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Digital Microlearning and Self-Regulated Learning: Exploring Learners' Experiences toward Sustainable Learning

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Abstract

Technological advances in digital learning have led to the transformation of education through flexible microlearning, but its effectiveness is greatly influenced by the self-regulated learning (SRL) capacity of students in managing their learning processes. This study aims to examine participants' experiences of utilising digital microlearning through the Ruang Karya platform, as well as the role of SRL in promoting continuous learning. The study used a qualitative approach with a phenomenological method to understand the meaning of the learning experience directly experienced by the participants. Data were collected through in-depth interviews until saturation was reached. The results of the study show that digital microlearning provides easy access, time flexibility, and concise, focused material presentation, thus increasing learning efficiency. However, the effectiveness of this is greatly influenced by SRL skills such as time management, goal setting, learning strategies, and self-monitoring and evaluation. Participants with good SRL skills tend to have a more optimal and meaningful learning experience. Integrating microlearning digital and SRL also promotes independent learning, increases intrinsic motivation, and strengthens preparedness to face academic and future challenges. Therefore, strengthening SRL is crucial in optimising microlearning digital as a sustainable learning strategy in the digital era.

[Kemajuan teknologi dalam pembelajaran digital telah membawa transformasi di bidang pendidikan melalui microlearning yang fleksibel, namun keefektifannya sangat dipengaruhi oleh kemampuan belajar mandiri (SRL) siswa dalam mengelola proses belajar mereka. Penelitian ini bertujuan untuk mengkaji pengalaman peserta dalam memanfaatkan microlearning digital melalui platform Ruang Karya, serta peran SRL dalam mendorong pembelajaran berkelanjutan. Penelitian ini menggunakan pendekatan kualitatif dengan metode fenomenologis untuk memahami makna pengalaman belajar yang dialami langsung oleh para peserta. Data dikumpulkan melalui wawancara mendalam hingga tercapai kejenuhan. Hasil penelitian menunjukkan bahwa pembelajaran mikro digital memberikan akses yang mudah, fleksibilitas waktu, serta penyajian materi yang ringkas dan terfokus, sehingga meningkatkan efisiensi belajar. Namun, keefektifan hal ini sangat dipengaruhi oleh keterampilan SRL seperti manajemen waktu, penetapan tujuan, strategi belajar, serta pemantauan dan evaluasi diri. Peserta dengan keterampilan SRL yang baik cenderung memiliki pengalaman belajar yang lebih optimal dan bermakna. Integrasi pembelajaran mikro digital dan SRL juga mendorong pembelajaran mandiri, meningkatkan motivasi intrinsik, serta memperkuat kesiapan dalam menghadapi tantangan akademik dan masa depan. Oleh karena itu, penguatan SRL sangat penting dalam mengoptimalkan pembelajaran mikro digital sebagai strategi pembelajaran yang berkelanjutan di era digital.]

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1. Introduction

Advances in digital technology have given rise to a variety of learning platforms that enable individuals to access materials flexibly and quickly. However, in practice, many learners still struggle to maintain consistency in their learning, manage their time, stay motivated, and complete the learning process on an ongoing basis, despite the abundance of available learning resources. This situation indicates that the main issue in digital learning no longer lies in limited access to information, but rather in learners' ability to manage their own learning process independently. This phenomenon is evident in the use of microlearning-based platforms such as Ruang Karya, where short, easily accessible materials are often not fully complemented by learners' strong self-regulated learning skills [1].

This issue is supported by research findings indicating that ease of access to digital learning does not always correlate with long-term learning success, as many learners still struggle to maintain focus, manage learning strategies, and build consistent learning commitment [2]. Theoretically, this situation can be explained through the concept of self-regulated learning (SRL), which refers to an individual's ability to manage their own learning goals, strategies, motivation, and evaluation. On the other hand, the theory of digital microlearning explains that the presentation of material in a concise, focused, and flexible manner can help learning become more adaptive to individual needs in the digital age. Therefore, the integration of microlearning and self-regulated learning is crucial to supporting the creation of independent, adaptive, and sustainable learning amidst the development of educational technology.

This issue also aligns with the global education agenda outlined in the Sustainable Development Goals, particularly SDG 4: Quality Education, which emphasises inclusive, equitable access and lifelong learning opportunities [3]. Lifelong learning is understood as a continuous effort to develop competencies in response to changing demands [4]. Therefore, digital platforms adopting flexible approaches like microlearning, when combined with self-regulated learning, play a crucial role in enabling learners to manage their learning independently and sustainably, supporting the achievement of these global objectives.

Theoretically, lifelong learning is defined as the continuous development of knowledge and skills across the lifespan, unrestricted by formal educational settings. Digital microlearning emerges as an innovation that delivers concise, focused, and accessible content, making learning more adaptable to individual needs in the digital era [5][6]. Meanwhile, self-regulated learning (SRL) refers to learners' ability to manage their learning processes, including goal-setting, strategy use, progress monitoring, and self-evaluation [7]. These concepts are interconnected: microlearning provides a flexible structure, while SRL functions as an internal mechanism guiding the learning process. Their integration forms a foundation for adaptive, continuous, and independent learning within technology-based education.

The urgency of this research lies in the need to examine more comprehensively the integration of digital microlearning and SRL in supporting continuous learning amid digital transformation. Rapid technological developments require adjustments in learning strategies, particularly in learners' capacity to manage their learning independently [8]. While microlearning offers flexibility and efficiency, SRL determines the effectiveness of its use [9]. Therefore, this study contributes to strengthening the conceptual understanding of the relationship between these variables and their role in fostering adaptive, autonomous, and sustainable learning in modern education.

Previous research studies indicate that discussions on self-regulated learning have focused on various aspects, such as the use of artificial intelligence-based technologies like ChatGPT to support independent learning,[10] the use of multimodal and multichannel data to monitor and analyse self-regulation processes,[11] and the impact of assessment tools,[12] such as rubrics,[13] on academic performance,[14] self-efficacy,[15] and learners' learning management strategies [16]. Digital microlearning has been examined in the context of the effectiveness of presenting short materials on learning retention,[17] its implementation in learning such as in Islamic religious education, the development of educators' digital competencies, the flexibility and accessibility of learning based on digital platforms such as Ruang Karya, the integration of literacy in digital learning, and global trends in its application across various fields of education. These findings indicate that both concepts make a significant contribution to the development of modern learning.

Based on the above, this study aims to comprehensively analyse the contribution of digital microlearning and self-regulated learning to sustainable learning from an SDGs perspective. The research focus is directed at how the integration of both can shape a learning process that is adaptive, self-directed, and long-term oriented, as well as relevant to the demands of education in

the digital age. This study is expected to provide both conceptual reinforcement and practical implications for the development of learning strategies that are not only pedagogically effective but also aligned with efforts to achieve sustainable development goals, particularly in the field of education.

2. Method

This study employs a qualitative approach, specifically a phenomenological research design, aimed at uncovering the meaning of learners' lived experiences in utilising digital microlearning via the *Ruang Karya* platform, as well as how they develop self-regulated learning to support continuous learning. The phenomenological approach adopted draws on the work of Edmund Husserl, which emphasises understanding the essence of an individual's subjective experience through the process of phenomenological reduction [18]. The choice of this approach is based on the need to explore students' learning experiences in depth so that authentic meanings regarding their interactions with digital microlearning-based learning can be identified.

The research subjects were selected purposively based on the criteria of students who actively use the *Ruang Karya* platform in the microlearning-based learning process and who have experience in managing their own learning. The recruitment of participants was conducted in stages until data saturation was reached, i.e. the point at which the information obtained had become repetitive and no new significant themes were identified. Data saturation in this study was achieved after the researcher interviewed 10 participants, a number deemed to represent the depth and sufficiency of data required for a phenomenological study.

Data were collected through semi-structured in-depth interviews, allowing participants to express their experiences, perceptions, and learning strategies while engaging with digital microlearning in Ruang Karya. The interviews explored aspects such as time management, goal-setting, learning strategies, and reflections on the learning process. Participatory observation was conducted to capture learners' behaviours directly within the platform context, ensuring both verbal and contextual data. Documentation, including learning activity records, screenshots, and relevant archives, was used as supporting data. Data analysis followed the phenomenological approach of Clark Moustakas [19]. Data validity was ensured through method triangulation by comparing interview, observation, and documentation data to maintain consistency. Member checking was conducted by confirming interpretations with participants to ensure alignment with their intended experiences. This approach enabled the study to produce in-depth, credible, and contextual findings regarding the contribution of digital microlearning in Ruang Karya and self-regulated learning to sustainable learning from an SDGs perspective.

3. Results

The following table presents the findings of the research, which were obtained from the participants' direct experience of using digital microlearning through the Ruang Karya platform. The findings are organised based on the research focus, which covers participants' experience of using digital microlearning, the self-regulated learning (SRL) strategies they applied during the learning process, and the contribution of both to sustainable learning. Each theme and sub-theme in the table illustrates patterns of experience, learning behaviour, and participants' views on the learning process they underwent. Additionally, participant quotations are presented to reinforce the findings and demonstrate how these experiences manifest in the context of digital learning. Thus, the table helps to provide a comprehensive overview of the relationship between digital microlearning, self-regulated learning, and sustainable learning in the context of this study.

Table 2. Research Findings

No	Main Theme	Subtheme	Description of Findings	Representative Quote
1	Microlearning Digital Experience	Accessibility	Students experience ease of access to learning flexibly through the *Ruang Karya* platform without time and place constraints	"Learning can be flexible, not limited to the classroom, anytime."
2	Microlearning Digital Experience	Material Effectiveness	The concise and focused presentation of materials helps students understand the core content more quickly	"The material goes straight to the point, so it's easier to understand."

3	Microlearning Digital Experience	Limited Depth of Understanding	Some students experience difficulties in understanding complex materials due to limited depth of explanation	"Sometimes it lacks detail when the material is quite difficult."
4	Self-Regulated Learning Strategies	Time Management	Students are able to manage their learning time independently according to their needs and conditions	"I usually manage my own study time, for example at night."
5	Self-Regulated Learning Strategies	Goal Setting	Students set specific learning goals before starting their learning activities	"I usually decide what I want to study first."
6	Self-Regulated Learning Strategies	Learning Strategies	Students apply various strategies such as repeating materials, taking notes, and seeking additional resources	"If I don't understand, I repeat the video or search online."
7	Self-Regulated Learning Strategies	Monitoring and Evaluation	Students monitor and evaluate their learning progress independently	"I check again whether I really understand or not."
8	Learning Independence	Increased Independence	Microlearning encourages students to become more independent in their learning process	"I've become more used to studying on my own without being told."
9	Learning Independence	Learning Responsibility	Students demonstrate increased responsibility toward their learning process and outcomes	"If I don't study, I'm the one who loses."
10	Sustainable Learning	Learning Habits	More consistent and continuous learning habits are developed	"I study more often, even if only a little at a time."
11	Sustainable Learning	Intrinsic Motivation	Students develop intrinsic motivation to continue learning independently	"I feel more motivated to learn because it's easy to access."
12	Sustainable Learning	Future Readiness	Students feel more prepared to face academic and career challenges in the future	"I feel more prepared because I'm used to independent learning."
13	Role of Technology	Digital Support	Digital technology facilitates access and the overall learning process	"Technology really helps learning nowadays."
14	Role of Technology	Educational Relevance	Microlearning is perceived as relevant to the dynamic needs of modern education	"It fits today's fast-paced era."

The findings show that digital microlearning in Ruang Karya promotes a flexible and targeted learning pattern, though it remains limited in delivering in-depth material. High accessibility allows participants to learn anytime and anywhere, making the process adaptable to individual needs. Concise and focused content improves efficiency and accelerates understanding; however, difficulties with complex material indicate the need for supplementary advanced resources. Findings on self-regulated learning (SRL) reveal that participants increasingly manage their learning independently through flexible time management, clear goal-setting, active strategies (e.g., reviewing materials and seeking additional sources), and self-monitoring and evaluation. This is accompanied by greater learning autonomy, reflected in reduced reliance on external guidance and stronger personal responsibility for learning outcomes, indicating that microlearning supports both cognitive development and independent learning attitudes.

4. Discussion

4.1 The Dynamics of Digital Microlearning in Fostering Self-Regulated Learning Among Participants on the *Ruang Karya* Platform

Learning systems continue to evolve alongside societal change, with modernisation driving innovations such as digital microlearning. This approach breaks complex material into small, concise units, improving comprehension and knowledge retention through gradual, repeated delivery. Its integration with digital technology enhances effectiveness, creating a flexible and systematic learning model suited to the digital era [20]. This transformation is evident in platforms such as Ruang Karya, which adopt flexible, practice-based learning. The platform supports competency development in academic skills, scientific writing, and public speaking, allowing learners to access materials at their own pace while engaging in practice supported by continuous feedback. An output-oriented approach ensures that learners not only understand concepts but also apply them in tangible forms [21]. A key feature of microlearning is its step-by-step delivery through "bite-sized" content, enabling focused attention and faster comprehension. Learning is structured sequentially for example, scientific writing progresses from basic concepts to structure and practical application [22]. This aligns with George Miller's perspective on manageable information units and John Sweller's cognitive

load theory, which emphasises reducing overload through chunking. As highlighted by Hector Correa, digital microlearning is therefore effective in supporting personalised learning and enhancing critical thinking [23].

The learning space at Ruang Karya provides flexible access through mutually agreed schedules, allowing learners to study anytime and anywhere while selecting materials based on their preferences [24]. This flexibility reflects a core feature of digital microlearning and aligns with Cognitive Load Theory, which supports efficient long-term retention [25], while also accommodating learners' short attention spans and high mobility [26]. The system adopts a task-based approach, where learners complete assignments after engaging with concise learning units, reinforcing understanding through direct practice in line with microlearning principles and Kolb's experiential learning theory [27]. Continuous task engagement also promotes self-regulated learning (SRL), as learners manage tasks, monitor progress, and evaluate outcomes, strengthening autonomy. Thus, microlearning and task-based learning function not only as delivery strategies but also as mechanisms for developing self-regulation [28].

These tasks are supported by immediate, continuous feedback, enabling learners to identify errors, refine understanding, and improve outcomes. Feedback strengthens self-reflection, consistent with Zimmerman's SRL framework, and, as noted by Hattie and Timperley, supports learning goals, progress, and improvement strategies, enhancing metacognitive awareness and autonomy. In practice, digital microlearning in Ruang Karya demonstrates flexible and adaptive dynamics, with learners engaging independently or through mentor-guided pathways, reflecting constructivist principles and diverse learning needs [29][30]. Overall, this indicates a shift from linear to modular learning, where segmented content enhances flexibility, continuity, and efficiency by reducing cognitive load [31], while expanding access and strengthening active learner engagement.

Furthermore, this dynamic is strengthened by the integration of immediate feedback as a core element of the learning design. Prompt, specific, and continuous feedback sustains learning continuity while facilitating reflection on learning outcomes. Within feedback and learning theory, effective feedback bridges actual performance and learning objectives, enabling ongoing correction and regulation [32]. Thus, feedback in each learning cycle functions as an evaluation mechanism that enhances understanding and supports the adjustment of learning strategies. The integration of content segmentation, task assignment, and responsive feedback indicates that digital microlearning on the Ruang Karya platform is designed as a flexible system oriented toward continuous and systematic optimisation of the learning process.

4.2 Learners' Self-Regulated Learning Strategies in Accessing and Managing Digital Microlearning

Self-regulated learning (SRL) refers to learners' ability to plan, organise, direct, control, and evaluate their own learning to achieve predetermined goals, encompassing cognitive, affective, and behavioural aspects [33]. In the context of Ruang Karya, SRL is reflected in learners' capacity to define learning objectives so that content engagement aligns with desired outcomes. Core characteristics of SRL include goal-setting, strategic planning, continuous monitoring, reflection, and strategy adjustment [34]. These are essential in optimising digital microlearning, which requires learner independence and active engagement. Features such as flexible access, segmented content, task-based activities, and immediate feedback function not only as instructional design elements but also as stimuli that foster diverse SRL strategies in managing and evaluating learning independently [35].

SRL develops through structured stages, beginning with the forethought phase, which involves goal-setting, strategic planning, and motivational components such as self-efficacy and outcome expectations [36][37][38]. This phase provides the foundation that shapes the effectiveness of subsequent learning processes. Learners in Ruang Karya demonstrate varied orientations, including mastery of specific skills, conceptual understanding, task completion, and participation in external activities such as competitions. These differences lead to diverse SRL strategies and adaptive instructional dynamics guided by mentors. Strategies oriented toward mastery typically involve structured repetition, intensive practice, and gradual skill reinforcement. This aligns with mastery goal orientation, where learners focus on competence development and deep understanding. In Zimmerman's framework, such strategies are reflected in self-control practices, including rehearsal, material organisation, and consistent time management to achieve targeted competencies [39].

Conversely, a focus on conceptual understanding encourages the use of elaborative cognitive strategies, such as connecting new information with prior knowledge, interpreting meaning, and developing reflective understanding. This aligns with constructivist perspectives and deep learning approaches that emphasise meaning-making. In this context, self-regulated learning (SRL) involves self-monitoring and reflection to ensure comprehensive understanding [40]. Variations in goal-setting also shape learning strategies. Learners with task-completion goals tend to adopt task-oriented strategies, including prioritisation, time management, and regular progress monitoring. This reflects performance goal orientation, where success is defined by achieving specific targets. From Pintrich's perspective, such strategies relate to behavioural regulation, focusing on efficiency and accuracy in task completion [41]. Externally oriented goals, such as seeking recognition or validation, further influence SRL strategies. Learners in this orientation optimise resource management by utilising mentor feedback, engaging in peer discussions, and adjusting strategies based on external standards. This aligns with social cognitive theory, which highlights the role of social interaction in shaping self-regulation. Overall, these strategies demonstrate continuous adaptation to ensure learning objectives are effectively achieved.

Differences in learning objectives directly shape the diversity of self-regulated learning (SRL) strategies, influencing how learners manage the microlearning process in Ruang Karya. These variations are evident in how learners access, organise, and utilise learning resources, reflecting individual goal orientations. A microlearning environment that offers multiple formats such as visual, textual, and video materials enables the development of multimodal learning strategies. This diversity allows learners to select formats aligned with their cognitive preferences, relating to strategic planning and resource management in SRL, where learners determine the most effective resources to achieve their goals [42]. Accordingly, learning approaches also vary, including listening for comprehension, note-taking for memory support, and repetition for deeper understanding and retention. Moreover, flexible access in digital microlearning strengthens time management and self-monitoring strategies. In line with Zimmerman's social cognitive theory, SRL emerges from the interaction of cognitive, motivational, and contextual factors. Learners demonstrate this through clear goal-setting, consistent study scheduling, focused revision, and independent evaluation of understanding. Overall, the diversity of microlearning formats in Ruang Karya not only enriches learning resources but also stimulates the development of adaptive and differentiated self-regulation strategies.

The next stage of self-regulated learning (SRL) in Ruang Karya is the self-reflection phase, which involves self-evaluation and self-control strategies. This phase assesses learning effectiveness and identifies areas for improvement. In Zimmerman's framework, it consists of self-evaluation of outcomes and self-reaction, encompassing cognitive and affective responses to results [43]. This process is essential for achieving learning goals and reducing misunderstandings. Evaluation practices vary according to learners' characteristics and strategies. Learners with structured approaches tend to review notes, compare materials with task results, and revisit unclear content, reflecting systematic self-monitoring and consistency in understanding. In contrast, reflective learners focus on identifying errors through mentor feedback, analysing mistakes, and formulating corrective actions for subsequent learning cycles [44]. In microlearning contexts, this is particularly effective, as segmented content allows immediate improvement in the next unit. Thus, self-evaluation and self-regulation function not only as the final stage of learning but also as a regulatory mechanism linking prior experiences with future planning. This confirms that SRL in digital microlearning at Ruang Karya operates cyclically and continuously, where each evaluation informs the optimisation of strategies in subsequent stages.

4.3 The Contribution of Digital Microlearning and Self-Regulated Learning to Lifelong Learning from an SDG Perspective

Lifelong learning in modern education is no longer viewed merely as continuous learning, but as a systematic effort to develop individuals' capacity for independent, adaptive, and context-relevant learning [45]. Digital transformation has reshaped how learners access, manage, and internalise knowledge, extending learning beyond formal spaces and times. Consequently, sustainable learning requires the integration of technology, flexibility, and learners' ability to manage their own learning processes. This aligns with the global agenda of the United Nations, particularly Sustainable Development Goal 4 (Quality Education), which emphasises inclusive, equitable access and lifelong learning opportunities for all [46]. Sustainable learning thus focuses on strengthening self-directed learning skills, making the integration of digital learning and self-regulated learning essential for building an adaptive, inclusive, and sustainable education system. In the digital era,

access to education has expanded through microlearning, whose flexibility enables broader participation without time and space constraints. This not only increases learning engagement but also promotes more equitable and inclusive opportunities, particularly for learners with diverse needs and contexts.

Within the framework of continuous learning, digital microlearning supports learning continuity and long-term capacity development, aligning with the concept of lifelong learning as an ongoing process throughout life. This reinforces its relevance to the United Nations' agenda, particularly SDG 4: Quality Education, which emphasises inclusive, equitable, and quality access to learning [47]. In this context, microlearning strengthens independent learning and optimises learners' ability to manage their learning within digital environments. Beyond expanding access, digital microlearning enhances learning efficiency through segmented and focused content. Its concise structure enables better time management, reduces cognitive load, and improves focus, resulting in more targeted and in-depth understanding. These improvements align with the goals of quality education by enhancing learning outcomes and process effectiveness. Moreover, its adaptive and flexible nature supports educational inclusivity by accommodating diverse learner needs and contexts. Overall, the integration of efficiency, accessibility, and flexibility highlights the contribution of digital microlearning in advancing high-quality, inclusive, and sustainable education.

The development of digital learning places self-regulated learning (SRL) as a key prerequisite for learner autonomy, shifting learners from passive recipients to active agents in managing their own learning experiences [48]. This fosters internal and reflective learning awareness, enabling continuous independent development and the formation of consistent learning habits integrated into daily life. Sustained SRL practices support a long-term learning orientation aligned with lifelong learning principles. Learning continuity thus no longer depends on formal systems, but on individuals' ability to maintain motivation and learning routines independently. This aligns with SDG 4, which emphasises lifelong learning opportunities, positioning SRL as a foundational element for sustainable, adaptive, and responsive education in the face of global change.

The integration of digital microlearning with self-regulated learning (SRL) forms an adaptive, flexible, and learner-centred model of sustainable learning [49]. Segmented, accessible content combined with learners' ability to manage goals, strategies, and evaluation creates a personalised yet continuous learning experience, while strengthening active engagement. This reflects a shift toward positioning learners as primary agents in constructing and sustaining their learning, aligning with adaptive education demands and the principles of SDG 4.

Overall, the findings confirm that digital microlearning in Ruang Karya not only provides flexible access but also fosters SRL, learning autonomy, and sustainable learning habits. A strong relationship is evident between microlearning design and learners' ability to manage their learning independently. However, limitations in content depth indicate the need for further reinforcement to address complex material. The novelty of this study lies in integrating digital microlearning and SRL within an SDG-based sustainable learning framework using a phenomenological approach.

5. Conclusion

Digital microlearning via the Ruang Karya platform contributes significantly to creating a flexible, adaptive, and learner-centred learning experience. Concise, focused, and accessible content enables efficient understanding of core concepts while encouraging active engagement, positioning microlearning not only as an information delivery medium but also as a stimulus for independent learning. The results also highlight *self-regulated learning* (SRL) as a key factor in optimising microlearning. Learners' abilities in time management, goal-setting, strategy selection, and self-monitoring and evaluation shape more effective and meaningful learning experiences, fostering autonomy, responsibility, and sustainable learning capacity.

The integration of microlearning and SRL supports sustainable learning through consistent habits, intrinsic motivation, and readiness for future academic and career challenges. This has implications for digital learning design, particularly in developing microlearning that supports self-regulation through goal-setting, reflection, and access to advanced materials. The novelty of this study lies in integrating digital microlearning and SRL within an SDG-based lifelong learning framework using a phenomenological approach. However, limitations include a small sample size, the specific context of Ruang Karya, and the focus on subjective experiences without quantitative measurement. Future research should employ quantitative methods with broader samples and

contexts, and develop models that combine microlearning with in-depth content to address complex topics.

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