العراقية
المجلات الاكاديمية العلمية
IRAQI Academic Scientific Journals
Al-Itqan Journal of Humanities
available online at
https://iasj.rdd.edu.iq/journals/journal/view/575
ISSN: 3105-1073 (OnLine)
المجلة معتمدة بالترقيات العلمية حسب كتاب وزارة التعليم العراقية (46404-1410) في 2026/4/27

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

Asst. Lect. Eltifat Neamah Odhaib
General Directorate of Education in Wasit
eodhaib@uowasit.edu.iq

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

م.م. التفات نعمة عذيب
وزاره التربية / المديرية العامة لتربيه واسط

Abstract
Micro-learning represents one of the recent innovative educational approaches that present information in small portions, which makes this form of learning ideal for use in low resource educational environments. This study is intended to examine the applicability and effectiveness of micro-learning in improving the engagement and knowledge retention of learners in low resource classrooms. Micro-learning represents a new educational method that has not been extensively researched in the context of developing countries where access to educational materials and technologies is limited. The current research attempts to fill this gap by examining the application of micro-learning as a practical method for improving learning in such environments. The study was conducted at Al-Narjis Secondary School for Girls, which represents a government school with limited technological capacity. Purpose of this study was to evaluate the effectiveness of micro-learning modules in order to improve engagement and retention level of the learner. In pre-test and post-test design, improvement in academic achievement among students was measured, whereas in observational data collection, improvement in the engagement level of learners was measured. Findings demonstrated that post-test scores of learners were significantly high, which implied the improved retention of information by the learners. Observational data also indicated that learners have become more motivated and participated in micro-learning than the conventional method of teaching. These findings support the effectiveness of micro-learning as an effective and adaptable technique of teaching in the under-resourced environment, which is a good alternative to traditional teaching.
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 key objective of this research is to evaluate the efficacy of micro-learning as a teaching approach in a low-resource classroom setting. The key focus of this study will be on:

1.Analyze how the micro-learning technique has helped improve the engagement of the students in resource-limited secondary school settings.
2.Determine how micro-learning has increased the knowledge retention capacity of the students.
3.Identify the reactions and attitudes of the students towards micro-learning.
4.Measure the viability of micro-learning in the context of conventional teaching methodologies in resource-limited settings.

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

1.What is the impact of micro-learning on student engagement in resource-starved classes?
2.How good is micro-learning in improving knowledge retention among secondary school students?
3.How do students perceive micro-learning as an approach to learning?
4.Is micro-learning feasible in classes where technology is limited?

The research is relevant both in the theoretical and practical sense for the process of instruction innovation in difficult conditions of education. From the theoretical side, the study extends the scope of microlearning studies by applying them to developing countries' education systems, where traditional methods of teaching are used because of technical restrictions (Ally, 2009). In terms of practice, the research identifies low-cost techniques for teachers which would allow enhancing students' achievements regardless of the absence of expensive equipment.

In addition to this, the research is also relevant to global educational development objectives, especially SDG 4, where education that is inclusive and of high quality is considered important (United Nations, 2015). By

identifying an effective teaching model based on resource availability, the research has potential application in areas like curriculum planning and education NGO's operating in underprivileged areas.

This research project examines the application of micro-learning techniques at one public school in resource-limited conditions—Al-Narjis Secondary School for Girls. The sample comprises 25 girls who attend the school during the 2024-2025 academic year. Although this sample will be sufficiently small to conduct an examination of the issue, it will not provide the opportunity to generalize the findings to larger groups or other settings. This research does not make use of sophisticated technology platforms for micro-learning; instead, it will apply the theory to non-technological conditions.

Moreover, the study is focused on two main consequences – student engagement and retention, without exploring any additional psychological or scholarly implications that could arise. The future research could benefit from expansion to include control groups or male students.

2. Literature Review

2.1. Conceptualizing Micro-learning

It can be defined as a method of teaching that involves the distribution of learning material in small units intended to achieve particular goals. In contrast to conventional learning, microlearning emphasizes immediacy, succinctness, and learning-centered delivery using mobile or modular media (Bruck, Motiwalla, & Foerster, 2012). Learning takes place in short sessions that are meant to last for about 10 minutes and are based on learners' ability to learn and their 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'sMultimedia 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 a very important result of teaching. There is increasing evidence in academic literature about how micro-learning helps to achieve better retention because of the ability to learn in small increments. Research by Chenget. 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

A quasi-experimental design, specifically, one group pretest and posttest, was used in this research study to determine the effect of micro-learning on student interest and student persistence in a resource-limited class environment. The quasi-experimental design has been used widely in educational settings where randomization cannot be done, particularly in the classroom setting (Cook & Campbell, 1979). Through the use of this design, the researcher was able to measure alterations before and after the implementation of micro-learning interventions, maintaining ecological validity in the learning environment (Creswell & Creswell, 2018).

3.2. Setting and Participants

The experiment took place at Al-Narjis Secondary School for Girls, a government school situated in a low-resource urban area. There were 25 female students from 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.

Before taking part in the study, the students as well as their parents provided an informed consent while the administration of the school provided ethical approval following the ethical guidelines of educational research (BERA, 2018). The participants did not have any prior experience with microlearning techniques; hence, the findings were valid.

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

An English language test developed by the researcher was employed to determine the retention of students regarding the learning material. The test comprised of 30 multiple choice questions corresponding to the topics taught in the micro-learning modules. A pilot test was conducted on a comparable sample of students in order to ascertain the reliability and validity of items (Kuder-Richardson 20 coefficient = .82).

3.5. Data Collection Procedures

The data collection process was conducted through three phases. Firstly, the engagement and retention pre-test were administered to students at the end of the first week. Secondly, the intervention was carried out for six weeks from the second week up until the seventh week. Thirdly, the post-test and engagement test were conducted to students at the end of the last week.

Field notes and observations of teachers were also made to support the quantitative data through triangulation by capturing qualitative data on learner reaction and behavior patterns during the intervention (Marshall & Rossman, 2016).

3.6. Data Analysis

The quantitative data were analyzed through the use of SPSS version 27. The paired samples t-tests were used to analyze the results of the engagement scale test and retention test before and after the implementation of the intervention. The level of significance was set at $p < .05$. Descriptive statistics, which included the mean and standard deviation, were also computed. Cohen's d was calculated for effect size (Lakens, 2013).

The qualitative field notes were analyzed thematically to help give additional insights into the quantitative data collected. These themes include increased classroom participation, decreased anxiety, and increased interest in lesson material.

3.7. Validity and Reliability

For the purpose of increasing internal validity, the research had consistency in the way instructions were delivered and the correlation between the module contents. The instruments used were either standardized or were pilot tested for their reliability. The triangulation of quantitative and qualitative data increased the validity of the study (Patton, 2015). However, it must be noted that there was no control group in the study.

3.8. Ethical Considerations

Ethical standards were followed in all research procedures done. Anonymity was ensured and all data were kept confidential. It was made clear to the students that they could withdraw from the study at any time without facing any kind of repercussions. It was the objective of the study to benefit the participants educationally, following the concept of beneficence (Israel & Hay, 2006).

4. Results

This part of the discussion provides a statistical analysis of the gathered data with an intention to find out whether there is any effectiveness of the micro-learning strategy as far as the increase in student engagement and retention is concerned. The statistics involve the scores obtained through pre-test and post-test from the engagement scale and retention test taken by 25 girls at Al-Narjis Secondary School for Girls.

4.1. Descriptive Statistics

a. Student Engagement

Table 1 shows the mean and standard deviation values of student engagement scale scores 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 depicted in Table 1 below, the mean engagement score rose from 59.18 (SD = 4.78) to 66.32 (SD = 6.17), thus suggesting significant improvements in the students' behavioral, emotional, and cognitive engagement.

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

There was an increase in the mean retention score from 55.64 (SD=5.92) to 65.35 (SD=6.26) indicating significant improvement in content retention with the introduction of micro-learning modules.

4.2. Inferential Statistics

a. Paired Samples t-Test: Engagement

To assess the importance of the change in engagement, a paired sample t-test was performed:

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

The above conclusion shows that there is a statistically significant increase in the engagement of students owing to the micro-learning method. The p-value < .001 shows that there is a high degree of confidence when the null hypothesis was rejected.

b. Paired Samples t-Test: Retention

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

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

Once again, the finding is highly significant, demonstrating the presence of a strong impact of micro-learning intervention on knowledge retention. The rise in the scores can never be accidental.

4.3. Effect Size

Along with statistical significance, the effect size was measured using Cohen's d, which refers to the degree of improvement.

Measure	Cohen's d
Engagement	2.57
Retention	3.22

Both effect sizes show large effect size (Cohen, 1988) and thus confirm that the micro-learning technique significantly impacted both engagement and retention.

4.4. Interpretation of Results

a. Engagement Improvement

The marked improvement in the engagement scores is not only an example of statistical significance but also pedagogical significance. Shorter learning intervals were well received by the students, supporting the recent research findings that micro-learning increases 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

Retention was significantly higher. With an effect size of 3.22, not only could micro-learning help the learners learn faster but also retain the learned information for a longer period. This is evident from a study carried out by Roediger & Butler (2011) regarding the importance of retrieval practice for long-term memory formation.

It is possible that the brevity and module-length nature of the content coupled with the regularity of the ungraded quizzes helped to elicit improved encoding and memory retrieval.

4.5. Additional Observations

The observations made and recorded through casual observations and teacher diaries indicated that students appreciated the fact that the microlearning modules were concise and easy to understand. Some students even asked for more modules so that they could do them at home. The above-mentioned behavior is supported by the results.

The instructors noted lower levels of anxiety during class tests, which could also have contributed to higher engagement and cognition.

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 results showed large effect sizes, thereby corroborating the huge impact of micro-learning on teaching in poor settings.

4.These findings were further validated by qualitative insights showing increased class morale and satisfaction among learners.

5. Findings and Discussion

Discussion

The following chapter presents an interpretation and explanation of the key results found through the statistical analysis. This chapter provides a critical look at the importance of the changes found in the areas of student engagement and retention.

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 is consistent with the findings of most researchers who have established that micro-learning increases learner engagement, motivation, and interaction, particularly in environments that lack adequate resources or those that are virtual (Nikou & Economides, 2018). Engaged learning involves behavior, emotion, and cognition (Fredricks et al., 2004) and seemed to be enhanced on all three aspects.

The huge value of Cohen's d of 2.57 serves to reiterate the practical importance of this advancement even more. Cohen (1988) states that anything larger than 0.8 qualifies as a large effect size, and hence this result clearly surpasses this threshold.

It would appear that micro-learning takes care of one of the most important challenges facing classrooms with limited resources: Attention fatigue and disengagement resulting from conventional teaching methods (Buchem&Hamelmann, 2010). This method ensured that students remained mentally and emotionally engaged with the material being taught.

5.2. Substantial Gains in Content Retention

The second notable discovery is the significant increase in the retention of the information. The mean retention score of the students improved from 55.64 to 65.35, with t-value being 16.09 ($p<.001$), and an extremely large effect size of $d = 3.22$. This demonstrates that apart from making interactions with the information possible for the students, the microlearning modules ensured retention of information by the students.

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. Both measures revealed statistical significance in improvement, with substantial effect sizes indicating the importance of the changes. Students became more attentive, motivated, and involved while being taught through micro-learning techniques, and their ability to remember the instructional content improved significantly.

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 summary, there are several ways that micro-learning can be used as an effective solution to certain issues facing learning contexts with limited resources. This technique’s ability to help engage learners in their classes

as well as enhance their learning process and retention rates makes it a perfect fit for use in teacher training, curriculum creation, and class teachings. More research is encouraged in order to explore these outcomes further.

References

· Ally, M. (2009). *Mobile learning: Transforming the delivery of education and training*. Athabasca University Press.

· Bates, T. (2015). *Teaching in a digital age: Guidelines for designing teaching and learning*. Tony Bates Associates.

· BERA (British Educational Research Association). (2018). *Ethical guidelines for educational research* (4th ed.). https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018

· Bruck, P. A., Motiwalla, L., & Foerster, F. (2012). Mobile learning with micro-content: A framework and evaluation. *Journal of the Research Center for Educational Technology, 8*(1), 1–31.

· Buchem, I., &Hamelmann, H. (2010). Micro-learning: A strategy for ongoing professional development. *eLearning Papers, 21*, 1–12.

· Cheng, Y. W., Wang, Y., Cheng, I. L., & Chen, N. S. (2019). An in-depth analysis of the interaction transitions in a collaborative Augmented Reality-based mathematic game. Interactive Learning Environments, 27(5–6), 782–796. https://doi.org/10.1080/10494820.2019.1610448.

· Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings*. Houghton Mifflin.

· Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE.

· Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59–109.

· Giurgiu, L. (2017). Micro-learning—An evolving eLearning trend. *Scientific Bulletin, 22*(1), 18–23.

· Hug, T. (2005). Micro-learning and narration: Exploring possibilities of utilization of narrations and storytelling for the designing of "micro units" and didactical micro-learning arrangements. In *Proceedings of the Fourth Media in Transition Conference* (pp. 1–6).

· Ifenthaler, D., & Yau, J. Y. K. (2020). Utilising learning analytics to support study success in higher education: A systematic review. *Educational Technology Research and Development, 68*(4), 1961–1990. https://doi.org/10.1007/s11423-020-09788-z

· Israel, M., & Hay, I. (2006). *Research ethics for social scientists*. SAGE Publications.

· Kang, S. H. K. (2016). Spaced repetition promotes efficient and effective learning: Policy implications for instruction. *Policy Insights from the Behavioral and Brain Sciences, 3*(1), 12–19.

· Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4*, 863. https://doi.org/10.3389/fpsyg.2013.00863

· Marshall, C., & Rossman, G. B. (2016). *Designing qualitative research* (6th ed.). SAGE Publications.

· Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.

· Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*(2), 81–97.

· Mitra, S., &Dangwal, R. (2010). Limits to self-organizing systems of learning—The Kalikuppam experiment. *British Journal of Educational Technology, 41*(5), 672–688.

· Nikou, S. A., & Economides, A. A. (2018). Mobile-based micro-learning and assessment: Impact on learning performance and motivation of high school students. *Journal of Computer Assisted Learning, 34*(3), 269–278.

· Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). SAGE Publications.

· Roediger, H. L., & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Sciences, 15*(1), 20–27.

· Sung, Y.-T., Chang, K.-E., & Liu, T.-C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education, 94*, 252–275.

· Sweller, J., van Merriënboer, J. J. G., &Paas, F. G. W. C. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review, 31*, 261–292. https://doi.org/10.1007/s10648-019-09465-5

· UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. https://unesdoc.unesco.org/ark:/48223/pf0000379707

· United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. https://sdgs.un.org/2030agenda

· van Merriënboer, J. J. G., & Kirschner, P. A. (2018). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Routledge.

· World Bank. (2020). *Ending learning poverty: What will it take?*https://www.worldbank.org/en/topic/education/publication/ending-learning-poverty