Effectiveness of micro-learning as an instructional innovation in basic education: The case of a public basic school in Ghana

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ABSTRACT

Present-day learners are accustomed to interactive and engaging methods of learning with the aid of technological tools. In line with this, microlearning has emerged as an innovative approach to learning. While widely studied in corporate training and higher education, studies at the basic educational level, specifically, as a classroom-based, formally structured and collectively paced instructional tool used in real time are limited. This study investigated the efficacy of microlearning as an instructional innovation in basic education, specifically the impact of microlearning on learner performance and the perceptions of teachers and a head teacher on the use of microlearning. The Cognitive Theory of Multimedia Learning guided this study. An embedded mixed-methods design was employed. The study involved seventy-three learners, two teachers and one head teacher. For the quantitative phase, an experiment was conducted on seventy-three learners who were randomly assigned into three classes. Data were collected through pre- and post-tests and analysed using Kruskal–Wallis and Wilcoxon Signed-Rank Tests. For the qualitative phase, data were gathered via semi-structured interviews with the participants to explore their perceptions of microlearning. Qualitative data collected from the interviews were analysed using thematic analysis. Results indicated that the microlearning significantly improved learner performance. The participants also had positive perceptions of microlearning, emphasising that the teaching technique compared to traditional instruction, enhanced engagement and comprehension due to the use of brief lessons combining visuals, narrations, and text. Nonetheless, the participants had concerns regarding implementing microlearning in everyday classroom due to challenges such as financial constraints and technical competence. The study concluded that microlearning has a strong potential to enhance learning outcomes and should be considered as an instructional approach in regular classroom practice. Recommendations were provided for considering its adoption in regular teaching practices and the provision of skills training to teachers on its use.

Keywords: Basic School, Learner Performance, Microlearning, Quasi-Experiment, Ghana

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I. INTRODUCTION

Over the years, education has undergone significant transformation in response to evolving learner needs and technological advancement. Contemporary learners currently prefer interactive, participatory, and technology-enhanced instructional experiences to passive and linear forms of content delivery (Lynch & Knight, 2011). Traditional teacher-centred approaches, where learners passively receive information are increasingly misaligned with learners who prefer engaging and multimodal interaction. This shift has resulted in the adoption of innovative instructional approaches that redefine the roles of teachers and learners, positioning learning as cognitively engaging rather than transmissive (Purković et al., 2024).

Microlearning is defined as the delivery of focused, bite-sized learning units aligned with specific objectives often delivered via technology (Kovachev et al., 2011). It is an instructional design architecture grounded in segmentation (Hug, 2005) and is composed of microcontents that are loosely structured but interconnected (Buchem & Hamelmann, 2010). Microlearning results in improved test scores, knowledge retention, and learner satisfaction compared to traditional instructional approaches (Mohammed et al., 2018; Giurgiu, 2017; Leela et al., 2019). Several studies suggest that microlearning enhances learner performance (Fidan, 2023), improves retention (Dolasinski & Reynolds, 2021) and enhances attention (Javorcik & Polasek, 2019). Grounded in the Cognitive Theory of Multimedia Learning, microlearning emphasizes segmentation and the use of multimedia (Mayer, 2024). The theory posits that well-designed multimedia instruction can reduce cognitive load and foster meaningful learning. This suggests that microlearning, when designed according to multimedia learning principles, can function as an effective instructional approach for enhancing learning outcomes.

Despite growing research on microlearning in higher education, corporate training, and professional development, its application in basic education is limited (Silva et al., 2025). Also, much of the existing research has been conducted within broader pedagogical frameworks such as flipped classrooms (Fidan, 2023), self-directed learning (Palti & Rosenberg-Kima, 2022), scenario-based learning (Zulueta & Panoy, 2022), and blended learning or e-learning ecosystems (Semingson et al., 2015). In addition, studies on microlearning commonly emphasise individual access and self-pacing. A study was conducted by Palti and Rosenberg-Kima (2022) to assess the impact of task-centred microlearning on self-regulated learning in grade eight learners in Israel. The learners accessed microlearning units individually and worked in teams to develop digital escape rooms. Another study was conducted by Závodná et al. (2024) to find the impact of microlearning modules on learner outcomes and perceived effectiveness in a lower secondary school in the Czech Republic. Using two experimental groups and one control group, the authors developed and implemented microlearning lessons via Google Classroom, Scratch and Blooket which allowed for individualised self-paced learning. Similarly, Suleiman et al. (2025) developed microlearning modules which were implemented via mobile devices and internet connectivity in basic schools in Nigeria (Suleiman et al., 2025). Another study by Zulueta and Panoy (2022) determined the impact of scenario-based microlearning on science skills of grade six learners. Implemented via distance learning through self-access modules, it resulted in improved performance and learner satisfaction. In these studies, microlearning is frequently implemented through mobile devices, online platforms, or app-based environments.

Although microlearning is frequently associated with self-paced learning and individual access through mobile or digital devices, these characteristics are not universally regarded as defining features of the concept. Hug (2005) proposed that microlearning can be understood through several interacting dimensions including time, content, curriculum, form, process, mediality, and learning type. Within this perspective, microlearning is primarily characterised by the granularity and organisation of learning units. Similarly, Monib et al. (2025) posit that microlearning centres on the delivery of small targeted units of instructional content aligned with specific learning objectives. Sankaranarayanan et al. (2022) define microlearning as a digital instructional strategy that breaks down content into brief activities and is focused on specific outcomes. Across literature, microlearning is more consistently characterised by brevity, focus on a single learning objective, self-contained content units, and reduced cognitive demands. In addition, Sankaranarayanan et al. (2022) note that while mobile devices are well-suited to the delivery of short learning units, microlearning is not inherently dependent on mobile technology. However, empirical evidence on microlearning as a structured, collectively paced instructional strategy embedded within classroom teaching remains limited, particularly in basic education settings. Therefore, this study investigates the implementation and effectiveness of microlearning as a classroom-based instructional structure in which learners collectively engage with short, focused learning units under teacher facilitation.

1.1 Research Questions

i. What is the effect of microlearning on performance of learners?
ii. How do teachers and head teachers perceive microlearning as an instructional approach?

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Cognitive Theory of Multimedia Learning

The Cognitive Theory of Multimedia Learning was proposed by Mayer (CTML). The theory posits that learning occurs through active cognitive processes when individuals engage with multimedia materials (Mayer, 2024). It is underpinned by three core assumptions; dual-channel assumption, limited capacity assumption, and active processing assumption. The dual-channel assumption posits that learners process information through separate visual and auditory channels. The limited capacity assumption that suggests that each channel has a limited information-processing capacity, hence, excessive information can overload the working memory. Further, the active processing capacity emphasises that meaningful learning involves an integration of cognitive processes during instruction. A central premise of CTML is that, the working memory has limited capacity. During learning, this limited capacity goes through either extraneous processing, essential processing, or generative processing (Mayer, 2024). Extraneous processing refers to the cognitive activity that does not contribute to achieving the instructional goal, and arises from the inclusion of irrelevant elements in learning materials. Essential processing refers to the mental effort needed to form a representation of the core content in working memory. Generative processing involves the mental effort used to understand and make sense of the information. These three forms of processing all compete for the same limited cognitive resources. As a result, cognitive capacity used for extraneous processing reduces the capacity available for essential and generative processing, while capacity used for essential processing may also limit the capacity available for generative processing. In line with this, microlearning delivers content in a way that recognises the limited processing capacity of the working memory by delivering content through bite-sized units. According to Tufan (2021), microlearning designed with cognition elements and multimedia principles better support knowledge acquisition. The underlying premise of investigating microlearning under the Cognitive Theory of Multimedia Learning lens is based on the notion that individuals can achieve a deeper level of comprehension when exposed to small-sized learning materials of several formats (Mayer, 2024). In line with this, microlearning encourages active participation through interactive elements fostering deeper engagement with the content.

2.2 Empirical Review

2.2.1 Microlearning Approach

Microlearning is a digital instructional approach that segments content into short learning activities designed to achieve specific learning outcomes (Sankaranarayanan et al., 2022) and typically takes the shape of brief films, audio files, descriptive writings, images and graphics, small quizzes, or a combination of some (Söderberg, 2023). The video formats use text, images, sound, and illustrations to communicate its content within a single learning unit. This becomes a multimedia. In line with the Cognitive Theory of Multimedia Learning, the use of various media formats enhances information assimilation and retention (Mayer, 2024). While microlearning emphasises brevity, authors have proposed varying durations for microlearning lessons. For instance, Mckee and Ntokos (2022) suggest that microlearning video lessons should ideally last between five and eight minutes. Similarly, Javorcik and Polasek (2019) explain that microlearning activities can usually be completed within five to seven minutes. Hug (2005) describes microlearning as a teaching approach made up of seven parts: learning content, curriculum, format, types of learning, media, learning process, and time. Giurgiu (2017) also suggests microlearning as a useful method for lifelong learning because it fits well with modern technology and can be adapted to meet learners' needs.

Even though microlearning has many benefits, some researchers have concerns about it. One issue is that it may not support deep thinking. Zhang et al. (2015) explain that learners need to stay very focused when using short, broken pieces of content. In addition, learners may find it difficult to connect different pieces of information into a clear understanding, especially when there are too many microlearning resources (Huo & Shen, 2015). Due to this, Söderberg (2023) argues that microlearning is more suitable for simple and practical topics, as complex subjects may require more time.

2.2.2 Microlearning and Learner Performance

Learning performance has been defined in various ways, but it generally refers to learners' ability to demonstrate and apply essential knowledge and skills required for success both in and beyond the classroom (Young et al., 2003). It reflects how well learners achieve intended learning objectives and is typically assessed through measures such as assignments, tests, and class participation (Steinmayr et al., 2015). Academic performance encompasses both the acquisition of practical and theoretical knowledge and observable outcomes, including grades or scores in achievement tests (Steinmayr et al., 2015). Test results are commonly used to indicate the extent to which learners have attained specified learning goals (Riswanto & Aryani, 2017; Geng et al., 2019; Okyere et al., 2018).

Various factors influence academic performance, including the instructional strategies adopted by teachers (Firmender et al., 2014) and the learning models they employ (Al-Ani, 2013). In this regard, microlearning acts as an approach which aligns with cognition of individuals by reducing cognitive load and enabling students to better comprehend content (Susilana et al., 2022). By reducing unnecessary cognitive demands and encouraging cognitive engagement, microlearning can support improved academic performance. Research increasingly shows its positive effect on learning outcomes, with several studies reporting that learners who receive instruction through microlearning perform better academically than those taught through conventional teaching methods. For example, Eden et al. (2020), in a quasi-experimental study involving computer science students reported significantly higher test scores among learners in the microlearning group than those in the control group.

In a related study, Wen and Zhang (2015) evaluated a Micro Lecture Mobile Learning System (MMLS) at Guangzhou Medical University in China and found that students who used the system significantly outperformed those who did not. Javorcik and Polasek (2019) also concluded that microlearning is an effective instructional approach that facilitates the achievement of learning objectives, with students perceiving it as more beneficial than conventional e-learning, particularly for those with special needs. In addition, Dolasinski and Reynolds (2021) reported that microlearning led to increased knowledge acquisition and was positively perceived by students, who indicated improvements in reasoning, creativity, and problem-solving skills. Mohammed, et al (2018) found that microlearning improved learning outcomes by 18% and resulted in an 82% pass rate compared to traditional instruction. Similarly, Giurgiu (2017) observed that learners retained at least 20% more knowledge when taught using microlearning approaches. The array of studies on microlearning is a testament to its relevance in teaching and learning in the contemporary times hence the need for investigation of efficacy at all levels of education.

2.2.3 Perception of Teachers and Headteachers on the Use of Microlearning

Even though learner-centred classrooms are facilitated by teachers, their acceptance of new teaching approaches is essential for successful implementation. School leaders such as head teachers, also play an important role by motivating teachers to integrate innovation into teaching (Brolund, 2016). Instructional leaders work closely with teachers to promote effective teaching practices and set clear academic goals (Brolund, 2016). This collaboration contributes to effective instructional practices that promote learner success. Learning outcomes can also improve when the classroom environment is designed in ways that support learners' cognitive processes. The successful implementation of microlearning therefore depends on instructional leadership and the active involvement of teachers in classroom practice. Therefore, both groups must accept and support this approach, as their involvement influences how well new technological approaches are integrated into classrooms (Greaves et al., 2010). However, there is limited research on head teachers and teachers' perceptions of using microlearning for instruction. Sankaranarayanan (2022), through interviews with a course instructor, found that the teacher preferred microlearning because students showed high interest and commitment, and it improved their performance. The instructor even planned to teach the entire course using microlearning in the following academic year. Similarly, Hu and Liu (2020) explored university teachers' views on incorporating microlearning into traditional classrooms. Their study showed that over 80% of educators supported including microlearning in the curriculum, especially through short instructional videos that help students learn independently. Nonetheless, little is known about the perceptions of head teachers regarding microlearning.

III. METHODOLOGY

3.1 Research Design

This study adopted an embedded mixed-methods design, which involves the use of a primary approach with a secondary method nested within it (Creswell & Plano Clark, 2018; Kuranchie, 2021). The study was primarily quantitative, with a qualitative component embedded within the design. The quantitative phase employed a randomized experimental pre-test–post-test control group design to examine the impact of microlearning on learner performance. Qualitative data were collected after the experiment. The qualitative phase sought to provide insight into the participants' experiences with microlearning.

3.2 Research Participants

We conducted the study in a public basic school in Ghana. The participants included Basic Stage 8 learners with ages ranging from 12 to 16 years. The learners were 73 in number. Additionally, 2 teachers and 1 head teacher participated in the qualitative phase through semi-structured interviews. The teachers taught Integrated Science while the head teacher was responsible for providing instructional leadership.

3.3 Instruments

To gather data for the study, tests were developed by the researchers. Each test comprised ten multiple-choice questions. Pre-tests were developed to gather data on learners' prior knowledge on the lessons, to establish a baseline level of understanding and a basis for comparison with subsequent tests. Post-tests were also developed to measure the extent of learners' understanding of the learning materials as well as the knowledge retained after instruction. The post-test questions were similar in structure and content to those in the pre-test.

After the test items were developed, they were reviewed by two teachers and the head teacher, who served as the instructional leader, to ensure alignment with the standards of the National Council for Curriculum and Assessment (NaCCA). The instrument was also examined by a specialist in Evaluation and Assessment to confirm its validity and appropriateness.

The reliability of both the pre-test and post-test items was determined using the Kuder–Richardson Formula 20 (KR-20). For the pre-tests, the first lesson produced a KR-20 coefficient of 0.74, the second lesson 0.84, the third lesson 0.74, and the fourth lesson 0.89. For the post-tests, the first lesson yielded a KR-20 coefficient of 0.87, the second lesson 0.82, the third lesson 0.84, and the fourth lesson 0.78. These coefficients indicate satisfactory reliability for all instruments, as values above 0.70 are generally considered acceptable according to Nunnally and Bernstein (1994). In addition, item difficulty indices were calculated for all tests. The results showed that all items fell within the moderate difficulty range, with values between 0.30 and 0.70 regarded as acceptable by Wiersma and Jurs (1990).

A semi-structured interview guide was used to collect qualitative data from the teachers and head teacher. The interview guide was used to collect data on the perceptions of the teachers and head teacher on the usefulness of microlearning as an instructional approach.

3.4 Data Collection Method

A quasi-experimental study was conducted to ascertain the efficacy of microlearning in improving students' understanding of instructions. The study began with a random assignment of individual learners into three groups. This was done using a computer-generated randomisation procedure. Each participant was assigned a random number using the RAND function in Microsoft Excel and the list was sorted in ascending order. Based on this ordered list, participants were assigned to groups of twenty-five, twenty-five, and twenty-three respectively. There were two experimental groups and one control group named Microlearning Group 1(M1), Microlearning Group 2 (M2), and Traditional Group (T) respectively. There were twenty-five learners in Microlearning Group 1, twenty-five in Microlearning Group 2, and twenty-three in Traditional Group. Microlearning Groups 1 and 2 received instructions through microlearning. However, the Traditional Group received conventional teacher-centred instruction covering the same content. The use of two identical experimental groups was intended to assess the consistency and replicability of the impact of microlearning. The study was implemented over a period of 6 weeks, teaching four different topics in Integrated Science which are Plant and Animal Cell, Atomic Structure, Carbon Cycle, and Rainfall.

The videos used were guided by the CTML principles signaling, redundancy, personalization, coherence, spatial contiguity, pre-training, modality and multimedia. The videos reflected the coherence principle through the exclusion of irrelevant visuals, background music, and non-essential information, ensuring that learners' attention was focused on essential instructional content. The signaling principle was evident in the use of visual cues such as highlighting, arrows, and emphasis on key terms to guide learners' attention to critical elements of the lesson. In line with the redundancy principle, there was minimised verbatim on-screen text while narration was present, thereby avoiding unnecessary cognitive overload. In addition, the spatial contiguity principle was reflected in videos where related text, visuals, and narration were presented closely together, supporting integrated processing of information. The videos also aligned with the pre-training principle, where key concepts and terminology were introduced before complex explanations, and the modality principle, which favoured narration combined with visuals rather than text-heavy presentations. In line with the multimedia principle, verbal explanations were paired with visual explanations to support dual-channel processing. The personalisation principle was also evident in the use of conversational narration styles that made the instructional content more learner-friendly and engaging.

The study began with a pre-test, where learners were quizzed on the course content before the start of each lesson. After that, lessons were implemented. Microlearning Groups 1 and 2 were taught using microlearning videos which were accessed collectively without individual mobile devices. Lessons were delivered in short, structured instructional units during regular classroom sessions accessed via a shared projected screen. On the other hand, the Traditional Group received instruction using traditional linear teaching methods. All the three classes were taught by the same teachers. The head teacher was present at all the lessons monitoring and observing the lessons. Post-tests were then administered to the learners of the three groups to assess the knowledge they attained after the lessons. Following the quantitative analysis, face-to-face interviews were conducted with the teachers and head teacher using a semi-structured interview guide to explore perceptions of the instructional effectiveness of microlearning. Interview sessions lasted within 20-30 minutes and were audio-recorded with the participants consent.

3.5 Data Analysis

Normality tests were conducted using the Shapiro-Wilk test, which yielded $p < 0.05$ for some variables. For each lesson across the three groups, Skewness and Kurtosis values varied, with Skewness values ranging from -2.62 to 1.27 and Kurtosis values ranging from -1.37 to 4.17. While some values were within acceptable range (-2 to +2), as suggested by George and Mallery (2010), others were outside this range. Given these results, assumptions of normality were not fully met across all variables. Therefore, non-parametric tests were employed for inferential analysis to ensure robustness of findings. The quantitative data was analysed using the Wilcoxon Signed-Rank test and the Kruskal-Wallis test. Specifically, the pre-test scores of the three groups were compared using the Kruskal-Wallis test to determine whether there were any initial differences among the three groups before the intervention. Within each group, pre-test and post-test scores were compared using the Wilcoxon Signed-Rank test to assess changes in individual learner performance following the microlearning intervention. Additionally, post-test scores across the three groups were compared using the Kruskal-Wallis test to examine whether improvements differed significantly amongst the three groups. Effect sizes were calculated using r for Wilcoxon Signed-Rank Test and epsilon-squared ($\mathcal{E}^2$) for Kruskal-Wallis Test.

A post hoc power analysis was conducted based on the observed effect size ($\varepsilon^2 = 0.14$; approximately $f = 0.40$), the achieved sample size ($N = 73$), and an alpha level of 0.05. The analysis indicated that the statistical power for detecting effects of this magnitude was 0.86. A sensitivity analysis was also conducted to determine the minimum detectable effect size given the achieved sample size ($N = 73$), with $\alpha = 0.05$ and power set at 0.80 for a three-group design. The analysis indicated that the study was powered to detect effects of $f = 0.37$ or larger.

Qualitative data collected from the interviews were analysed using thematic analysis. We followed the six-phase process outlined by Braun and Clarke (2021) to ensure a rigorous and systematic analysis. This process included familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and writing the report. To ensure trustworthiness, the coding process was reviewed through peer debriefing and reflexive notes. All interviews were audio-recorded to ensure accurate documentation and to facilitate a more thorough and in-depth analysis. The qualitative findings were supported by verbatim quotes of participants.

3.6 Ethical Considerations

Participants provided consent before engaging in the study, with detailed information clearly outlining the purpose of the research, the voluntary nature of participation, and their right to withdraw at any time without penalty. Anonymity and confidentiality were strictly upheld, with all data securely stored and used exclusively for research purposes. The study complied with international ethical standards and institutional review board guidelines, ensuring participants' rights, and well-being were prioritised throughout.

IV. FINDINGS & DISCUSSION

4.1 Findings

Normality tests conducted using Shapiro Wilk's showed $p<.05$. Skewness values ranged from -2.62 to 1.27 and Kurtosis values ranged from -1.37 to 4.17. Hence, non-parametric tests were used for the analysis, specifically, Kruskal Wallis Test for comparison across groups and Wilcoxon Signed-Rank with each group.

Table 1

Preliminary Analysis using pre-test scores

Lesson	Median	H	df	sig
Lesson 1	M1=5 M2=5 T=5	0.45	2	0.80
Lesson 2	M1=5 M2=5 T=5	0.002	2	0.999
Lesson 3	M1=6 M2=5 T=6	0.77	2	0.68
Lesson 4	M1=4 M2=4 T=5	2.18	2	.336

Baseline equivalence across the three instructional conditions (Microlearning Group 1, Microlearning Group 2, Traditional Group) was assessed using Kruskal–Wallis tests for each lesson. No significant differences were observed in pre-test scores for all the lessons ($p>.05$). Median pre-test scores ranged from 4 to 6 across groups, indicating statistical comparability prior to the intervention. Wilcoxon's Signed- Rank comparison of pre-test and post-test scores within each group.

Table 2

Microlearning Group 1

Lesson	Z	Sig	N	r
Lesson 1	-4.04	<.001	25	.81
Lesson 2	-4.22	<.001	25	.84
Lesson 3	-4.04	<.001	25	.81
Lesson 4	-3.77	<.001	25	.75

Table 3

Microlearning Group 2

Lesson	Z	Sig	N	r
Lesson 1	-3.72	<.001	25	.74
Lesson 2	-4.32	<.001	25	.86
Lesson 3	-3.48	<.001	25	.70
Lesson 4	-4.02	<.001	25	.80

Table 4
Traditional Group

Lesson	Z	Sig	N	r
Lesson 1	-1.29	.197	23	.27
Lesson 2	-1.81	.071	23	.38
Lesson 3	-0.87	.382	23	.18
Lesson 4	-1.03	.302	23	.22

Wilcoxon Signed Rank tests indicated significant differences between pretest and post-test scores of both microlearning groups across all the lessons ($p < .05$). In contrast, there was no statistically significant difference between the pre-test and post-test results of the traditional group across all the lessons ($p>.05$). This indicates a significant improvement in the performance of those who learned with microlearning and no significant improvement in the performance of those who were taught via the traditional instruction.

Table 5
Comparison of post-test scores

Lesson	Median	H	p	ε²	Post-hoc
Lesson 1	M1=7 M2=7 T=5	11.59	.003	.14	1>3 2>3
Lesson 2	M1=9 M2=9 T=5	24.84	<.001	.33	1>3 2>3
Lesson 3	M1=8 M2=10 T=6	23.87	<.001	.32	1>3 2>3
Lesson 4	M1=7 M2=7 T=5	18.44	<.001	.23	1>3 2>3

Kruskal–Wallis tests were conducted on post-test scores. Effect sizes were estimated using epsilon-squared (ε^2). A Kruskal-Wallis test indicated that there was a significant difference in students' test scores across the three groups for all the lessons ($p < .001$), with large effect sizes. However, the effect size for Lesson 1(ε^2=.14) was exactly at the threshold for a large effect size. Post-hoc comparisons with Bonferroni correction for multiple tests were conducted. Given that three pairwise comparisons were performed, the significance threshold was adjusted from $\alpha = .05$ to $\alpha = .017$ (.05/3). These indicated that across all lessons, the median test scores of learners in Microlearning Group 1 was significantly higher than that of learners in the Traditional Group. The median test scores of learners in Microlearning Group 2 were also significantly higher than that of learners in the Traditional Group. However, there was no significant difference between the median test scores of learners in the Microlearning Groups.

Across the four lessons, both Microlearning Groups produced statistically significant and large within-group learning gains. However, the Traditional Group did not yield significant improvement. In-group pre-test and post-test scores comparisons showed large effects in performance of microlearning groups. Post-hoc comparisons also revealed no differences. No differential effects were observed between the two microlearning groups.

4.2 Qualitative Results

Three themes and their respective subthemes emerged from the analysis of the qualitative data, which are Benefits of microlearning (engagement and focus, improved understanding, and motivation); Concerns of using microlearning (power outages, poor audio quality, financial burden); and Suggestions for improvement (Addressing technical challenges and improving audio quality)

4.2.1 Benefits of Microlearning

Engagement and Focus: Microlearning videos were mentioned in the interviews as helping students stay focused and interested. Participants reported that this method easily captured students' attention. They explained that using pictures, animations, and bright colours helped students pay attention for a longer time. These features also made the content easier to understand. Participants added that combining short text with attractive images created a more engaging learning environment. This approach worked well for students who have shorter attention spans. Participants noted:

> *The animation was a key beneficial feature which draws students' attention and keeps them focused and in suspense, anticipating what is going to happen next. The colourful display was interactive and stimulating.*

> *It was an immersive learning environment which captured their interest throughout the lessons.* (HT 1, 3rd May 2025).
> *The foremost benefit is the interest that it ignites in the kids. This is because they see the abstract concepts in real life forms and it catches their interest. So it increases their focus and attention in the lesson. The videos also ensure lot of participation.* (Tr 1, 3rd May 2025).
> *The colorful and dynamic nature of the videos keeps students focused. Visual learning through microlearning, such as the motion of electrons or the depiction of rainfall, aids students' understanding and retention of concepts.* (Tr 2 on 3rd May 2025).

Improved Understanding: Participants postulated that microlearning helped students understand lessons better, especially difficult or abstract topics such as those treated in Integrated Science. They explained that the animations, voice explanations, and short texts made complex ideas simpler, making learning easier and effective. Visuals such as diagrams and simulations helped make abstract ideas more concrete, while audio explanations helped students understand better through repetition. Short and clear written points such as bullet notes or captions also helped students remember what they learned. Participants noted that these combinations worked well for different types of learners, especially those who learn better through seeing or listening. Videos showing things such as biological processes or chemical structures made topics easier to understand compared to only using textbooks. Participants noted;

> *The colourful display or words and images created a better explanation of concept or ideas. For instance, the video on rainfall had the rain being displayed with the blue color which clearly represented raindrops. And with the lesson on atomic structure, the atoms were shown in colorful ways that I think made the understanding and identification also easier. The videos can also be replayed at any time whenever learners require which helps them retain the information.* (Tr 1on 4th May, 2025).
> *Sometimes concepts in science are complex and abstract. Microlearning provides a practical and visual format of these concepts which helps them to understand it fully. The videos had key terms which were emphasized through the audio and written boldly which, I believe, would help them retain the information better. The videos can also be paused or slowed down at any time which is also beneficial to the slow learners. They can easily understand at their own speed.* (Tr 2 on 4th May, 2025).

Motivation: Participants contended that microlearning is a good alternative to traditional teaching and can help increase students' motivation. The variety in microlearning makes lessons less boring and gives students more interesting ways to learn. They explained that the sounds and visuals in microlearning videos make students more likely to feel motivated and want to engage with the lessons. Participants reported:

> *It is an additional way of learning and an alternative to using just the teacher's voice. The students were focused and it was a good motivation for them. It is an approach which resonates with their natural interests in colourful images. I noticed their excitement as several colourful images were presented in the video lessons.* (Ht 1 on 4th May 2025).
> *The lessons were mainly based on using video with writing and sounds rather than the teacher's voice which was stimulating for learners because it offered a better way for students to learn. They were confident at the end of the lessons. This generated a more positive attitude towards learning.* (Tr 1 on 4th May 2025).
> *The video had key terms which were emphasized through the audio and written boldly which I believe would foster a genuine interest in learning and help them retain the information better. This will also make them motivated to learn and transfer concepts.* (Tr 2 on 4th May 2025).

4.2.2 Concerns of Using Microlearning

Power outages: Although microlearning has many benefits, participants expressed concerns about how it could be effectively implemented in schools. They raised concerns about technical issues which could impede its usage. Power outages were mentioned as a possible impediment to accessing the learning materials during microlearning. Participants also noted that in places with unreliable electricity, it could be difficult for students to complete lessons or stay engaged with the content. The participants noted:

> *One challenge of this learning system is the potential for operational issues, such as power outages, which could disrupt the process.* (Tr 1 on 5th May 2025)
> *Power interruption would interrupt classes because the microlearning lessons rely on electricity.* (Tr 2 on 4th May 2025).

Poor audio quality: Another concern was poor audio quality in videos. Participants explained that clear sound is very important for understanding, especially when students are listening to explanations of difficult topics. If the audio is not clear, it could make learning harder, particularly for students who learn better by listening or auditory learners. The participants noted:

> *I observed that some students struggled to immediately understand the information presented in the video, as the sound quality was not sufficiently clear.* (Tr 1 on 5th May, 2025)
>
> *The foreign accents in some videos were found to cause difficulties for students, affecting their understanding of spoken words.* (Tr 2 on 5th May).

Financial Constraints: The cost of using microlearning was also mentioned as a challenge. Participants said that setting up this type of learning system can be expensive, which may make it difficult to implement. The participants asserted:

> *The lack of necessary resources such as laptops and projectors can be a hindrance to this learning approach. This places a level of financial burden on schools that want to adopt this approach, which can be a challenge.* (Tr 2 on 5th May 2025).
>
> *Implementing the microlearning approach would require financial commitment such as investing into laptops and projectors as well as training the teachers. This is an extra cost that is incurred by management as a result of its implementation. It is an approach that can be constrained by finances.* (Ht 1, 5th May 2025).

4.2.3 Suggestions for Improvement

Participants gave suggestions on how to make microlearning more effective. They focused mainly on solving technical problems and improving the audio to match students' language needs. Addressing technical challenges: The participants advised schools that they may want to employ microlearning as a teaching technique technical issues such as power outages needed to consider and plan for continuous power supply. They held the view that schools having standby generators so that learning is not interrupted using this technique would be ideal. A participant expressed:

> *Since the lessons relied on a projected screen, when there is light off, it would a challenge. You know, in our country unstable power supply is not realised all the time. That is why we need to have regular supply and if possible, a standby generator should be in schools.* (Ht 1 6th May 2025).

Improving the quality of audios: The participants advised teachers to improve the quality of the audio they would use for microlearning. During the experiment, they observed technical challenges such as poor audio quality, foreign accents, and other technological issues. Consequently, they advised the use of more familiar and local accents believing that would help students understand the content more easily. In addition, they suggested simplifying the language used in the lessons so that students can follow at their own pace. The participants explained:

> *The videos that were used had more of a foreign accent. If I had to put one together myself, using simpler words and an indigenous voice will enable the learners relate more and hear better. This would ultimately improve the audio aspect of microlearning. Also, in order to avoid issues of power outages, there should be a stand by generator.* (Ht 1 on 6th May 2025).
>
> *The voices that were used in the videos were foreign. Some words were not clear because of the pronunciation and the students could not understand. In those instances, they had to mainly rely on the illustrations and texts. With this, playing the video twice would provide a better chance of hearing and understanding the words. Alternatively, the videos could be recorded using a local accent and a more familiar language.* (Tr 1 on 6th May 2025).
>
> *The learners sometimes found it hard to catch the words because of the language, so the accent should be more of a familiar one. There should also be a generator on standby so that power outages do not disrupt the lessons.* (Tr 2 on 6th May 2025).

Generally, the participants believed that if these issues are addressed, microlearning can become more effective and suitable for students at the basic level of education to help them better understand and use what they learn.

4.3 Discussion

The findings demonstrated that microlearning significantly improved learners' performance across all lessons, suggesting that short and segmented learning units lead to improvement in learning gains. This is consistent with CTML which posits that, learning in small segmented units reduces cognitive overload, leading to meaningful learning and retention (Mayer, 2024). By presenting lessons in short multimedia units, learners were able to effectively process and retain information. This study extends existing knowledge on microlearning by demonstrating that this technique of teaching is not only effective in online, mobile-based, or self-paced learning environments but can function as a collectively paced instructional approach in a formally structured classroom setting.

The findings of the study align with studies by Monib et al. (2025), Palti and Rosenberg-Kima (2022), and Závodná et al. (2024), which found an improvement in performance of learners who were taught using microlearning as compared to those who were part of the traditional instruction cohorts. However, this study contradicts a study by Yin et al. (2020) which found no significant improvement in performance of learners who used chatbot-based microlearning. The differing results could be attributed to the varying microlearning designs. Yin et al. (2020)

implemented microlearning integrated with chatbot-based interaction which may have introduced additional cognitive demands resulting in extraneous processing. Meaningful learning is hampered when instructional designs introduce many cognitive processing demands and compete with essential information processing, leading to lower retention (Mayer, 2024).

Qualitative findings further indicated that microlearning keeps learners engaged, motivated, and enhances comprehension of abstract and complex ideas. The combination of colourful visuals, animations, audio, and short texts creates a better learning experience for learners. This asserts the dual-channel assumption of CTML which posits that learning improves when both the visual and auditory channels of an individual are induced in the learning process (Mayer, 2024). This aligns with a study by Buchem and Hamelmann (2010) which revealed that microlearning embedded with multimedia elements improves student engagement and learning.

Nonetheless, concerns were raised regarding power outages, financial constraints, and poor audio quality which could affect implementation. These issues are consistent with other studies by Suleiman et al. (2025) and Zulueta and Panoy (2022) that found resource and infrastructure challenges when implementing technology-based learning in schools. Overall, results of the experiment coupled with the positive perceptions of the participants highlight the efficacy of microlearning in improving learner outcomes.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study demonstrates that microlearning can significantly enhance instruction in basic education. The findings indicate that microlearning improves learners' performance, as reflected in higher test scores. In addition, the results suggest improvements in learner engagement and comprehension, especially for abstract topics such as those covered in science. Overall, this study highlights the potential of microlearning as an effective instructional approach for supporting teaching and learning in basic education.

5.2 Recommendations

Based on the findings of this study which indicate improved learner performance, engagement, and comprehension, management of basic schools are encouraged to adopt video-based microlearning strategies as part of regular teaching practices. Curriculum developers may also consider embedding microlearning formats into instructional materials for formal instruction, particularly for abstract topics, to support learners' comprehension and retention. In addition, school management should organise professional development workshops and training sessions to equip teachers with the necessary skills to effectively design and implement microlearning strategies in classroom practice.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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