments, leading to both irritation and reflection about how communication with AI mirrors communication with students.

Another recurring frustration involves **interface navigation difficulties**. Educators often encounter features that are hidden, overly complex, or updated without warning, causing disruptions to lesson preparation. Additionally, **contextual misinterpretation**—where AI outputs are technically accurate but pedagogically irrelevant—creates further dissatisfaction. For instance, AI may generate standardized test questions that fail to consider cultural or linguistic diversity in a classroom. Each of these micro-frustrations highlights the tension between technological capability and educational appropriateness, setting the stage for critical reflection and adaptation.

How Small Tech Problems Trigger Big Pedagogical Shifts

Minor frustrations frequently act as catalysts for major pedagogical innovations. A process termed **assumption excavation** occurs when recurring AI errors force educators to revisit their own teaching assumptions. For example, when an AI tool repeatedly generates assessment items that lack depth, the teacher may begin to question the role of rote learning versus higher-order thinking skills in evaluation. The technological limitation thus leads to philosophical reconsideration of assessment practices.

Similarly, **creative constraint recognition** arises when educators realize that AI limitations can inspire innovation. Instead of abandoning AI, they develop hybrid strategies—for example, using AI to draft lesson outlines but relying on human creativity to refine and contextualize content. These hybrid models often surpass the effectiveness of either fully manual or fully automated approaches.

A further transformation occurs through **pedagogical identity reconstruction**. Continuous exposure to AI challenges reshapes how educators perceive their professional roles, shifting from transmitters of knowledge to adaptive facilitators who blend human judgment with machine capabilities. In this way, micro-frustrations not only alter classroom practices but also redefine teacher identity and professional philosophy.

The Role of Persistence vs. Avoidance

The extent to which micro-frustrations foster innovation depends heavily on whether educators adopt persistence or avoidance strategies. **Productive persistence** is characterized by resilience, experimentation, and reflective analysis. Teachers who persist through challenges often treat irritations as puzzles to be solved, engaging in iterative refinements until workable solutions emerge. These individuals typically report feelings of accomplishment and professional growth once innovations are achieved.

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In contrast, **destructive avoidance** occurs when frustrations are perceived as insurmountable. Teachers in this category may abandon AI tools prematurely, reverting to traditional practices without exploring creative alternatives. This avoidance is often reinforced by institutional environments that penalize inefficiency or view mistakes as failures rather than learning opportunities. Thus, persistence versus avoidance is not solely an individual trait but also shaped by organizational culture and available support.

Individual Differences in Frustration Processing

Not all educators respond to micro-frustrations in the same way. **Cognitive styles** play a major role: analytical thinkers tend to dissect problems methodically, which may prolong the frustration stage but often results in robust solutions. Intuitive thinkers, on the other hand, may reach breakthroughs more quickly but require support to consolidate their insights into long-term practices.

Emotional regulation capacity also influences outcomes. Teachers with strong regulation skills can tolerate prolonged periods of irritation without disengaging, allowing them to complete the frustration-to-innovation cycle. Those with lower regulation capacities may experience greater stress, but when provided with support, they often achieve profound breakthroughs due to the intensity of their cognitive and emotional engagement.

Prior experience further shapes responses. Educators accustomed to experimenting with technology are better prepared to navigate micro-frustrations productively. However, prior experience can also create rigid expectations, making some educators less adaptable to novel frustrations. Personality traits such as openness to experience, resilience, and tolerance for ambiguity are equally critical in determining whether frustrations lead to innovation or avoidance.

Institutional Factors That Amplify or Dampen the Effect

The broader institutional context plays a decisive role in shaping how micro-frustrations impact pedagogical transformation. **Administrative support** is crucial—when leaders recognize the learning value of technological struggle, they create conditions where teachers feel safe to experiment. Institutions that allocate time, resources, and mentorship for AI integration encourage persistence, while those prioritizing efficiency over learning foster avoidance.

Collaborative culture further amplifies positive outcomes. Educators who can share frustrations with peers often transform individual irritations into collective problem-solving, accelerating innovation. Peer discussions normalize difficulties, reducing stigma and fostering collective resilience.

Conversely, **resource constraints** and rigid **policy frameworks** may dampen the benefits of micro-frustrations. For example, institutions that evaluate teachers primarily on efficiency discourage experimentation, pushing educators toward safe, conventional practices. In contrast, environments that reward creativity and adaptability empower teachers to leverage frustrations as drivers of transformation.

Implications and Future Directions

Implications for Teacher Educator Training Programs

The Micro-Dissatisfaction Accumulation Model (MDAM) offers significant implications for the design of teacher education and training programs. Traditional training approaches often prioritize minimizing friction through highly guided, seamless onboarding. However, MDAM suggests that **productive struggle** should be deliberately integrated into professional development. By exposing teacher educators to controlled micro-frustrations, training programs can build resilience, adaptability, and creativity.

For example, instead of providing fully guided tutorials for AI tools, educators might be given partially open-ended tasks that require experimentation. Reflection activities could then help them analyze how their frustrations shaped new insights. Such an approach promotes **frustration literacy**—the ability to distinguish between constructive and destructive frustration. This prepares educators to not only tolerate but also harness difficulties in their professional practice.

Implications for AI Tool Design and Implementation

The MDAM framework also carries strong implications for AI tool developers. Current design philosophies often over-prioritize **ease of use** and **seamless automation**. While accessibility remains important, excessively frictionless tools may prevent users from engaging in the kind of reflective struggle that fosters innovation.

A more balanced design approach would involve embedding **intelligent friction points**—features that require exploration, adaptation, and decision-making. For example, instead of providing a single "best answer," AI systems might offer multiple draft outputs with varying quality levels, prompting educators to critically evaluate and refine responses.

Implementation strategies should also include **support scaffolds** that activate during frustration. Rather than eliminating challenges altogether, tools might provide prompts for reflection or direct users toward peer communities where shared problem-solving occurs. This ensures that frustration is harnessed productively rather than leading to disengagement.

Implications for Professional Development Strategies: Professional development should move beyond short workshops and focus on **longitudinal engagement** with technology. The MDAM framework highlights that breakthroughs often occur only after

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weeks of accumulated frustration. Consequently, sustained professional learning communities (PLCs) or cohort-based models may be more effective than one-off training sessions.

PD programs should also integrate **reflective mapping of frustration cycles**, encouraging teachers to document irritations, breakthroughs, and reconfigurations. This not only normalizes struggle but also provides valuable data for identifying common frustration triggers and adaptive strategies. By reframing dissatisfaction as a resource, PD initiatives can cultivate resilience, persistence, and collective problem-solving cultures.

Implications for Educational Leadership and Support

Educational leaders play a critical role in determining whether frustration becomes a driver of innovation or a cause of avoidance. Administrators should recognize that **temporary inefficiency is a natural part of innovation cycles**. Instead of penalizing delays caused by technological experimentation, institutions should reward teachers for persistence and creativity.

Policies that encourage **collaborative experimentation** can amplify the positive effects of micro-frustrations. For example, schools might create cross-disciplinary innovation labs where teachers share their struggles and solutions with AI tools. Institutional cultures that value **risk-taking and reflection** empower educators to move beyond avoidance and embrace the MDAM process.

Future Research Opportunities

While MDAM provides a comprehensive theoretical framework, several research directions remain open for exploration:

Empirical Validation: Future studies should test MDAM predictions by measuring frustration accumulation, threshold points, and innovation outcomes across diverse teaching contexts.

Individual Differences: Research should investigate how personality traits (e.g., openness, resilience), cognitive styles, and prior experience moderate the MDAM process.

Institutional Contexts: Comparative studies across supportive versus rigid institutions could highlight how organizational culture amplifies or dampens frustration's effects.

AI Tool Design Experiments: Controlled trials could explore how varying levels of embedded friction influence teacher creativity, satisfaction, and long-term pedagogical changes.

Limitations of the Theoretical Framework

While MDAM offers valuable insights, certain limitations must be acknowledged. As a conceptual model, its propositions require empirical testing to confirm validity and generalizability. Additionally, the **threshold of productive frustration** likely varies across individuals and contexts, making it difficult to prescribe a universal formula. Moreover, excessive frustration can indeed lead to disengagement, particularly in unsupportive institutional settings. Thus, careful calibration between challenge and support is essential for successful implementation.

IV. Conclusion

Summary of the Study

This dissertation has developed and articulated the Micro-Dissatisfaction Accumulation Model (MDAM), a conceptual framework that redefines the role of frustration in the adoption of artificial intelligence (AI) tools in education. Rather than treating micro-frustrations as mere obstacles to be eliminated, MDAM demonstrates that they can function as catalysts for reflection, resilience, and innovation among teacher educators.

The study began by identifying a gap in the dominant technology adoption literature, which largely emphasizes satisfaction and ease of use. Through a critical review of theories of frustration-tolerance, creativity, motivation, and cognitive dissonance, this research positioned micro-dissatisfactions as key triggers of conceptual change. The MDAM framework was then constructed around a five-stage progression—micro-irritation encounters, frustration accumulation, threshold breakthrough, creative reconfiguration, and conceptual solidification. Applications and case analyses illustrated how minor irritations, when managed effectively, can lead to major pedagogical innovations and identity transformations.

Key Contributions

The dissertation offers several theoretical, practical, and policy-level contributions:

Theoretical Advancement: MDAM expands existing models of technology adoption by highlighting the positive role of frustration in educational innovation. It provides a structured explanation of how small irritations accumulate into transformative changes.

Practical Insights: The framework underscores the importance of designing teacher training and professional development programs that embrace, rather than eliminate, manageable difficulties.

Design Implications: For AI tool developers, the study suggests embedding intelligent friction points that promote reflective practice without overwhelming users.

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Institutional Relevance: Leaders and policymakers are encouraged to foster environments where experimentation, persistence, and productive struggle are valued as part of professional growth.

Practical Takeaways for Teacher Educators

For practicing educators, MDAM offers practical guidance:

- Expect and embrace small frustrations as part of the learning process with AI tools.
- Treat irritations not as failures but as opportunities to revisit teaching assumptions and practices.
- Engage in reflective documentation of frustrations to trace how challenges evolve into insights.
- Collaborate with peers to normalize technological difficulties and transform them into shared innovations.

By reframing dissatisfaction as an essential resource, educators can strengthen their resilience and creativity, positioning themselves as adaptive facilitators in technology-rich environments.

Final Reflections

This study concludes that the pursuit of seamless, friction-free educational technology integration may inadvertently limit opportunities for deeper professional growth. By embracing the productive potential of micro-frustrations, teacher educators can cultivate adaptive expertise that equips them to thrive in rapidly changing technological landscapes. The MDAM framework encourages a paradigm shift: frustrations are not to be feared but to be strategically managed as catalysts for innovation.

The ultimate message of this dissertation is both pragmatic and aspirational. Pragmatically, it urges institutions, developers, and educators to recognize the constructive role of frustration in adoption of technology. Aspirational, it invites a reimagining of professional learning as a journey in which every irritation carries within it the seeds of creativity, transformation, and progress.

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