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Microlearning and Learning Performance in Higher Education: A Post-Test Control Group Study

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Keywords

microlearning, instructional design, instructional methods, cognitive load theory, learning effectiveness

Abstract

This study aimed at evaluating the effectiveness of microlearning in higher education. The sample consisted of first-year MBA students, and a post-test control group design was used to assess the effectiveness of a microlearning module. The results indicated that the use of microlearning was significantly related to learning performance and participants' reactions to the module. Moreover, the microlearning group scored significantly higher than the control group. The findings suggest that microlearning has the potential to improve learning outcomes and enhance participant engagement. However, the study has certain limitations, and future research is needed to gain a comprehensive understanding of the optimal design and delivery of microlearning modules. The study supports the use of microlearning in higher education as an effective instructional strategy.

Introduction

Microlearning is an instructional method that delivers concise learning content in easily digestible formats, addressing the limitations of traditional training approaches (Hug, 2022). It allows learners to acquire knowledge in short bursts, aligning with their fast-paced lifestyles (So et al., 2020). Microlearning can take diverse forms, such as videos, quizzes and simulations, accessible through various devices (Ghirardini, 2011).

While microlearning has gained popularity in industries like healthcare and finance, its application in an academic setting, particularly business schools, remains unexplored. This study aims to bridge this gap by examining the effectiveness of microlearning modules in enhancing the learning performance of Masters in Business Administration (MBA) students. Figure 1 presents the growing research in the area.

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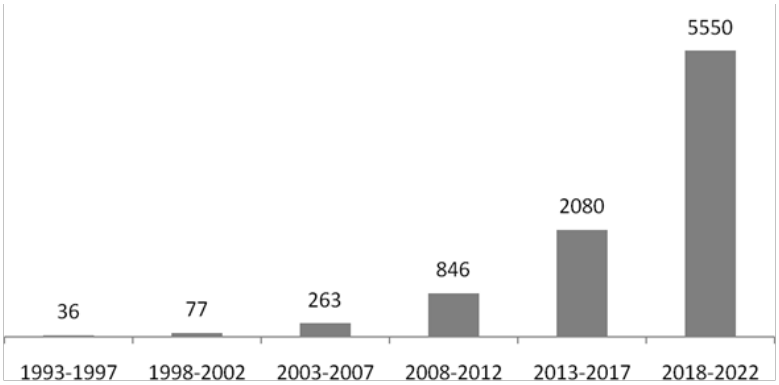

Figure 1: Growth trend of microlearning publications
Source: McKee & Ntokos (2022)

Empirical research on the effectiveness of microlearning in higher education is limited and has yielded mixed results, necessitating a systematic investigation (McKee & Ntokos, 2022). This study focuses on exploring the potential of microlearning modules to reduce cognitive load and improve learning outcomes in business schools. By evaluating the effectiveness of microlearning modules, this research contributes to evidence-based practices in higher education and enhances instructional methods in business schools. Specifically targeting MBA students, the study aims to fill a research gap by examining the effectiveness of microlearning in MBA education, an area with limited prior research. The recommendations inform the design and implementation of microlearning modules in business school programmes, with the goal of optimising their effectiveness.

Objectives and Hypotheses

This research aimed at investigating the instructional effectiveness, learning performance, and cognitive load associated with microlearning; and the following hypotheses were proposed:

H1: The use of microlearning modules will significantly impact the level of student learning.

H2: Microlearning modules will significantly impact the participants' reaction to the learning module.

In this post-test control group design study, researchers randomly assigned MBA students to either the experimental group, which received microlearning modules, or the control group which received traditional teaching methods. The study collected data on learning performance and student reaction through quizzes and surveys. The researchers analysed the collected data to test the hypotheses and determine the effectiveness of microlearning modules compared to traditional teaching methods.

This research has important implications for various groups involved, such as academic institutions, educators and students. It investigates the impact of microlearning modules on learning performance using cognitive load theory (Sweller, 2010). Firstly, it adds valuable insights to the existing microlearning literature by providing evidence-based findings, which can guide educators and designers in developing more effective teaching methods. Secondly, it applies cognitive load theory to microlearning, allowing the development of teaching approaches

that minimise cognitive load. This is beneficial for MBA students as it provides them with tools to improve their learning performance and reduce cognitive burden. Lastly, the results of the study can inform business school programmes, leading to improved teaching strategies and enhanced learning experiences.

Literature Review

Microlearning is a technology-based instructional method that involves delivering learning content in small, bite-sized modules. It has gained popularity in recent years due to its ability to provide learners with short bursts of information that can be easily absorbed and retained (Siegle et al., 2021). Microlearning modules are typically designed to be between three to five minutes in length and can be delivered in a variety of formats, including videos, infographics, quizzes and interactive simulations. The content of microlearning modules is typically focused on a specific learning objective and can be accessed on-demand, making it a flexible and convenient learning method (Simanjuntak & Haris, 2023).

Studies have shown that microlearning can be an effective instructional method in various contexts, including corporate training and higher education (Kuzminska et al., 2022). In corporate training, microlearning has been found to be an effective way to deliver job-specific training and improve employee performance. In higher education, microlearning has been found to be effective in enhancing student engagement and learning performance. A study by Pappas (2017) found that microlearning modules increased student engagement and improved learning outcomes in a university setting. The study also found that microlearning modules can help students retain information better and apply it more effectively.

From a cognitive load theory (Sweller, 2010) perspective, microlearning is beneficial because it reduces cognitive overload by breaking down complex information into smaller, more manageable pieces (Zhu, 2022). This allows learners to process the information more effectively and retain it better. In summary, the literature suggests that microlearning is an effective instructional method that can enhance learning outcomes, improve retention and reduce cognitive load (Rajaram, 2020). Its popularity is increasing due to its flexibility, convenience and ability to provide learners with on-demand access to learning content.

Microlearning and Cognitive Load Theory

Cognitive Load Theory (CLT) is a well-established and widely recognised theory of learning that centres around the crucial role of cognitive load in the learning process. CLT posits that cognitive load pertains to the mental effort required for processing information in working memory during learning endeavours (Zheng & Gardner, 2019). CLT identifies three distinct types of cognitive load: intrinsic, extraneous and germane. Intrinsic cognitive load characterises the inherent complexity of the learning material itself. Extraneous cognitive load is attributable to instructional design or delivery factors that may impede learning. Conversely, germane cognitive load directly pertains to the learning process and facilitates knowledge acquisition (DeLeeuw & Mayer, 2008). The overarching aim of CLT is to optimise cognitive load to enhance learning outcomes.

Instructional designers play a pivotal role in achieving this objective by minimising extraneous cognitive load, effectively managing intrinsic cognitive load and promoting an increase in germane cognitive load (Mayer & Moreno, 2010). Numerous studies have demonstrated the effective application of CLT across diverse learning contexts. For instance, Sweller et al., (2011) established that CLT principles can significantly improve learning

outcomes in higher education and online learning environments. Moreover, CLT has exhibited efficacy in corporate training settings. Sitzmann and Ely (2011) discovered that integrating CLT principles into the design of training materials resulted in enhanced learning outcomes and increased transfer of acquired knowledge to job-related tasks.

Regarding microlearning, CLT suggests that employing bite-sized learning modules can effectively reduce extraneous cognitive load by breaking down complex information into smaller, more manageable segments (Mayer & Moreno, 2010). This approach aids learners in processing information more efficiently and retaining it more effectively. Existing literature substantiates CLT as an effective theory of learning with broad applicability across various contexts for optimising cognitive load and improving learning outcomes. Specifically, within the microlearning domain, CLT advocates the use of compact learning modules as a viable strategy for reducing cognitive load and enhancing learning performance (Olivier, 2021).

Microlearning and Learning Performance

The efficacy of microlearning in enhancing learning performance has been extensively investigated, with multiple studies reporting positive outcomes. For instance, Max et al. (2018) conducted a randomised controlled trial to examine the impact of microlearning on medical students and found that those who received microlearning modules exhibited significantly superior learning outcomes compared to those who received traditional lecture-based instruction.

Similarly, Eden et al. (2020) employed a quasi-experimental design to investigate the effects of microlearning on computer science students. The study revealed that students exposed to microlearning modules achieved significantly higher scores on the final exam than their counterparts who underwent traditional lecture-based instruction.

Additional research has explored the effectiveness of microlearning in workplace settings. Govender and Madden (2020) conducted a study within a retail organisation, demonstrating that employees who received microlearning modules displayed significantly enhanced job performance, when compared to those who underwent traditional training. Likewise, Emerson and Berge (2018) conducted a randomised controlled trial to assess the impact of microlearning on information retention in the workplace. The results indicated that employees exposed to microlearning modules exhibited significantly superior retention of information in comparison to those who received traditional training.

Collectively, the literature supports the effectiveness of microlearning as an instructional approach for improving learning outcomes across various domains, encompassing educational and workplace contexts alike. By deconstructing complex information into smaller, manageable units, microlearning enables learners to process and retain information more effectively, consequently leading to enhanced learning performance (Kuzminska et al., 2022).

Microlearning and Learning Context

Microlearning has been widely researched in various contexts, including educational and workplace settings, and has been found to be effective in improving learning outcomes. Here are a few examples of previous research on microlearning:

Educational context: A study by Aleassa et al. (2020) investigated the effectiveness of microlearning in improving the knowledge and skills of nursing students. The study used a randomised controlled trial design and found that students who received microlearning modules performed significantly better on a post-test than those who received traditional instruction.

Workplace context: A study by Lockee (2021) examined the effectiveness of microlearning in improving the performance of salespeople in a pharmaceutical company. The study used a quasi-experimental design and found that salespeople who received microlearning modules had significantly higher sales performance than those who received traditional training.

Language learning context: A study by Wang et al. (2020) investigated the effectiveness of microlearning in improving the vocabulary acquisition of English language learners. The study used a quasi-experimental design and found that learners who received microlearning modules had significantly better vocabulary acquisition than those who received traditional instruction.

Professional development context: A study by Hsu et al. (2021) explored the effectiveness of microlearning in improving the professional development of medical professionals. The study used a quasi-experimental design and found that professionals who received microlearning modules had significantly higher self-efficacy and motivation than those who received traditional training.

Microlearning has gained significant attention as a technology-driven method of instruction that has the potential to improve learning outcomes. Studies suggest that microlearning consistently produces positive effects on student and employee performance and satisfaction. This effectiveness can be explained by the cognitive load theory, which acknowledges the limited cognitive resources available to learners and the negative impact of excessive cognitive load on the learning process (Sweller, 2010). By providing information in small, manageable chunks, microlearning effectively reduces cognitive load, thereby facilitating optimal learning (Ghafar et al., 2023). However, the specific application of microlearning in business school programmes has not been extensively explored. Further research is needed to uncover the potential benefits and implications of microlearning in this context, allowing for the development of tailored microlearning approaches that meet the unique needs of business school students. Such research has the potential to enhance learning experiences and improve educational outcomes in business school programmes.

Methods

The research design employed in this study utilised a post-test control group design comprising two groups: an experimental group and a control group. This design is commonly employed in experimental research to establish the causal relationship between an intervention and an outcome variable. It enables researchers to control for extraneous variables that may impact the outcome variable, ensuring the study's internal validity. The experimental group in this study received a microlearning module, while the control group received a document-based version of the same module. Upon completing the module, participants from both groups took a quiz designed to evaluate their learning performance. The quiz consisted of questions covering the content presented in the microlearning module.

Participants

In order to recruit the participants for this study, the researchers approached colleges in Bangalore, India. The final set of participants belonged to a b-school and were in the first year of their two-year MBA programme. Participation was not made mandatory and consent was sought prior to the study. One-hundred and four students agreed to be a part of the study. To ensure that the students were at the same level with regards to their knowledge, the participation was limited

to students of a particular course. Approximately 18% of the students were male and the students belonged to the age group of 21 to 26 years.

Materials and Instruments

The module selected for this study focused on the topic of the Global Mobility Framework, which was unfamiliar to the participants. Both the regular and microlearning modules used in the study were prepared by the same lecturer and administered to both groups simultaneously. The control group received a research article on the topic and were instructed to read it and respond to the quiz and reaction survey. In contrast, the experimental group received a microlearning module created using the 7taps application. The 7taps microlearning app is a platform designed to deliver bite-sized learning content to users, making learning more accessible and engaging. The app allows the creation of short, focused lessons or modules that are easy to digest and can be consumed on-the-go.

Upon completing the module, participants were asked to answer quiz questions and provide responses to the reaction survey, both of which were designed using the Google Forms platform. The microlearning module presented the contents of the research article in the form of points and included quizzes and challenges at periodic intervals to test the participant's level of understanding

The learning outcomes were measured as per the Kirkpatrick (1959) model. The first level of the Kirpatrick model suggests measuring the reaction of the participants. To measure participants' reaction to the programme, Brown's (2005) instrument was employed. This instrument assessed overall reaction, enjoyment and perceived relevance, consisting of seven items rated on a five-point scale. The instrument demonstrated high reliability, with a Cronbach's alpha score of 0.92. This was established through a pilot study. Sample items included statements such as "The lecture was relevant to my education" and "The lecture provided useful examples and illustrations."

The second level of the Kirkpatrick model refers to the knowledge gained or the level of learning. Learning outcomes were evaluated through a post-test comprised of ten multiple-choice questions. Each correct answer carried a value of one point, and no penalty was imposed for incorrect responses. Participants were allowed to attempt the test only once. The test was administered to both groups in person.

Procedure

The participants were invited to voluntarily participate in the study and were assured that their test results would not be used in evaluations. After obtaining informed consent, 104 students were finally chosen for the study. The students were then randomly assigned to two groups. The control group was comprised of 52 students and the experimental group contained 52 students.

Both groups received the same module on the Global Mobility Framework but in different formats. The control group received a research article, while the experimental group received a microlearning module designed on the 7taps application.

Both the groups were asked to complete a quiz and a reaction survey questionnaire. The quiz measured learning performance and consisted of multiple-choice questions. The reaction survey questionnaire, developed by Brown (2005), measured the overall reaction to the module, level of enjoyment and perception of its relevance. The survey used a five-point Likert scale and consisted of seven items. Both the quiz and survey were administered on the Google Forms platform.

Data obtained from the quiz and survey were analysed using statistical software to compare the performance of the two groups. The analysis included descriptive statistics such as mean and standard deviation, and inferential statistics such as t-test and effect size calculations. The significance level was set at $p < 0.05$.

Results

The objective of the study was to evaluate the effectiveness of a microlearning module in the context of higher education. The participants were MBA students in their first year of the programme. The researchers chose a post-test control group design to assess the effectiveness of the module. This section presents the analysis of the collected data. Initially, the researchers analysed the distribution of the data using descriptive statistics, and the results are shown in Table 1.

Table 1: Descriptive Statistics of the Variables

Variable	Mean	Std. Deviation	Skewness	Kurtosis
Reac_tech	4.028	.8604	-1.096	1.191
Reac_enj	4.038	.8086	-.857	1.119
Reac_rel	4.072	.7772	-.704	.299
Reac	4.044	.7314	-1.096	1.986
Learn	6.14	1.037	-1.412	2.341

The mean score for the reaction (Reac) was 4.04, and the mean scores for the sub-dimensions of (Reac_rel) relevance, (Reac_enj) enjoyment and (Reac_tech) technology were also greater than 4. The average score on the test taken after the module was 6.14. This suggests that the accuracy rate for the test was approximately 61%. This score represents the level of learning. The skewness and kurtosis values were within the limits of +3 and -3, indicating that the data could be treated as normally distributed and that parametric tests could be used for the analysis (Kline, 2005). A correlation analysis was used to examine the relationship between the variables of reaction, learning and microlearning. The correlation matrix is presented in Table 2.

Table 2: Correlation Matrix

	Microlearn	Rt	Re	Rr	R	Test
Microlearn	1					
Reac_tech	.251*	1				
Reac_enj	.239*	.694**	1			
Reac_rel	.155	.636**	.722**	1		
Reac	.249*	.916**	.885**	.852**	1	
Learn	.456**	.195*	.161	.089	.176	1

The study found a significant and positive correlation ($r = 0.456$) between the use of the microlearning module and learning performance. Furthermore, the participants' reaction to the

module was also significantly and positively related to the use of the microlearning module (r = 0.25). The dimensions of reaction related to technology used (r = 0.25) and enjoyment (r = 0.24) were also significantly and positively related to the use of the microlearning module. However, there was no significant relationship found between microlearning and the relevance dimension.

To determine if the participants who received the microlearning module scored significantly higher than those who received the regular module, an independent sample t-test was conducted. Additionally, an independent sample t-test was used to compare the difference in the reaction to the module. The results of these tests are presented in Table 3.

Table 3: Comparison of the Mean Scores

Microlearn		N	Mean	t	df	Sig.	Mean diff
Reac_tech	C	52	3.814	-2.617	102	0.01	-0.429
	E	52	4.244				
Reac_enj	C	52	3.846	-2.486	102	0.015	-0.385
	E	52	4.231				
Reac_rel	C	52	3.952	-1.589	102	0.115	-0.240
	E	52	4.192				
Reac	C	52	3.863	-2.598	102	0.011	-0.363
	E	52	4.225				
Learn	C	52	5.673	-5.180	102	0.000	-0.942

The findings support our research hypotheses.

H1: The use of microlearning modules can significantly impact the level of learning.

To test this hypothesis, an independent sample t-test was conducted. The results showed that the experimental group (participants of the microlearning module) had a significantly higher mean score (M = 6.6) than the control group (participants of the regular module) with a mean score of 5.6 ($p < 0.05$). Therefore, the hypothesis was accepted.

H2: The use of microlearning modules significantly impacts the participants' reaction to the learning module.

The participants who used the microlearning module (mean = 4.22) reacted more positively to the new learning strategy than those who used the regular module (mean = 3.8, $p < 0.05$). While a comparison of the mean scores for the dimensions of reaction suggests that the microlearning module rated higher on the dimensions of enjoyment, relevance and technology, the difference in the mean scores was only found to be significant for the dimensions of enjoyment and technology.

Hence, there is statistical evidence to conclude that the use of a microlearning module significantly improves the level of learning and the reaction of the participants to the module.

Discussion

The objective of the study was to evaluate the effectiveness of a microlearning module in the learning performance of MBA students. To do so, the researchers used a post-test control group design, where one group underwent the microlearning module and the other participated in a regular self-learning module. The control group was provided with a document that they were expected to read and then answer the questions in the test.

The effectiveness of the tool was evaluated through reaction and learning, the first two levels of the Kirkpatrick (1959) model. Reaction was measured through an instrument that was made available to the students immediately after the programme and the students were asked to rate the programme in terms of the level of enjoyment, reaction to the technology used and the perception of relevance. On the dimensions of enjoyment and reaction to technology, the students of the microlearning module rated the programme significantly higher than the students of the regular module. On the dimension of relevance, although the students of the microlearning module rated the programme higher, the difference was not found to be statistically significant. Overall, the students of the experimental group reacted more positively to the microlearning module. Thus, there is statistical evidence to conclude that participants are likely to react more positively to a microlearning module.

The findings of the study indicate that microlearning can be a powerful teaching tool and can significantly improve learning performance and satisfaction. The findings are in line with many other studies on microlearning. In a study by Pascual et al. (2018), the researchers used microlearning to train stroke patients and their caregivers through microlearning components of flashcards and cheat sheets. The response from the patients and caregivers was overwhelmingly positive. Similarly, Gross et al. (2019) studied the reaction of participants of a crew resource management training programme and found that the experimental group rated the intervention more than 50% higher on relevance and usefulness. However, Sichani et al. (2018) evaluated the use of microlearning in lessons for medical students and found that the participants in the microlearning module were extremely dissatisfied. This may be attributed to the fact that the microlearning module was used as a standalone instructional technique and the absence of additional supporting learning resources, like a lecture or online module, may have reduced the effectiveness of the module. Furthermore, Sichani et al. (2018) also propose that since the students were accustomed to traditional lecture-style classroom learning, the abrupt change to a text- driven learning method may have been unsettling.

To evaluate the increase in knowledge or knowledge retention, the researchers of this study conducted a test after the module. The students of the microlearning module scored significantly higher than their counterparts in the regular module. Similarly, Mohammed et al. (2018) revealed the effectiveness of microlearning modules, particularly for complex and technical subjects, in improving learning outcomes. Schumacher and Ifenthaler (2018) also contributed to this body of evidence by showing that microlearning modules were effective in reducing cognitive load and enhancing learning outcomes when compared to traditional classroom training. However, the authors acknowledged that the design and delivery of microlearning modules played a significant role in their effectiveness.

Thus, the findings of the current study add to the empirical evidence of the effectiveness of microlearning modules. While the findings of the study propose that microlearning is an effective learning tool, the intervention planned for the study was meant to supplement classroom teaching and the tool was found to be effective. However, in studies where the microlearning module was the only teaching tool, statistical evidence for its effectiveness was not found (Taylor & Hung, 2022).

The findings of the current study corroborate previous research, underscoring the potential benefits of microlearning modules in improving learning outcomes and participant reactions. Nonetheless, further research is warranted to investigate the optimal design and delivery of microlearning modules in diverse educational contexts and for different topics.

Implications of the Study

This section discusses the implications of the study, both theoretical and practical.

Theoretical Implications

The findings of the study demonstrate that employing microlearning modules effectively enhances learning in higher education. Participants who received the microlearning module outperformed the control group, which received a regular module, in the post-test. Moreover, the participants who received the microlearning module displayed significantly higher levels of enjoyment and positive responses to the training programme's technology compared to those who received the regular module.

Microlearning involves providing students with information in manageable, bite-sized portions. The study confirms that microlearning is an effective learning tool, and students generally have a positive reaction to microlearning modules. As a result of this experimental study, the researchers propose a microlearning paradigm consisting of three stages: Consumption, Conceptualisation, and Confirmation, each playing a vital role in the learning process. The model is shown in Figure 2.

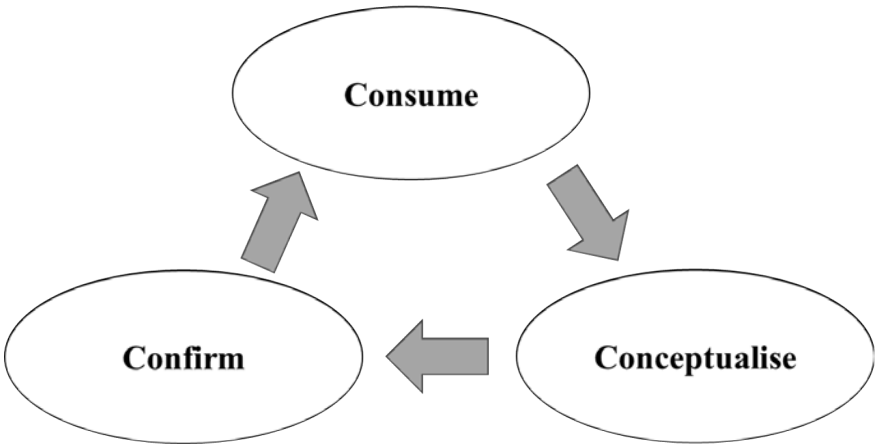

Figure 2: Three stage model of microlearning paradigm
Source: Own work

In the Consumption stage, learners assimilate the provided information. This stage introduces students to new knowledge or ideas that they may not have encountered previously. The information is presented in a condensed and understandable format, such as text, graphics, audio or video. This stage is crucial as it establishes the foundation for learning and provides the necessary information to proceed to the subsequent stage.

In the Conceptualisation stage, the microlearning module complements the main teaching pedagogy. After acquiring the material, learners attempt to relate it to prior knowledge or apply it to familiar situations. This stage is essential for learners to make meaningful connections with the content and integrate new knowledge with existing knowledge. Activities like problem-solving, introspection and practical application of knowledge contribute to the conceptualisation stage.

The third stage, Confirmation, involves testing or evaluating the acquired knowledge to identify any gaps and provide learners with an opportunity to review the subject matter. This

phase assists students in solidifying their understanding and identifying areas that require further study. Quizzes, questionnaires, and reflection exercises are examples of assessment methods employed in the Confirmation stage. Confirmation is critical as it enables students to assess their progress and identify areas where they may need additional assistance. Designing the microlearning module with these three stages in mind can significantly enhance learning effectiveness. This model has been proposed specifically for microlearning and differs from other learning theories in this regard.

Implications for Practice

The findings of this study carry significant implications for the design of educational and training programmes in higher education. The utilisation of microlearning modules yielded notable improvements in both learning outcomes and participant reactions to the training programme. Consequently, microlearning can be recommended as an effective instructional strategy in higher education.

Furthermore, the results emphasise the importance of incorporating cognitive load theory into instructional material design. By implementing microlearning modules, the cognitive load experienced by learners is reduced, leading to enhanced learning and knowledge retention. These findings provide educators and instructional designers with valuable insights to create more effective and efficient learning materials tailored to learners' specific needs.

Moreover, the study demonstrates a positive correlation between the integration of technology in educational settings and learner outcomes. Thus, educators should consider the integration of technology into their teaching and learning activities to foster improved learning and engagement.

Overall, this study highlights the paramount significance of evidence-based instructional design practices in higher education. Educators and instructional designers are encouraged to embrace microlearning and technology as a means to optimise the learning experience for their students.

Microlearning possesses transformative potential in revolutionising educational approaches by offering flexible and personalised learning experiences that enhance knowledge retention and student engagement (McKee & Ntokos, 2022). As technology becomes increasingly accessible, the utilisation of microlearning in education is anticipated to witness rapid growth in the forthcoming years (Kuzminska et al., 2022). Educational institutions and instructors ought to contemplate the incorporation of microlearning into their instructional strategies, while maintaining a balance with other pedagogical methods. This holistic approach will facilitate the provision of a comprehensive and effective learning experience that caters to the diverse needs of students.

Study Limitations and Recommendations for Future Research

The present study acknowledges several limitations that warrant careful consideration. Firstly, the relatively small sample size may restrict the generalisability of the findings. To enhance external validity, future investigations could employ larger and more diverse samples. Additionally, expanding the study duration would enable examination of the long-term impact of microlearning on learning outcomes.

Secondly, the study focused exclusively on the Global Mobility Framework as the subject matter and targeted first-year MBA students as participants. Caution should be exercised when extending the findings to other contexts or topics. Future research endeavours could explore the

efficacy of microlearning modules across various academic disciplines and among diverse learner populations to ascertain the breadth of its impact.

Furthermore, the study solely examined the short-term effects of the microlearning module, leaving the long-term sustainability of the benefits uncertain. Future investigations could delve into the enduring effects of microlearning modules, providing a more comprehensive understanding of their impact over time. This would involve assessing participant learning outcomes beyond immediate post-module assessments.

Lastly, the study did not account for individual differences such as prior knowledge, cognitive abilities, and learning styles, all of which potentially influence the effectiveness of microlearning modules. Future studies should examine the intricate interplay between these individual differences and the outcomes of microlearning modules, shedding light on the nuanced factors at play. Considering these factors would allow for a more nuanced interpretation of the findings and the development of tailored instructional approaches.

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