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THE ROLE OF MICROLEARNING IN ENHANCING LEARNING ENGAGEMENT AMONG GEN Z STUDENTS

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Abstract:

Amidst swiftly changing educational demands, microlearning has surfaced as an effective method to boost learning involvement, especially for Generation Z (Gen Z) learners. Generation Z, recognized for their digital literacy and inclination for brief, on-demand content, is progressively attracted to microlearning as a productive and effective method for gaining knowledge. This research examines the role of microlearning on enhancing learning engagement for Gen Z students through short, targeted lessons that cater to their limited attention spans and capacity for multitasking. A quantitative research approach was employed involving 150 university students in Kota Kinabalu, Sabah, Malaysia. Data were collected using a structured online questionnaire and analyzed using SPSS Version 26. The findings revealed a strong positive correlation between microlearning and learning engagement ($R = 0.643$, $p < 0.001$), with 41.3% of the variance in engagement explained by microlearning practices. Additionally, students who used microlearning frequently demonstrated significantly higher levels of self-directed learning ($p = 0.025$), adaptability ($p = 0.008$), knowledge retention ($p = 0.000$), and overall learning satisfaction ($p = 0.000$). Among the components assessed, interactive and personalized microlearning formats showed the strongest effects. These results affirm that microlearning is a highly effective approach to meet the learning preferences of Gen Z students. The study offers valuable insights for educators and policymakers aiming to integrate digital microlearning strategies to improve student engagement, adaptability, and academic outcomes in higher education contexts.

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Introduction

The fast-paced evolution of digital technology is reshaping the world of higher education in profound ways. According to MarketsandMarkets (2023), the global digital education market is expected to skyrocket from USD 19.4 billion in 2023 to a whopping USD 66.7 billion by 2028, growing at a compound annual rate of 28.0%. This sharp increase highlights just how much educational institutions are leaning on digital tools and platforms to deliver learning experiences, an acceleration that was notably propelled by the COVID-19 pandemic, which forced schools and universities to shift quickly to online formats.

Generation Z, typically defined as individuals born between 1997 and 2012, stands out as the first true generation of digital natives. Growing up surrounded by technology has deeply influenced how they prefer to learn in favoring interactive, personalized, and tech-driven educational approaches. A 2024 study by the Consumer Technology Association found that 86% of Gen Z consider technology essential to their daily lives, a sentiment that far exceeds that of previous generations. In fact, a large portion of Gen Z learners prefer multimodal learning, with 75.7% supporting this approach (University of Cyberjaya, 2024).

Considering these changing priorities, microlearning has come into its own as a pedagogical method. Microlearning is appealing to Gen Z's preference for bite-sized, on-demand information, with information being delivered in short, bite-sized chunks. This educational methodology not only (re)conforms to the learning styles of "digital natives" but is also a means of responding to issues of engagement and retention in an age of information excess. Studies show that microlearning enhances student participation and educational outcomes on the university level (Simanjuntak & Haris, 2023). Furthermore, adaptive microlearning systems can alleviate the cognitive load on learners while simultaneously increasing learning adaptability (Zhu et al., 2024).

This study aims to examine the impact of microlearning on the level of engagement with learning among students from Generation Z in Malaysian higher education institutions focusing only in Kota Kinabalu, Sabah. Contemplating technology and the specific learning habits of this generation crossing paths, the study aims to provide an analysis of the benefit of micro-learning on the modernization of educational experiences.

Problem Statement

Amidst the current digital age, the Generation Z (Gen Z) educational practices are different from previous generations and these learners easily get bored, often multitask during interaction and prefer interactive and on-demand content. According to studies, Gen Z students typically disengage from learning content after only eight seconds if it is not engaging enough (Microsoft, 2023). Conventional teaching approaches like lengthy lectures and textbook-driven instruction find it challenging to capture these students' attention, potentially harming their motivation, knowledge retention, and academic success. A 2024 report from the Consumer Technology Association reveals that 86% of Gen Z view technology as vital to their everyday

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lives, notably higher than earlier generations, highlighting their dependence on digital media in personal and educational settings.

As Generation Z's learning styles are changing, the time is right to investigate the education's innovative teaching practices that are in tune with the Gen Z's digital skills and needs. One trend creating interest is microlearning with an idea where immediate access to information is provided in short, focused bites for a digital audience. According to Grand View Research (2023), the microlearning market is expected to grow at a compound annual rate of 13.4% from 2022 to 2030, reflecting a growing demand for flexible and easily accessible learning options. Microlearning has become proliferating recently, though actual effectiveness of microlearning for the improvement of student involvement, facilitation of self-directed learning, and long-term learning outcome in higher education has scarcely been researched.

Therefore, the objective of this investigation is to fill the gap in the literature and investigate how microlearning influences academic achievement outcomes for Gen Z students. This study will examine the effect of microlearning on engagement, motivation, adaptability and knowledge retention. The purpose is to provide better guidance for academia, instructional designers, and policymakers who wish to implement microlearning-based strategies in their courses and institutions.

Literature Review

The different ways that Generation Z students like to learn are causing higher education schools to change quickly. This cohort, born between the late 1990s and early 2010s and grew up in a digital world, has three main characteristics such as they are constantly dependent on technology; they prefer interactive learning methods; and they want an educational experience that is both tailored to their specific needs and adapts to those needs. This group cannot stay focused in the traditional school system, which is marked by long lectures and too many chances to be distracted.

Microlearning has emerged as an effective method, providing succinct, targeted learning modules tailored to the cognitive and behavioural characteristics of Gen Z learners. This study delves into how microlearning affects how interested students are in learning. It examines four primary aspects: student involvement, self-directed learning, adaptation, and information retention. This study intends to determine the degree to which microlearning enhances salient aspects of learning and reinforces effective pedagogical practices.

Understanding Microlearning

The method of imparting knowledge known as microlearning serves up content in small and easily absorbed portions. Each portion of content usually lasts a few seconds up to 20 minutes much shorter than what is typical of conventional learning. Microlearning focusses on a particular topic for a short duration and targets a specific objective for the learning session, hence enhancing cognitive memory (Hug, 2017).

Microlearning, often referred to as "bite-sized learning," is an educational strategy that emphasizes learning through smaller, more digestible pieces of content and encourages brief, more directed, and often shorter-term activities associated with that content. A "learning module" is "an instructional unit that engages participants in a brief activity intentionally designed to produce a specific result" (p.11) according to Kossen and Ooi (2021). According to studies, microlearning lowers the risk of mental exhaustion since it is brief (allowing for

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convenient breaks) and specific (allowing the brain to focus on a single task) (Emerson & Berge, 2018).

Several formats of microlearning exist, including video-based tutorials, gamified learning modules, interactive quizzes, and mobile-friendly educational applications. The key advantage of microlearning lies in its ability to cater to modern learners' preference for fast, accessible, and engaging content (Leong et al., 2021). Research suggests that microlearning improves student motivation, engagement, and academic performance, particularly when combined with interactive and multimodal learning strategies (Buchem & Hamelmann, 2010).

Gen Z Learning Preferences and the Need for Microlearning

Gen Z learners exhibit several characteristics that make microlearning particularly suitable for their educational needs. According to Prensky (2001), this generation prefers visual and interactive content, multitasking, and real-time feedback. Additionally, Gen Z students favor self-directed learning opportunities, where they can control the pace and sequence of their educational experiences (Scholz, 2020).

The traditional lecture-based model of higher education may be failing to engage Gen Z students. This cohort seems to favor utilities of the digital age and often has a shorter attention span (Akin et al., 2022; Steinhauser, 2022). On the other hand, research and practice continue to advocate the use of microlearning as a means of improving learning engagement (Dicheva et al., 2015; Glover, 2013; Majid et al., 2022).

Microlearning and Learning Engagement

Learning engagement is a vital factor exerting influence on academic success. Fredricks et al. (2004) characterise engagement as encompassing behavioural, emotional, and cognitive attributes that affect students' involvement in learning activities. Studies indicate that microlearning enhances these aspects by promoting active participation, real-world application, and immediate feedback loops (Kapp, 2012). Microlearning resources increased student engagement by 50% compared to traditional learning formats, according to a study on digital learning tactics (Johnson et al., 2020).

Microlearning strategies such as short quizzes, interactive videos, and game-based learning elements can increase student motivation and reduce cognitive fatigue (Lim et al., 2019). Furthermore, by offering learning modules that students can access at their convenience, microlearning encourages a self-paced learning approach, reducing pressure and enhancing retention (Ghergulescu & Muntean, 2016).

The brevity of microlearning can be efficacious for students with limited time or short attention spans, but the ongoing exposure to brief, isolated learning sessions cannot keep motivation going. Creating a microlearning environment can falsely suggest completion of a lesson without full understanding. Learners often desire enticing experiences, and when the experience is diluted into chunks or exercises, they may feel disconnected or even disengaged. For many, that is not a basis for being fully "learned." Some individuals may perceive the absence of richer interactions or deeper analysis, typically afforded by extended learning formats, as a "missed opportunity" for a more comprehensive experience (Skalka & Drlik, 2020; Bitakou et al., 2023).

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When comparing micro-lectures to a didactic teaching paradigm, Subramaniam & Muniandy (2019) found that although students were very engaged, there did not seem to be any notable distinctions. Students who took part in the micro-lectures in a computer science course scored similarly on exams to those who were instructed via traditional lectures (Kävrestad & Nohlberg, 2019)

Microlearning and Self-Directed Learning

Self-directed learning signifies the competency of learners to start, establish learning objectives, and independently obtain understanding in a manner that is largely free of direct oversight (Knowles, 1975). Research shows that microlearning pushes self-directed education by delivering content that is just-in-time and bite-sized, allowing learners to engage with it at their own pace and own place (Littlejohn & Margaryan, 2014).

With microlearning, students are empowered to explore topics of interest, revisit content as needed and customise their educational experiences to meet their own requirements (Ebner & Holzinger, 2007). This flexibility is particularly valuable in higher education, where autonomous learning or known as self-directed learning is important to academic success and lifelong skill development (Garrison, 1997).

Microlearning and Adaptability

Being adaptable in learning means students can handle unique learning situations, integrate different kinds of educational materials, and use what they have learned in different settings (Bransford et al., 2000). Considering the strong engagement of Generation Z with digital platforms and multimedia resources, microlearning aligns well with their dynamic, tech-oriented learning style (Buchner, 2020).

Studies suggest that by using artificial intelligence (AI) to personalize content through microlearning platforms can enhance and develop the learning efficiency and knowledge application (Benedetto & Schaper, 2018). Students can achieve clearer recommendations on how to perform better in their studies from these platforms, and it is because these platforms make it much easier for students to discern and utilize the recommendations that they receive. *(Shang & Shi, 2019).*

Because of their closeness to technology, Generation Z could learn in an individualized and interactive manner. (Seemiller & Grace, 2019). Research shows that learners from Generation Z prefer classrooms that center on three features: real-world relevance, diversity, and inclusivity (Dorn et al., 2020).

Microlearning and Knowledge Retention

Microlearning has been shown to significantly improve information retention. For instance, a study reported that microlearning boosts information retention by 80% and knowledge transfer efficiency by 17% when compared to the conventional techniques (Hug et al., 2009). Microlearning addresses this problem by simplifying complex concepts into manageable parts, enabling students to better understand and remember information (Hug, 2017). Studies on language acquisition showed that learners utilizing microlearning applications remembered 25% more vocabulary terms than those in conventional classroom environments (Ebner et al., 2018).

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A study conducted by Guo et al. (2014) found that compared to extended lectures, students who participated in short-term, targeted learning modules demonstrated much better recall and retention over the long term. Furthermore, knowledge retention is boosted by microlearning using spaced repetition. This method has been demonstrated in several studies to enhance memory retention significantly (Cepeda et al., 2006). Empirical studies have proven that students exposed to microlearning modules perform better academically. A study indicated that students who participated in microlearning content achieved superior exam scores and expressed enhanced satisfaction with the learning experience (Zhang et al., 2004).

In certain areas, such as the health sector, microlearning has been proven to raise the knowledge and confidence levels of students in health professions when it comes to completing necessary procedures, retaining requisite information, conducting essential research, and taking part in collaborative activities and yet, despite these positives, microlearning also brings with it a handful of negatives, such as possible challenges to pedagogical norms; technology biases; and concerns over privacy (Gagne et al., 2019).

Summary of Relevant Previous Studies

Table 1 provides a summary of relevant prior studies.

Table 1: Summary of Key Previous Studies on Microlearning and Related Constructs

Author(s) & Year	Focus Area	Key Findings
Hug (2017)	Microlearning	Microlearning reduces cognitive overload and enhances modular learning efficiency.
Emerson & Berge (2018)	Microlearning	Supports competency-based training and improves workplace learning outcomes.
Ebner & Holzinger (2007)	Self-Directed Learning	Microlearning empowers learners to independently explore and revisit materials flexibly.
Garrison (1997)	Self-Directed Learning	Autonomy in learning enhances motivation and lifelong learning development.
Kapp (2012)	Learning Engagement	Game-based microlearning promotes active engagement and sustained attention in learners.
Johnson et al. (2020)	Learning Engagement	Students using microlearning showed a 50% increase in engagement vs. traditional formats.

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Shang & Shi (2019)	Adaptability	AI-based microlearning tools improved learners' ability to adapt to various learning contexts.
Buchner (2020)	Adaptability	Microlearning supports digital adaptability through personalized and flexible content delivery.
Guo et al. (2014)	Knowledge Retention	Short-form content improved long-term recall over traditional lectures.
Ebner et al. (2018)	Knowledge Retention	Microlearning tools enhanced vocabulary retention by 25% compared to conventional methods.

Theoretical Framework

The underpinning theories for this study are two established theories of education which support the effectiveness of students' improved engagement and learning gains that is, Cognitive Load Theory and Constructivism.

Cognitive Load Theory (Sweller, 1988)

Cognitive Load Theory (CLT) suggests that learners have a limited working memory capacity, and this capacity can be exceeded when large amounts of information are presented simulatenously (Sweller, 1988). When instructional content exceeds this capacity, it can impede comprehension and retention. Microlearning, by design, mitigates this issue by presenting content in small, digestible segments that focus on a single learning objective. This lowers unnecessary cognitive load and lets learners concentrate on processing the essential content, which improves retention and the transfer of knowledge. For Generation Z, who are often juggling several simultaneous information streams, their processing preferences make them well-suited to the retrieval practice that microlearning embodies.

Constructivism (Bruner, 1961)

Constructivism, as conceptualized by Bruner (1961), highlights that learners build knowledge actively through experiences and interactions instead of simply receiving information and processing it passively. This theory underpins student-centered approaches in which learning occurs through exploration, contextual relevance, and engagement. Microlearning supports constructivist principles by offering interactive, learner-controlled, and contextually relevant content that encourages reflection and self-paced exploration. Particularly for Gen Z students, who prefer autonomy and digital interactivity, microlearning creates a constructivist environment conducive to deeper learning. By engaging with brief, targeted content that allows real-time feedback and iteration, learners build upon prior knowledge, facilitating meaningful and personalized learning experiences.

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These theories provide a robust base for understanding how microlearning can match the ways in which digital-native students like to learn and can also provide better evidence that microlearning is an effective way of teaching when one looks at engagement, adaptability, and knowledge retention.

Methodology

This study implemented a quantitative methodology to probe the impact of microlearning on learning engagement, self-directed learning, adaptability, and knowledge retention in Generation Z learners. The method was chosen to offer statistical insights regarding the connections between these variables. Data were gathered from undergraduates at Universiti Teknologi MARA (UiTM) and Tunku Abdul Rahman University of Management and Technology (TAR UMT), both situated in Kota Kinabalu, Sabah. A structured online survey was shared through WhatsApp, and the responses were examined using SPSS Version 26. This approach guaranteed organized data gathering and examination to validate dependable conclusions regarding the educational effectiveness of microlearning.

Research Design and Timeframe

This research utilized a quantitative approach to explore the connection between microlearning and several learning outcomes such as engagement, adaptability, self-directed learning, and knowledge retention in Generation Z students. Quantitative methods were chosen for their capability to evaluate the magnitude and orientation of associations between variables using statistical approaches (Creswell, 2014). The research was carried out over three months, spanning from October 2024 to December 2024, allowing sufficient time for data gathering, verification, and analysis.

Study Setting and Population

The research was carried out within two higher education institutions located in Kota Kinabalu, Sabah, Malaysia:

1. Universiti Teknologi MARA (UiTM), Sabah Branch, and
2. Tunku Abdul Rahman University of Management and Technology (TAR UMT), Sabah Branch.

These institutions were selected because of their varied student demographics and continuous incorporation of digital learning technologies, rendering them ideal environments for examining microlearning practices among Gen Z students. The focus group included undergraduate students aged 18 to 22, who embody the standard demographic for Gen Z and are regarded as digital natives

Sampling and Data Collection

A non-probability convenience sampling technique was employed to seek out participants. One hundred fifty university students freely engaged in the study. Primary data were gathered through a structured online questionnaire, formulated based on existing constructs in the literature about microlearning and student engagement. The questionnaire was disseminated digitally through WhatsApp, a prevalent communication channel among Malaysian students, ensuring accessibility and efficient distribution.

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The Survey Instrument Comprised Five Sections:
Section A: Demographic Information
Section B: Frequency and Use of Microlearning Tools
Section C: Learning Engagement Indicators
Section D: Self-Directed Learning Practices
Section E: Adaptability and Knowledge Retention Perceptions

A 5-point Likert scale was applied to assess the degree of agreement with each statement. The scale extended from 1 (Strongly Disagree) to 5 (Strongly Agree).

Data Analysis
The gathered data were exported and analysed utilising the Statistical Package for the Social Sciences (SPSS) Version 26. The analysis encompassed descriptive statistics (frequency, mean, standard deviation) and inferential statistics, comprising regression analysis, ANOVA, and Pearson's correlation. The tests were performed to ascertain the significance and strength of the correlations between microlearning and the diverse educational outcome factors.

Research Workflow
To enhance clarity and transparency, the research process is illustrated in the workflow below:

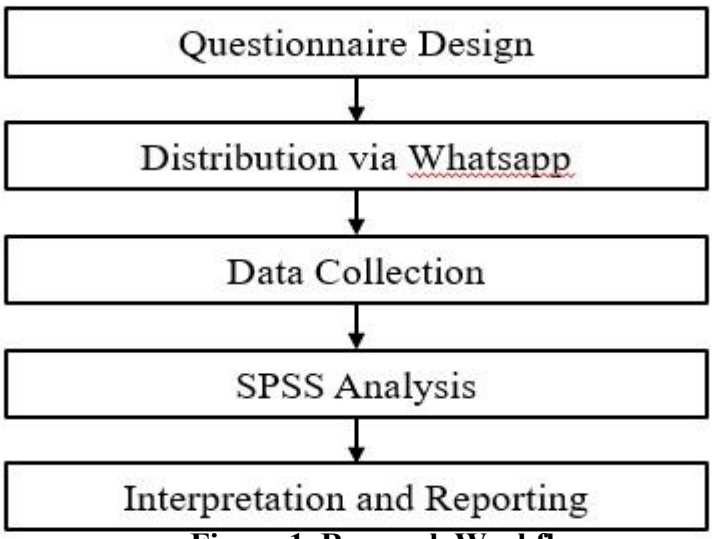

Figure 1. Research Workflow

Findings and Discussion

Table 2: Demographic

Demography		Frequency (N=150)	Percent
Age	18 to 22 years old	150	100
Academic level	Undergraduate	143	95.3
	Others	7	4.7
Gender	Male	43	28.7
	Female	107	71.3

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The demographic profile of the respondents consists of 150 individuals, all aged between 18 to 22 years old (100%). In terms of academic level, the majority are undergraduate students (95.3%), while a small percentage (4.7%) belong to other academic categories. Regarding gender distribution, 28.7% of the respondents are male (43 individuals), whereas females constitute the majority at 71.3% (107 individuals).

Hypotheses

H0: Microlearning not positively influences learning engagement among Gen Z students.
H1: Microlearning positively influences learning engagement among Gen Z students.
Level of significant, α=0.05

Table 3: Model Summary (H1)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.643a	0.413	0.401	0.535

a. Predictors: (Constant), microlearning 3, microlearning 1, microlearning 2

As shown in Table 3, the R-value is 0.643, indicating a strong positive correlation between microlearning and learning engagement. The R Square value of 0.413 suggests that 41.3% of the variance in learning engagement is explained by microlearning. The Adjusted R Square (0.401), which accounts for model complexity, is slightly lower but still indicates a meaningful explanatory power. The standard error of the estimate (0.535) represents the average deviation of the observed values from the predicted values.

Table 4: ANOVAa (H1)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.405	3	9.802	34.261	.000b
	Residual	41.768	146	0.286		
	Total	71.173	149			

a. Dependent Variable: learning
b. Predictors: (Constant), microlearning 3, microlearning 1, microlearning 2

As reflected in the results of Table 4 Anova assesses whether the overall regression model is statistically significant. The F-statistic is 34.261, and the p-value is 0.000 ($p < 0.05$), representing that the model significantly explains the variation in learning engagement. This means that at least one of the microlearning variables has a significant effect on learning engagement.

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Table 5: Coefficients[a] (H1)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.426	0.258		5.536	0
	microlearning 1(How often do you use microlearning platforms?)	0.002	0.051	0.003	0.046	0.964
	microlearning 2 (How effective do you find microlearning for acquiring new knowledge?)	0.21	0.049	0.311	4.324	0
	microlearning 3 [(Do you prefer microlearning (short, focused lessons) over traditional learning (lectures, textbooks)?)]	0.404	0.056	0.48	7.237	0

a. Dependent Variable: learning

As evidenced in Table 5, it provides insights into the individual effects of each microlearning variable:

- The constant (B = 1.426, p = 0.000) represents the baseline level of learning engagement when all microlearning variables are absent. Since the p-value is significant, the constant contributes meaningfully to the model.
- Microlearning 1 (B = 0.002, p = 0.964) has an almost negligible effect on learning engagement, and its p-value (>0.05) indicates that it is not statistically significant. This suggests that this particular aspect of microlearning does not contribute to learning engagement among Gen Z students.
- Microlearning 2 (B = 0.210, p = 0.000) shows a positive and significant effect on learning engagement. This implies that an increase in Microlearning 2 is associated with a higher level of engagement among students.
- Microlearning 3 (B = 0.404, p = 0.000) has the strongest positive effect on learning engagement, meaning that students who engage with this component of microlearning are more likely to experience enhanced engagement.

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Based on the results, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, confirming that microlearning positively influences learning engagement among Gen Z students. However, not all microlearning components contribute equally, with Microlearning 2 and Microlearning 3 showing significant effects, while Microlearning 1 does not significantly impact engagement.

H0: Students who use microlearning do not exhibit higher levels of self-directed learning compared to those who do not.
H2: Students who use microlearning exhibit higher levels of self-directed learning compared to those who do not.
Level of significant, α=0.05

Table 6: Descriptives - Self-Directed Learning (H2)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
never	1	2	.	.	.	.	2	2
rarely	12	3.42	0.515	0.149	3.09	3.74	3	4
occasionally	31	3.48	0.626	0.112	3.25	3.71	2	5
frequently	63	3.75	0.671	0.085	3.58	3.92	3	5
daily	43	3.7	0.674	0.103	3.49	3.91	2	5
Total	150	3.64	0.668	0.055	3.53	3.75	2	5

As shown in Table 6, the study examines whether students who use microlearning display higher levels of self-directed learning by comparison with those who do not. Descriptive statistics show that students who frequently or daily engage with microlearning tend to have higher self-directed learning scores. The mean self-directed learning scores increase with the frequency of microlearning use, with those who never used microlearning having the lowest score (2.00), while those who use it frequently (3.75) and daily (3.70) report higher scores. The overall mean self-directed learning score across all participants is 3.64 with a standard deviation of 0.668, showing moderate self-directed learning levels among the students.

Table 7: ANOVA (H2)

self

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.895	4	1.224	2.878	0.025
Within Groups	61.665	145	0.425		
Total	66.56	149			

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The results show a significant difference in self-directed learning scores based on microlearning frequency ($F = 2.878$, $p = 0.025$). Since the p-value (0.025) is less than the significance level ($\alpha = 0.05$), this indicates that the frequency of microlearning use has a statistically significant effect on self-directed learning levels.

Based on these findings, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_2) is accepted, confirming that students who use microlearning exhibit higher levels of self-directed learning compared to those who do not.

H0: Microlearning does not allow for greater adaptability and personalization in the learning process for Gen Z students.
H3: Microlearning allows for greater adaptability and personalization in the learning process for Gen Z students.
Level of significant, α=0.05

Table 8: Correlations (H3)

		microlearning 1	adaptability
microlearning 1	Pearson Correlation	1	.215**
	Sig. (2-tailed)		0.008
	N	150	150
adaptability	Pearson Correlation	.215**	1
	Sig. (2-tailed)	0.008	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

The study examines whether microlearning allows for greater adaptability and personalization in the learning process for Gen Z students. To determine the relationship between microlearning and adaptability, a Pearson correlation analysis was conducted. The results indicate a weak positive correlation ($r = 0.215$) between microlearning and adaptability, suggesting that as microlearning usage increases, adaptability and personalization in learning also tend to improve slightly. The correlation is statistically significant ($p = 0.008$), as the p-value is lower than the significance level of $\alpha = 0.05$, confirming that the relationship is not due to random chance.

Based on these findings, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_3) is accepted, meaning that microlearning allows for greater adaptability and personalization in the learning process for Gen Z students. However, as the correlation is weak, it indicates that while microlearning contributes to adaptability, other factors may also play a role.

H0: Microlearning does not significantly improves knowledge retention compared to traditional learning methods.
H4: Microlearning significantly improves knowledge retention compared to traditional learning methods.
Level of significant, α=0.05

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Table 9: Descriptives – Learning Engagement (H4)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
strongly disagree	3	1.67	0.577	0.333	0.23	3.1	1	2
disagree	7	3	0.577	0.218	2.47	3.53	2	4
neutral	91	3.46	0.704	0.074	3.31	3.61	2	5
agree	32	4	0.672	0.119	3.76	4.24	3	5
strongly agree	17	4.24	0.831	0.202	3.81	4.66	3	5
Total	150	3.61	0.818	0.067	3.47	3.74	1	5

The descriptive statistics provide an overview of the relationship between microlearning and learning engagement. The results show that students who strongly agree that microlearning enhances learning engagement have the highest mean score (4.24, SD = 0.831), followed by those who agree (4.00, SD = 0.672). In contrast, students who strongly disagree have the lowest mean score (1.67, SD = 0.577), and those who disagree have a mean of 3.00, SD = 0.577. The overall mean score is 3.61 (SD = 0.818), suggesting that, on average, students perceive microlearning as beneficial for their learning engagement. The confidence interval for the mean shows that most students' engagement levels fall between 3.47 and 3.74, further indicating a positive trend in learning engagement among those who use microlearning more frequently.

Table 10: ANOVA (H4)

learning engagement	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.452	4	6.863	13.756	0
Within Groups	72.341	145	0.499		
Total	99.793	149			

A one-way ANOVA test was conducted to determine whether the differences in learning engagement scores between groups were statistically significant. The analysis shows a statistically significant difference ($F = 13.756$, $p = 0.000$) between the groups. The between-group variance (Sum of Squares = 27.452, Mean Square = 6.863) is considerably larger than the within-group variance (Sum of Squares = 72.341, Mean Square = 0.499), indicating that students' perceptions of microlearning significantly impact their learning engagement. Since the p-value (0.000) is below the significance level ($\alpha = 0.05$), the results confirm that microlearning usage leads to significantly different levels of learning engagement, supporting the alternative hypothesis.

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Table 11: Multiple Comparisons (H4)

Dependent Variable: learning engagement
Tukey HSD

(I) microlearning 3	(J) microlearning 3	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
strongly disagree	disagree	-1.333	0.487	0.054	-2.68	0.01
	neutral	-1.795*	0.414	0	-2.94	-0.65
	agree	-2.333*	0.426	0	-3.51	-1.16
	strongly agree	-2.569*	0.442	0	-3.79	-1.35
disagree	strongly disagree	1.333	0.487	0.054	-0.01	2.68
	neutral	-0.462	0.277	0.458	-1.23	0.3
	agree	-1.000*	0.295	0.008	-1.81	-0.19
	strongly agree	-1.235*	0.317	0.001	-2.11	-0.36
neutral	strongly disagree	1.795*	0.414	0	0.65	2.94
	disagree	0.462	0.277	0.458	-0.3	1.23
	agree	-.538*	0.145	0.003	-0.94	-0.14
	strongly agree	-.774*	0.187	0.001	-1.29	-0.26
agree	strongly disagree	2.333*	0.426	0	1.16	3.51
	disagree	1.000*	0.295	0.008	0.19	1.81
	neutral	.538*	0.145	0.003	0.14	0.94
	strongly agree	-0.235	0.212	0.801	-0.82	0.35
strongly agree	strongly disagree	2.569*	0.442	0	1.35	3.79
	disagree	1.235*	0.317	0.001	0.36	2.11
	neutral	.774*	0.187	0.001	0.26	1.29
	agree	0.235	0.212	0.801	-0.35	0.82

*. The mean difference is significant at the 0.05 level.

To further examine which groups differ significantly, a Tukey HSD post-hoc test was conducted. The results indicate that students who strongly disagree with the benefits of microlearning have significantly lower learning engagement scores compared to those who agree ($p = 0.000$) and strongly agree ($p = 0.000$). Similarly, students who disagree show significantly lower engagement scores than those who agree ($p = 0.008$) and strongly agree ($p = 0.001$). Moreover, students who take a neutral position have much less engagement than those who agree ($p = 0.003$) and those who strongly agree ($p = 0.001$). These results imply that the more microlearning is perceived as a positive thing, the more students engage with it, which also implies that microlearning enhances knowledge retention.

Since the ANOVA test results show a significant difference ($p < 0.05$) in learning engagement scores among the groups, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_4) is accepted. This means that microlearning significantly improves knowledge retention compared to traditional learning methods. The post-hoc analysis further supports this conclusion, demonstrating that students who strongly agree with the effectiveness of microlearning show significantly higher engagement levels than those who are neutral or disagree. These findings underscore the beneficial effects of microlearning on student

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engagement and indicate its promise as a pedagogical tool for fostering enhanced retention of knowledge. However, further research could explore long-term retention effects and compare microlearning with various traditional learning strategies.

H0: Students who frequently engage in microlearning do not have a higher overall satisfaction with their learning experience.
H5: Students who frequently engage in microlearning have a higher overall satisfaction with their learning experience.
Level of significant, α=0.05

Table 12: ANOVA (H5)

overall

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.006	4	2.002	5.774	0
Within Groups	50.267	145	0.347		
Total	58.273	149			

According to the ANOVA results, the F-value is 5.774, and the p-value (sig.) is 0.000. The p-value is 0.000, which is less than the significance level (α) of 0.05. This suggests that there is a statistically significant variation in overall learning satisfaction depending on the frequency of student engagement in microlearning. Therefore, we dismiss the null hypothesis (H_0) and endorse the alternative hypothesis (H_5). This indicates that students who regularly participate in microlearning exhibit greater satisfaction with their overall educational experience.

Discussions

This research confirms microlearning boosts learning engagement, especially for Generation Z students who favor brief, interactive, and tech-oriented material. Recent studies indicate that microlearning modules boost student involvement and motivation far beyond what traditional formats achieve (Kravchenko, 2025). Microlearning's compact format interacts very well with Generation Z's limited attention span and their intense desire for information that is quick, to-the-point, and applicable. This makes for a far more interactive atmosphere in which to learn.

Moreover, the study's results for knowledge retention support existing literature suggesting that microlearning increases information retention rates. Research from Dresden University indicates that microlearning increases the information retention by 22% compared to conventional education methods (Elai.io, 2024). This enhancement comes from the focused and repeated nature of microlearning which makes learning effective and makes it easier to remember things in the long run.

The research additionally underscores how microlearning facilitates the kind of self-directed learning that educators are increasingly angling for in college and university classrooms. Microlearning modules give students the sort of flexibility and access that nudges them toward a learning pathway of their own design. These are the same kinds of nudge factors that are being built into systems of instructional design and into learning management systems to

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achieve the kind of learning outcomes that are associated with self-paced and, more importantly, self-directed learning. (Judijanto, 2025).

Furthermore, the adaptability of microlearning to various learning contexts and disciplines underscores its versatility as an educational tool. Current research has shown how well microlearning works to teach soft skills in various academic fields. This speaks to the possible widespread application of this pedagogical strategy across many higher education curricula, not just in a few niche programs (Xu et al., 2024).

In summary, in enhancing student engagement, knowledge retention, self-directed learning and adaptability in higher education, it seems an integration of microlearning into higher education a good potential of strategy for an effective learning strategy for digital native learners

Contributions

This study makes significant contributions to both academic research and educational practice. Theoretically, it contributes to the corpus of knowledge by verifying the significance of microlearning in formal higher education settings and linking it with existing learning theories such as Cognitive Load Theory and Constructivism. Empirically, the study provides current statistical evidence on how microlearning influences core educational outcomes among university students in Malaysia. Practically, the findings offer educators, instructional designers, and policymakers clear, data-driven insights to guide the design and integration of microlearning strategies into higher education curricula. This is especially relevant in digitally evolving academic environments where learner-centered, adaptive, and technology-enhanced pedagogies are increasingly necessary. From the perspective of instructional designers, prioritizing the development of adaptive content and promoting opportunities for self-directed learning is essential in addressing the distinct preferences and learning styles of Generation Z students. Furthermore, for policymakers, investing in robust digital infrastructure and advocating for the implementation of microlearning frameworks may contribute significantly to improving the accessibility, effectiveness, and equity of higher education especially within emerging regions such as Sabah.

Conclusion

This study successfully achieved its primary research objectives by empirically examining the impact of microlearning on learning engagement, self-directed learning, adaptability, knowledge retention, and overall learning satisfaction among Generation Z students. The findings revealed a statistically significant association between microlearning and learning engagement, particularly through personalized and interactive formats. The results affirmed that microlearning is more than a supplementary tool it serves as a pedagogically sound strategy capable of addressing the distinctive cognitive and behavioral traits of digital-native learners. These outcomes support the hypothesis that personalized, modular, and digitally mediated microlearning approaches are key drivers of educational effectiveness for Gen Z students.

Recommendations

Based on study findings, several recommendations can be proposed. First, integrate microlearning into Curriculum Design. Educational institutions should incorporate microlearning modules into their formal curricula to enhance student engagement, especially in subjects that typically struggle to capture attention through conventional lectures. Second, by focusing on Interactive and Personalized Learning Materials. As Microlearning 2 (Learning Engagement) and 3 (Self-Directed Learning) were the most effective, instructors should

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prioritize the use of interactive content (e.g., quizzes, short videos, gamified learning) and personalized learning pathways to meet diverse student needs. Not only that, train the educators in Microlearning Pedagogy. Provide professional development for lecturers and instructional designers on creating effective microlearning content. Training should emphasize multimedia integration, assessment strategies, and learner analytics. On the other hand, leverage the technology to enhance adaptability. Institutions should invest in AI-driven or adaptive learning platforms that adjust content delivery based on student performance and preferences, thus increasing personalization and long-term retention. Furthermore, future studies should explore the long-term effects of microlearning on academic performance and skill development, comparing its effectiveness across different disciplines and student demographics by conducting Longitudinal research. Also, to ensure all students benefit from microlearning, efforts must be made to minimize digital divides. This includes providing access to devices and internet connectivity, especially in rural and underserved areas by addressing accessibility and equity issues. By embracing microlearning as part of a broader digital learning strategy, educational institutions can create more engaging, effective, and student-centered learning environments tailored to the expectations and habits of the Gen Z generation.

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