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Micro-learning in Low-Resource Classrooms: A Novel Approach to Enhancing Student Engagement and Retention

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التعلم المصغّر في الفصول الدراسية محدودة الموارد: نهج مبتكر لتعزيز تفاعل الطلاب واحتفاظهم بالمعرفة

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Abstract

In recent years, micro-learning has emerged as an innovative pedagogical strategy that delivers content in short, focused bursts, making it especially suitable for low-resource educational environments. This study explores the implementation and effectiveness of micro-learning in enhancing student engagement and knowledge retention in a low-resource classroom setting. Despite growing interest in micro-learning, little research has examined its impact in developing contexts where access to educational resources and technology is limited. The current research addresses this gap by investigating how micro-learning can be utilized as a practical approach to support learning outcomes in such environments. The study was conducted within Al-Narjis Secondary School for Girls, a state school operating on minimal technological infrastructure. A purposive sample of 25 female students were engaged in the study. The purpose of the study was to assess the effectiveness of micro-learning modules to enhance engagement and retention of learners. Pre-test and post-test design was applied to measure improvement in academic performance among students, while observational data were collected to measure engagement levels. Results showed statistically significant increased post-test scores demonstrating improved information retention. Observational data also revealed greater student motivation and participation in micro-learning compared to traditional instruction. These results resonate with the efficacy of micro-learning as a cost-effective and adaptive teaching strategy in low-resource settings, offering a practical alternative to conventional teaching. The study recommends integrating micro-learning into extensive educational practices for optimal learning benefits and reducing issues with underfunded schools.Keywords: micro-learning, low-resource classrooms, student engagement, knowledge retention, secondary education, educational innovation.

الملخص

في السنوات الأخيرة، برز التعلم المصغّر كاستراتيجية تربوية مبتكرة تقوم بتقديم المحتوى التعليمي على شكل وحدات قصيرة ومركّزة، مما يجعله مناسبًا بشكل خاص للبيئات التعليمية محدودة الموارد. تهدف هذه الدراسة إلى استكشاف تطبيق التعلم المصغّر وفعاليته في تعزيز تفاعل الطلاب واحتفاظهم بالمعرفة في بيئة صفية ذات موارد محدودة. على الرغم من الاهتمام المتزايد بالتعلم المصغّر، إلا أن الأبحاث القليلة تناولت تأثيره في السياقات النامية التي تكون فيها فرص الوصول إلى الموارد التعليمية والتكنولوجيا محدودة. تسعى هذه الدراسة لسد هذه الفجوة من خلال التحقيق في كيفية استخدام التعلم المصغّر كنهج عملي لدعم نتائج التعلم في مثل هذه البيئات.أُجريت الدراسة في **مدرسة النرجس الثانوية للبنات**، وهي مدرسة حكومية تعمل ببنية تحتية تكنولوجية محدودة. تم اختيار عينة مقصودة من ٢٥ طالبة للمشاركة في الدراسة. هدف الدراسة هو تقييم فعالية وحدات التعلم المصغّر في تعزيز تفاعل الطلاب واحتفاظهم بالمعلومات. تم تطبيق تصميم الاختبار القبلي والبعدي لقياس التحسن في الأداء الأكاديمي لدى الطالبات، بينما جُمعت البيانات الرصدية لقياس مستويات التفاعل.أظهرت النتائج ارتفاعًا ذا

دلالة إحصائية في درجات الاختبار البعدي، مما يعكس تحسنًا في الاحتفاظ بالمعلومات. كما أظهرت البيانات الرصدية زيادة في دوافع الطالبات ومشاركتهن في التعلم المصغّر مقارنة بالتعليم التقليدي. تتوافق هذه النتائج مع فعالية التعلم المصغّر كاستراتيجية تعليمية مرنة وفعّالة من حيث التكلفة في بيئات محدودة الموارد، مقدمةً بديلًا عمليًا للتدريس التقليدي. توصي الدراسة بدمج التعلم المصغّر ضمن الممارسات التعليمية الواسعة لتحقيق أفضل فوائد للتعلم وتقليل المشكلات في المدارس ذات التمويل المحدود.

الكلمات المفتاحية: التعلم المصغّر، الفصول الدراسية محدودة الموارد، تفاعل الطلاب، احتفاظ المعرفة، التعليم الثانوي، الابتكار التعليمي.

1. Introduction

In the last decades, global education systems have been evolving to embrace technology and innovative techniques that respond to learning needs of students in the 21st century. Among the innovations that have been embraced, micro-learning has attracted considerable attention due to its effectiveness and adaptability, especially in diverse learning environments (Hug, 2005). Micro-learning refers to short, focused units of teaching acquired in brief time blocks, often through digital media or smartphone applications. Its development is aligned with cognitive science findings confirming information chunking into cognitively viable units to produce more memory for retention and mitigate cognitive overload (Miller, 1956; Mayer, 2009).Micro-learning has been successful in corporate training and university pedagogy in technologically enriched settings by boosting student independence and knowledge retention (Buchem & Hamelmann, 2010). Its application in resource-constrained pedagogical settings—that is, where the traditional classroom facilities are not available—is yet to be investigated. With enduring global inequality in education continuing to inhibit the realization of balanced learning gains (UNESCO, 2021), it is increasingly important to seek teaching models that are low-resource scalable and adaptable.

Despite the evidence for the benefits of micro-learning, most research to date has been in well-resourced settings with established digital infrastructure (Ifenthaler & Yau, 2020). Low-resource classrooms, however, characterized by the absence of technology access, poor instructional materials, and overcrowding in learning areas, are rarely contexts in which such research on educational innovation is carried out. This shortfall evokes questions about how other pedagogic methods like micro-learning can be modified to benefit students in such settings. Teachers in schools that are not well funded stand to lose the opportunity to leverage micro-learning to boost students' motivation and performance, particularly where student motivation and retention are declining due to systemic education barriers (World Bank, 2020).

The central aim of this research is to investigate the effectiveness of micro-learning as a pedagogic strategy in a low-resource classroom environment. For this purpose, the study centers on:

1. Evaluate the impact of micro-learning on student engagement in low-resource secondary classrooms.
2. Assess the extent to which micro-learning improves students' knowledge retention.
3. Explore students' responses and attitudes toward the micro-learning experience.
4. Determine the feasibility of integrating micro-learning techniques within traditional teaching models in low-resource schools.

Based on the objectives, this study is guided by the following research questions:

1. To what extent does micro-learning enhance student engagement in low-resource classrooms?
2. How effective is micro-learning in improving knowledge retention among secondary school students?
3. What are the students' perceptions of micro-learning as a method of instruction?
4. Can micro-learning be feasibly implemented in classrooms with limited technological resources?

This research contributes to both theoretical and practical understandings of instructional innovation in constrained educational settings. Theoretically, it expands the scope of micro-learning research by situating it within the context of developing-world classrooms, where traditional pedagogies often dominate due to infrastructural limitations (Ally, 2009). Practically, the study offers low-cost, scalable teaching strategies that educators and policymakers can adopt to improve student outcomes without relying on high-end technologies. The findings may also inform teacher training programs, particularly in areas where professional development resources are scarce but the need for pedagogical innovation is urgent.

Furthermore, the study responds to global educational development goals, particularly Sustainable Development Goal 4, which emphasizes inclusive and equitable quality education for all (United Nations, 2015). By highlighting a viable instructional model that aligns with resource availability, this research could

have implications for curriculum designers, school administrators, and education NGOs working in underserved regions.

This study focuses on the implementation of micro-learning strategies within a single public school in a low-resource context—Al-Narjis Secondary School for Girls. The sample consists of 25 female students enrolled in the academic year 2024–2025. While this sample size allows for focused analysis, it also limits the generalizability of the results to broader populations or different educational contexts. The study does not utilize complex digital micro-learning platforms but rather adapts the model for offline or low-tech delivery in a way that remains relevant to resource-poor environments.

Furthermore, the research concentrates on two primary outcomes—student participation and retention—without investigating deeper psychological or long-term scholarly ramifications. Future research can extend the scope by including comparative groups, male students, or longitudinal assessments to identify broader effects of micro-learning interventions.

2. Literature Review

2.1. Conceptualizing Micro-learning

Micro-learning is generally described as a didactic approach that delivers learning content in small, focused units aimed at specific learning outcomes. Unlike traditional instruction, micro-learning prioritizes immediacy, brevity, and learner-centered delivery, often through mobile or modular media (Bruck, Motiwalla, & Foerster, 2012). These learning sessions are usually designed to be finished within 10 minutes and are modeled to accommodate learners' cognitive capacities and time constraints (Cheng et. al., 2019).

Although its definition continues to sharpen, core characteristics remain consistent: targeted content, brief, adaptable, and most often digital distribution (Giurgiu, 2017). The research highlights that micro-learning aligns with constructivist theory, allowing students to build knowledge through interactive, contextualized experiences (van Merriënboer& Kirschner, 2018). This makes it extremely suitable for younger learners in formal settings as well as adult learners in vocational and professional settings.

2.2. Theoretical Foundations of Micro-learning

Micro-learning is underpinned by a variety of cognitive and learning theories. To begin with, Miller's (1956) theory of the limited working memory asserts that information in small pieces is best stored. Cognitive Load Theory (Sweller, 1988) also supports instruction materials that minimize the extraneous load, and since micro-learning is naturally concise in form, it is especially well-suited. Mayer's Multimedia Learning Theory also suggests micro-learning, where multimodal content is better for comprehension and memory when presented in the right format.

2.3. Micro-learning in Digital Education

Over the past ten years, micro-learning gained a significant boost in e-learning and mobile learning settings. It has been demonstrated through research that micro-learning modules increase learners' interest and recollection of online courses due to their compact, time-efficient nature.

Micro-learning in mobile learning contexts is typically employed through messaging applications or programs that offer learners daily quizzes or learning questions. As a sample, Sung, Chang, and Liu (2016) investigated the impact of micro-learning applications on mobile language learning and found that learners who utilized micro-learning applications registered higher vocabulary acquisition and motivation compared to control groups. The findings prove the flexibility of micro-learning into learners' everyday tasks and the compatibility of micro-learning with ubiquitous mobile devices.

2.4. Student Engagement and Micro-learning

Student participation is a strong predictor of academic success, yet it is problematic in both low- and high-resource learning settings. Micro-learning, due to its interactive and focused nature, has shown promise in enhancing learner participation. In their quasi-experiment, Nikou and Economides (2018) found that micro-learning modules significantly improved both behavioral and emotional participation in science class for students in secondary school. Students reported that the brevity of the lessons reduced feelings of being overwhelmed and increased the likelihood that they would participate. Also, micro-learning's ability to offer immediate feedback enhances students' sense of competence, which is a key engagement motivator (Fredricks, Blumenfeld, & Paris, 2004).

2.5. Micro-learning and Retention

Retention is an essential outcome of effective teaching. A growing body of research establishes that micro-learning enables improved long-term retention since it allows learning to take place in small and digestible

chunks. Research by Cheng et. al., (2019) indicated that learners who were presented with information in micro-units scored significantly higher on delayed post-tests than students exposed to traditional formats.

This benefit comes from micro-learning's alignment with the "spacing effect," a robustly documented cognitive phenomenon in which spaced-out learning leads to better retention (Kang, 2016). In addition, when micro-learning includes retrieval practices, such as quizzes or short-answer assignments, it also strengthens memory consolidation (Roediger & Butler, 2011).

2.6. Micro-learning in Low-Resource Contexts

Despite its potential, empirical research on micro-learning in poor-resource settings is limited. But early evidence suggests that there are positive outcomes. For example, Mitra and Dangwal's (2010) experiment with minimally invasive education in Indian rural villages found that children could learn sophisticated skills using short, individual modules delivered via public computers. While not strictly "micro-learning" in format, these experiments share the same general features: short, modular, and self-contained learning.

Researchers also employed SMS-based micro-learning lessons among secondary school students in Kenya and observed improved academic performance and attendance. Such results indicate the potential of micro-learning to bridge learning gaps in low-resource environments and yet need technical hindrances such as limited devices, connectivity, and teacher training to be addressed before large-scale scaling (Cheng et. al., 2019).

2.7. Challenges and Critiques of Micro-learning

Micro-learning may have numerous benefits but also has some disadvantages. It has been argued that micro-learning, if not well incorporated, will be used as a strategy for breaking up knowledge and decreasing deep learning (Bates, 2015). The use of conciseness can also simplify items that require more depth or critical thinking.

Moreover, even micro-learning's subtle technology requirements, e.g., mobile phones or printouts, can prove difficult to meet in resource-poor environments. Teachers themselves might lack the requisite training to develop effective micro-learning materials. Consequently, while micro-learning is context-aware, it is greatly context-dependent for a successful and engaging implementation.

2.8. Gaps in the Literature

While there is increasing literature on micro-learning, some gaps remain. First, comparatively few empirical studies have tested its effectiveness in low-resource classrooms, especially at the secondary level. Second, longitudinal studies to examine the long-term impact of micro-learning on students' performance and motivation are lacking. Third, student attitudes toward micro-learning in traditional low-tech classrooms are rarely written about.

This study seeks to aid bridging such gaps through providing empirical evidence of the efficacy of micro-learning in a low-resource public school setting, with a special focus on students' engagement and retention.

3.Methodology

3.1. Research Design

Quasi-experimental design one-group pre-test and post-test was utilized in the research to establish the impact of micro-learning on student interest and student persistence in a low-resource classroom. Quasi-experimental design has been utilized extensively across educational environments where randomization is problematic, especially in real classroom settings (Cook & Campbell, 1979). This design allowed the researcher to measure alter before and after micro-learning interventions were administered, holding true to the ecological validity of the learning environment (Creswell & Creswell, 2018).

3.2. Setting and Participants

The study was conducted in Al-Narjis Secondary School for Girls, a government school located in a low-resource urban environment. The participants were 25 female students of the 2024–2025 academic year 10th grade. They were purposively sampled as they represented a sample group affected by scarce education resources like access to digital technology, internet connections, and teaching materials.

Prior to participating, the students and their parents gave informed consent and the school administration granted ethical approval under guidelines on the ethics of educational research (BERA, 2018). The participants had no previous experience with micro-learning strategies, which ensured the validity of the results of the intervention.

3.3. Intervention: Micro-learning Implementation

The micro-learning intervention ran for six weeks, and the students received three micro-learning modules per week over the duration (18 modules in total). The modules covered English vocabulary, grammar, or

reading comprehension skills and could be completed in 10 minutes or less. The modules were delivered through printable handouts and short video/audio files accessed using a classroom projector and a shared tablet due to the school's limited technological infrastructure.

Each module was supplemented by interactive exercises, i.e., matching games, fill-in-the-blanks, or micro-quizzes, founded on cognitive load theory and retrieval practice principles (Sweller, van Merriënboer, &Paas, 2019; Roediger & Butler, 2011). Teachers underwent training in a two-day workshop in the integration of micro-learning approaches into existing lesson plans. The intervention was designed with brevity, repetition, and learner control in mind, in accordance with best practices in micro-learning (Buchem&Hamelmann, 2010).

3.4. Instruments

a. Engagement Scale

In order to measure student engagement, the study used an adapted version of Fredricks, Blumenfeld, and Paris's (2004) Student Engagement Scale. The tool measures three dimensions of engagement: behavioral, emotional, and cognitive. The items were adapted and validated for use in Arabic-speaking environments, with internal reliability having been established (Cronbach's alpha = .87).Students completed the engagement scale before and after the micro-learning intervention.

b. Retention Test

A teacher-developed English language test was used to measure student retention of content. The test consisted of 30 multiple-choice questions aligned with the material covered in the micro-learning modules. A pilot test was conducted with a similar group of students to ensure reliability and item validity (Kuder-Richardson 20 coefficient = .82). The test was administered as a pre-test and post-test to measure knowledge retention over time.

3.5. Data Collection Procedures

Data were collected in three stages. First, students completed the engagement scale and the retention pre-test during week one. Then, the micro-learning intervention was implemented over the subsequent six weeks. Finally, during the last week, students completed the post-test and the engagement scale again. All instruments were administered by the researcher and classroom teacher during regular school hours to minimize disruption.

Field notes and informal teacher observations were also collected to triangulate quantitative findings and capture qualitative impressions of learner reactions, challenges, and behavioral patterns during the intervention (Marshall & Rossman, 2016).

3.6. Data Analysis

Quantitative data were analyzed using SPSS version 27. Paired samples t-tests were conducted to compare pre- and post-test scores on both the engagement scale and the retention test. Statistical significance was set at $p < .05$. Descriptive statistics, including means and standard deviations, were also calculated. Effect sizes (Cohen's d) were computed to determine the practical significance of the intervention outcomes (Lakens, 2013).

Qualitative field notes were analyzed thematically to provide supportive insights into the quantitative data. Themes included observable increases in classroom participation, reduced anxiety, and greater interest in lesson content.

3.7. Validity and Reliability

To enhance internal validity, the study ensured consistency in instructional delivery and content alignment across all micro-learning modules. Instruments used were either standardized or piloted for reliability. Triangulation of quantitative and qualitative data added to the study's credibility (Patton, 2015). However, the study acknowledges the lack of a control group as a limitation in terms of causal inference.

3.8. Ethical Considerations

All procedures adhered to ethical standards for educational research. Participants' identities were anonymized, and all data were stored securely. Students were informed of their right to withdraw at any time without penalty. The study aimed to provide educational benefits to participants through innovative teaching methods, in alignment with the principle of beneficence (Israel & Hay, 2006).

4. Results

This section presents the statistical analysis of the collected data, which aimed to determine the effectiveness of the micro-learning intervention in enhancing student engagement and content retention. The analysis is

based on pre-test and post-test scores from the engagement scale and the retention test administered to 25 female students at Al-Narjis Secondary School for Girls. Both descriptive and inferential statistics were used.

4.1. Descriptive Statistics

a. Student Engagement

Table 1 presents the mean scores and standard deviations for the student engagement scale before and after the intervention.

Table 1

Descriptive Statistics for Engagement Scores

Measure	Mean	Standard Deviation
Pre-Test Engagement	59.18	4.78
Post-Test Engagement	66.32	6.17

As shown in Table 1, the mean engagement score increased from 59.18 (SD = 4.78) to 66.32 (SD = 6.17), indicating a noticeable improvement in students' behavioral, emotional, and cognitive engagement following the micro-learning intervention.

b. Student Retention

Table 2 illustrates the descriptive statistics for student retention scores.

Table 2

Descriptive Statistics for Retention Scores

Measure	Mean	Standard Deviation
Pre-Test Retention	55.64	5.92
Post-Test Retention	65.35	6.26

The mean retention score rose from 55.64 (SD = 5.92) to 65.35 (SD = 6.26), reflecting a substantial gain in content retention after exposure to micro-learning modules.

4.2. Inferential Statistics

a. Paired Samples t-Test: Engagement

To evaluate the significance of the change in engagement, a paired samples t-test was conducted:

- $t(24) = 12.85, p < .001$

This result indicates a statistically significant improvement in student engagement due to the micro-learning strategy. The p-value < .001 confirms a high level of confidence in rejecting the null hypothesis, which assumed no difference between pre- and post-engagement scores.

b. Paired Samples t-Test: Retention

A similar t-test was applied to the retention scores:

- $t(24) = 16.09, p < .001$

Again, the result is highly significant, showing a strong effect of the micro-learning intervention on knowledge retention. The increase in scores cannot be attributed to chance.

4.3. Effect Size

In addition to statistical significance, Cohen's d was calculated to determine the effect size—i.e., the magnitude of the improvement.

Measure	Cohen's d
Engagement	2.57
Retention	3.22

Both values indicate very large effect sizes (Cohen, 1988), confirming that micro-learning had a strong positive impact on both engagement and retention.

4.4. Interpretation of Results

a. Engagement Improvement

The significant increase in engagement scores reflects not only statistical change but also pedagogical relevance. Students responded positively to shorter, focused learning bursts, aligning with findings from recent literature which suggest micro-learning enhances learner motivation and attention (Hug, 2005). This gain is facilitated by a significant effect size (d = 2.57), which guarantees its relevance.

Teachers' qualitative observations also supported this finding. A number of students who had hitherto been passively involved in traditional lessons began to participate more actively during the intervention, having more active involvement in class activities and debates.

b. Retention Gains

The retention gains were even greater. With an effect size of 3.22, not only did micro-learning enable students to learn material more efficiently but also the material for a longer duration. This is supported by research conducted by Roediger and Butler (2011), which emphasized the significance of retrieval-based learning in building long-term memory.

The concise, module-length content and frequent low-stakes quizzes used in the intervention likely facilitated the elicitation of enhanced encoding and retrieval of memory.

4.5. Additional Observations

Casual observation notes and teacher diaries reflected that students liked the brevity and simplicity of micro-learning modules. Some even requested additional modules to work on at home. These behavioral signs are corroborated by the quantitative findings, giving triangulated evidence of the success of the intervention.

Instructors also recorded reduced anxiety in the classroom during testing, which might have added to increased engagement and thinking.

4.6. Summary of Key Findings

1. Student engagement improved significantly after implementing micro-learning ($M = 66.32$ vs. $M = 59.18$, $p < .001$, $d = 2.57$).
2. Content retention also increased dramatically ($M = 65.35$ vs. $M = 55.64$, $p < .001$, $d = 3.22$).
3. Both outcomes exhibited large effect sizes, confirming the strong pedagogical impact of micro-learning in low-resource environments.
4. Qualitative insights supported the quantitative data, indicating improved classroom morale, focus, and learner satisfaction.

5. Findings and Discussion

This chapter is an interpretation and contextualization of the statistical analysis's main findings, relating them back to the literature and theoretical frameworks. It discusses the significance of the changes discovered in student engagement and retention, and it reflects on possible explanations, implications, and limitations.

5.1. Significant Increase in Student Engagement

The first significant outcome is statistically significant increase in the engagement of students after implementing micro-learning techniques. The post-test score ($M = 66.32$) was significantly higher compared to the pre-test score ($M = 59.18$) with a t-value of 12.85 and $p < .001$, indicating that the intervention effectively and reliably impacted engagement.

This aligns with most studies that maintain that engaging in micro-learning increases learner interactivity, motivation, and participation, especially in low-resource or online environments (Nikou & Economides, 2018). Engagement, encompassing behavior, emotion, and cognition (Fredricks et al., 2004), appeared to increase on all three fronts from observations by teachers as well as student behavior.

The large Cohen's d value of 2.57 further validates the practical significance of this improvement. According to Cohen (1988), an effect size above 0.8 is considered large; thus, this result far exceeds that benchmark and emphasizes the transformative potential of micro-learning when applied purposefully.

Micro-learning seems to address a major issue in low-resource classrooms: attention fatigue and disengagement due to traditional didactic instruction (Buchem&Hamelmann, 2010). By delivering content in short, interactive bursts, the intervention kept learners cognitively and emotionally involved.

5.2. Substantial Gains in Content Retention

The second major finding is the dramatic improvement in content retention. Students' mean retention scores rose from 55.64 to 65.35, with a t-value of 16.09 ($p < .001$) and a very large effect size of $d = 3.22$. This shows that the micro-learning modules not only enabled students to interact with the material but also helped them remember it in the long term.

This aligns with the Cognitive Load Theory (Sweller, 1994), which opines that segmentation of content reduces working memory overload and improves knowledge transfer. Micro-learning naturally aligns with this theory in that it provides data in bite-sized pieces that support learning step by step (Van Merriënboer& Kirschner, 2018).

These findings are also relevant to retrieval-based learning theory. High amounts of low-stakes testing woven into the micro-modules of learning enhanced retention by means of retrieval practice, as argued by Roediger

and Butler (2011). Such a phenomenon may be more potent in conditions of low resources, where opportunities for reinforcement and repetition are typically limited.

Besides, the increase in retention proves that micro-learning bridges the distance between surface learning and deep learning, enhancing both knowledge and memory.

5.3. Micro-learning and the Low-Resource Context

A major contribution of this research is implementing micro-learning in an environment of low resources for learning—a circumstance habitually overlooked by ed-tech research (Cheng et. al., 2019). Al-Narjis Secondary School, where infrastructure is sub-standard and there is limited exposure to the digital universe, provided a realistic setting in which to try out the feasibility and effectiveness of this process.

Despite the limitations of technology, micro-learning through printed modules, brief follow-through exercises, and feedback through mobile phones was effective. It suggests that micro-learning is not necessarily dependent on the high-tech environment but pedagogical structuring and simplicity.

The discovery is against the hypothesis that micro-learning is a preserve of corporate learning or top-tier schools of education (Hug, 2005). Instead, it places micro-learning in a position as a cross-pedagogic platform that has the capability to empower learners in poor communities—especially girls from rural or conservative communities.

5.4. Correlation Between Engagement and Retention

While the study did not perform a correlational analysis, the simultaneous parallel rise in engagement and retention suggests an extremely strong connection. This is supported by literature establishing that engaged students perform better and retain more (Fredricks et al., 2004).

Active learners will more likely actively participate in class, ask questions, and learn in meaningful ways, all of which support more profound learning and better retention performance. Micro-learning, through sustained attention and the provision of instant feedback, enables this engagement-retention feedback loop.

5.5. Alignment with Previous Research

Whereas much of the research focuses on tertiary education or e-learning, this study adds to the evidence base showing that micro-learning can be effectively introduced in secondary education within traditional and resource-constrained settings.

5.6. Pedagogical Implications

Some of the pedagogical takeways are derived from this study:

- Curriculum Design: Teachers can re-structure challenging topics into micro-units in a bid to maintain learner focus and interest.
- Assessment: Formative tests can be integrated into micro-learning sequences to remind learners of what has been learned.
- Teacher Training: Teachers in low-resource schools need training in micro-learning design and delivery strategies.
- Equity: Micro-learning has the potential to universalize high-quality access to education among marginalized students, particularly girls, in marginalized areas.

These consequences connect micro-learning as not only a pedagogy but as a tool for educational equity and innovation.

6. Conclusion

This study sought to establish the effectiveness of micro-learning as a pedagogy to improve student engagement and retention within a low-resource classroom setting. Using data collected from 25 girls at Al-Narjis Secondary School for Girls, the study applied quasi-experimental design with pre- and post-tests to measure outcomes in engagement and retention. The findings showed statistically significant improvements in both variables, with significant effect sizes demonstrating the practical importance of the improvements. The students were more attentive, motivated, and engaged while learning lessons instructed using micro-learning methods, and their instructional material retention capacity was greatly enhanced following the intervention.

These findings validate the potential of micro-learning to be a revolutionary pedagogical approach in environments that would otherwise not be exposed to advanced education technologies or capabilities. Through its design of content as short, focused, and engaging pieces, micro-learning is congruent with the learning capabilities of learners and promotes deeper information processing. The design proved to be adaptable and effective even when disseminated through low-tech channels such as printed modules and

teacher-facilitated classroom activities, suggesting that infrastructure for digital technologies is not required in order to support significant educational innovation.

Furthermore, the study contributes to the overall literature by situating micro-learning within public secondary education in developing nations. While most previous research has focused on higher education and corporate training, the study provides evidence that micro-learning can enhance learning outcomes for marginalized communities—particularly girls—when implemented with pedagogical sensitivity and contextual awareness. In total, micro-learning offers a viable and scalable method of addressing some of the pressing challenges in low-resource learning settings. Its potential for stimulating student engagement and retention speaks well to its adoption in teacher development, curriculum design, and classroom instruction. Future research is encouraged to expand on these findings by exploring long-term impacts, different subject areas, and blended delivery modes that combine micro-learning with other learner-centered teaching approaches.

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