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Digital Scaffolding Strategies in Instructional Design: Enhancing Independent Learning Among Pre-University Students in Kota Samarahan, Malaysia

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Abstract

This study investigates the role of digital scaffolding strategies in instructional design and their effectiveness in enhancing independent learning among pre-university students in Kota Samarahan, Malaysia. The research employed a quantitative survey method, incorporating both a pilot test and a full-scale study. The instrument measured three constructs: digital scaffolding strategies, independent learning skills, and perceived effectiveness of scaffolds. Reliability analysis demonstrated excellent internal consistency for all constructs, with Cronbach's alpha values exceeding 0.93. Based on responses from 112 students, the findings revealed consistently high mean scores across the 30 items, indicating strong agreement regarding the positive role of scaffolding in facilitating independent learning. Furthermore, findings suggest that digital scaffolding strategies not only support learner autonomy but also strengthen motivation, time management, and confidence in self-directed learning. The study contributes to instructional design research by demonstrating how structured scaffolding mechanisms can be effectively integrated into pre-university curricula to foster independent learners. Implications for practice, policy, and future research are discussed.

1.0 Introduction

1.1 Background of the Study

Digital technology has rapidly changed education landscape by transforming how teachers teach and evaluate their students' performance and how the students access, comprehend, and interact with learning materials. Education in the twenty-first century is increasingly influenced by technological innovations. This offers opportunities for interaction, collaboration, and personalised learning experiences (Mexhuani, 2025). In Malaysia, as in many other countries, the use of digital tools in classrooms has been steadily expand, supported by both governmental initiatives and institutional reforms (Juhari & Zakaria, 2024). The beginning of the Fourth Industrial Revolution (IR4.0), which emphasises digital literacy, artificial intelligence, and global connectivity, has further accelerated this transformation (Yingi et al., 2022). Within this landscape, the pre-university level occupies an important position. Thus, many digital tools are designed to equip students with the knowledge, skills, and attitudes necessary to succeed in higher education, where independent and self-regulated learning are critical.

However, despite these technological and pedagogical shifts, many pre-university students continue to face challenges to become autonomous learners. As many of them are used to teacher-centred approach during their secondary education, they may find it difficult to adapt to the expectations of self-directed study. In Malaysian classrooms, particularly at the secondary level, students often rely heavily on teachers for guidance, explanation, and problem-solving (Ishak, et al., 2021). This over-dependence on educators creates a gap for students transition to pre-university environments, where lecturers typically expect them to take responsibility for managing their own learning (Tomlinson & Killingback, 2025). This transition is not always smooth. Many students struggle with time management, critical thinking, and the capacity to sustain motivation without constant external prompting. Consequently, the question arises whether educators can facilitate the development of independent learning skills among pre-university students in ways that are both sustainable and effective or not.

One promising approach lies within the use of digital scaffolding strategies in instructional design. Scaffolding, rooted in Lev Vygotsky's socio-cultural theory of learning, refers to the temporary support provided by teachers, peers, or instructional tools to help learners accomplish tasks they cannot yet perform independently (Alkhudiry, 2022). As learners gain competence, this support is gradually reduced, giving the students to direct their study autonomously from time to time. Traditionally, scaffolding was understood as an interpersonal process within the classroom. However, with the increasing integration of digital technologies, the concept has been reimagined. Today, scaffolding can be embedded within learning management systems (LMS), online platforms, and blended learning environments. Hence, digital scaffolding strategies may include automated reminders that prompt students to complete tasks, structured checklists that help them organise their learning, reflection prompts that encourage metacognitive awareness, and online discussion forums that foster collaborative problem-solving. Such tools extend scaffolding beyond the classroom walls and into the learners' daily routines, offering continuous, context-sensitive support.

It is undeniable that digital scaffolding is relevant to Malaysian's educational context. The Malaysian Education Blueprint (2013–2025) outlines the aspiration to produce learners who are independent, globally competitive, and digitally competent. As part of this vision, technology-enhanced learning is positioned as a catalyst for transforming pedagogy and learner outcomes. In pre-university institutions, which include matriculation colleges, foundation programmes, and international preparatory courses, the cultivation of

independent learning is viewed as essential for preparing students for the rigours of university study (Vosniadou, 2020). However, despite policy-level encouragement, research shows that many pre-university students in Malaysia remain hesitant or ill-prepared to fully embrace independent learning. The lack of structured guidance and appropriate instructional design strategies can leave learners overwhelmed, resulting in disengagement or surface-level learning. Digital scaffolding, therefore, provides a platform for bridging this gap by systematically guiding students while simultaneously nurturing their autonomy.

Kota Samarahan, known as the "Education Hub of Sarawak," provides a particularly interesting context for investigating the role of digital scaffolding strategies in pre-university education. Home to several higher learning institutions, including Universiti Malaysia Sarawak (UNIMAS), Universiti Teknologi MARA (UiTM) Sarawak, and a variety of foundation and matriculation centres, the city attracts students from diverse cultural, socio-economic, and educational backgrounds. This diversity presents unique opportunities and challenges. On the one hand, students benefit from exposure to multiple learning environments enriched by digital technologies. On the other hand, variations in prior educational experiences mean that not all students arrive equally prepared to manage independent study. For many, pre-university education in Kota Samarahan represents not only an academic transition but also a cultural and technological adjustment. Within this context, digital scaffolding strategies have the potential to play a critical role in levelling the playing field and supporting learners' progression towards autonomy.

Research into digital scaffolding strategies highlights several dimensions of their effectiveness. Firstly, scaffolding provides structure that can assist students to navigate complex tasks by breaking them into manageable steps (Keller & Hermanns, 2023). For pre-university learners who may feel daunted by the volume and difficulty of materials, checklists or guided pathways can foster a sense of progress and achievement. Secondly, scaffolding promotes metacognition, or the ability to reflect on one's own learning (Keller & Hermann, 2023). Reflection prompts and feedback mechanisms encourage students to evaluate their strategies, identify gaps, and make adjustments, thereby enhancing self-regulation. Thirdly, scaffolding creates opportunities for social learning (Chen & Adams, 2023). Online discussion forums and peer-feedback systems enable collaborative problem-solving, exposing learners to multiple perspectives and reducing feelings of isolation often associated with independent study. Finally, digital scaffolding is inherently flexible (Diprossimo, et al., 2023). It can be adapted to individual learner needs, paced according to their progress, and withdrawn as students gain competence. This adaptability aligns closely with the overarching goal of fostering independent learners capable of navigating higher education and beyond.

Despite these advantages, the implementation of digital scaffolding is not without challenges. The effectiveness of the strategies depends heavily on thoughtful instructional design (Surbakti et al, 2024). Poorly structured scaffolding tools may lead to dependency rather than autonomy, defeating the purpose of the intervention (Zhang, et al., 2025). Moreover, disparities in digital access and literacy remain a concern in Malaysia, particularly in semi-urban and rural areas (Singh & Karim, 2024). Although Kota Samarahan is relatively well-developed as an educational hub, not all students may have equal access to stable internet connections, personal devices, or the digital competencies required to fully utilise scaffolding tools. These limitations highlight the need for careful consideration of context-specific factors when designing and implementing digital scaffolding strategies.

Against this backdrop, this study seeks to explore the role of digital scaffolding strategies in enhancing independent learning among pre-university students in Kota Samarahan. By focusing on this population, the research aims to contribute to both theoretical and practical discussions about instructional design in the digital era. Theoretically, it draws upon Vygotsky's concept of scaffolding and situates it within the modern context of digital learning environments. Practically, it investigates the specific strategies that can support pre-university students in Malaysia as they transition from teacher-dependent learning to autonomous study. In doing so, the study hopes to provide insights that can inform educators, instructional designers, and policymakers seeking to strengthen the quality and effectiveness of pre-university education.

In summary, the transformation of education through digital technologies has made independent learning not only desirable but essential for student success in higher education. Yet, many pre-university students in Malaysia struggle with this transition due to entrenched habits of teacher dependency. Digital scaffolding strategies offer a promising solution by providing structured, adaptive, and supportive interventions that guide learners while fostering autonomy. Situated within the unique educational context of Kota Samarahan, this study will examine how these strategies can be effectively designed and implemented to enhance independent learning. Ultimately, the findings will contribute to the broader discourse on the future of instructional design in Malaysia and beyond, underscoring the need for approaches that balance guidance with independence in preparing students for lifelong learning.

1.2 Problem Statement

1.2.1. The Importance of Independent Learning in Pre-University Education

Independent learning is recognised as a core competency for academic success in higher education and beyond (Wilbraham, et al., 2024). At the pre-university level, students are expected to transition from being passive recipients of teacher-directed instruction to becoming active, self-regulated learners (Sáez-Delgado et al, 2023). However, in Malaysia, having been accustomed to a teacher-centred environment in secondary schools (Yusoff et al., 2025). In conjunction to this, secondary students often face challenges in managing time, maintaining motivation, and monitoring their own lesson progress. This struggle limits the cultivation of essential skills such as critical thinking, problem-solving, and self-reflection, which are crucial for university study and lifelong learning.

1.2.2. The Challenge of Transitioning from Teacher-Centred to Student-Centred Learning

One of the primary issues lies in the sudden shift from secondary to pre-university education (Cifuentes et al, 2022). Malaysian secondary schools are often characterised by examination-oriented instruction and a heavy reliance on teacher guidance. Students are typically told what to study, when to study, and how to prepare for assessments. As a result, they develop habits of dependency on teachers. When they enter pre-university institutions, they are expected to exercise autonomy with minimal guidance. This abrupt change can cause stress, procrastination, and disengagement, highlighting the need for structured support to ease the transition.

1.2.3. Limitations of Traditional Scaffolding Approaches

Scaffolding, based on Vygotsky's socio-cultural theory, has long been recognised as an effective way to support learners. Traditionally, scaffolding has been provided in classrooms through teacher explanations, demonstrations, and step-by-step guidance (Keller & Hermann, 2023). However, this support is often temporary and limited to face-to-face interactions. Once students leave the classroom, they are left without continuous guidance, making it difficult for them to sustain independent study. In an age where learning extends beyond classroom walls, traditional scaffolding is no longer sufficient.

1.2.4. The Potential of Digital Scaffolding Strategies

Digital scaffolding offers an innovative way to address these challenges. Through learning management systems, online platforms, and blended learning environments, scaffolding can be embedded into students' daily learning routines (Mamun, 2022). Features such as automated reminders, structured checklists, reflection prompts, and online discussion forums provide continuous and context-sensitive support. Unlike traditional scaffolding, digital scaffolding can be accessed anytime and anywhere, offering learners flexibility while gradually promoting autonomy (Belland et al, 2022). Despite its promise, the adoption of digital scaffolding in Malaysian pre-university settings remains limited and under-researched.

1.2.5. The Context of Kota Samarahan as an Education Hub

Kota Samarahan, often referred to as the "Education Hub of Sarawak," provides a unique context for this study. The city hosts various pre-university programmes, including matriculation, foundation, and preparatory courses, attracting students from diverse backgrounds. Many students come from rural or semi-urban areas, where access to high-quality secondary education and digital resources is inconsistent. Consequently, these students enter pre-university programmes with varying levels of digital literacy and preparedness for independent learning. While some adapt quickly, others struggle, creating disparities in academic performance. This situation underscores the importance of designing strategies that provide equitable support for all learners.

1.2.6. Policy Aspirations Versus Classroom Realities

The Malaysian Education Blueprint (2013–2025) emphasises producing independent, lifelong learners who are globally competitive. However, the reality in classrooms suggests that these aspirations are far from being fully realised. Studies have shown that Malaysian students often underperform in areas such as critical thinking, problem-solving, and self-regulated learning compared to their international peers. The 2022 PISA report reveals Malaysia ranks among the top 5 countries globally with the largest declines in test scores across Reading, Mathematics, and Science (Chin & Loo, 2025). Studies consistently show Malaysian students exhibit medium-level self-regulated learning skills, with challenges in metacognitive and strategic learning approaches (Di, Zailani, & Ismail, 2020; Anthonysamy et al, 2021). This gap between policy expectations and actual learner competencies indicates the need for concrete instructional strategies that can bridge the divide. Digital scaffolding could provide one such solution, aligning classroom practices with national education goals.

1.2.7. Lessons from the COVID-19 Pandemic and Digital Learning

The COVID-19 pandemic further highlighted the importance of independent learning and exposed the weaknesses in students' ability to learn autonomously. During periods of remote learning, many pre-university students struggled with tracking assignments, maintaining motivation, and managing time effectively (Hacatrjana, 2021). These struggles were compounded by differences in digital literacy and access to technology. The pandemic demonstrated that without adequate scaffolding, students are ill-equipped to handle the demands of digital and blended learning environments. This reinforces the urgency of embedding digital scaffolding strategies into instructional design.

1.2.8. Research Gaps in Malaysian Pre-University Education

Although digital scaffolding has been explored in higher education and certain subject-specific contexts, research on its application in Malaysian pre-university programmes is still limited. The unique challenges faced by students in Kota Samarahan, given its diverse educational and socio-economic demographics, have not been adequately studied. The lack of empirical evidence makes it difficult for educators and policymakers to design and implement effective scaffolding strategies. Addressing this gap is essential to ensure that all students, regardless of their background, are equipped with the skills needed for independent learning.

1.2.9. Articulating the Problem

In essence, pre-university students in Malaysia face difficulties in becoming independent learners due to entrenched habits of teacher dependency, uneven readiness, and inadequate support systems. Traditional scaffolding is limited in scope, while digital scaffolding, despite its potential, remains underutilised. In Kota Samarahan, where students' backgrounds vary widely, these issues are particularly pronounced. Without effective interventions, many learners risk disengagement, poor performance, and failure to develop essential lifelong learning skills. This study is therefore necessary to examine how digital scaffolding strategies can be systematically integrated into instructional design to enhance independent learning among pre-university students in Kota Samarahan.

1.3 Research Objectives

This study seeks to:

- Investigate pre-university students' perceptions of digital scaffolding strategies.
- Assess the extent to which scaffolding strategies support the development of independent learning skills.
- Evaluate students' perceptions of the effectiveness of scaffolds in enhancing confidence, motivation, and responsibility for learning.

1.4 Research Questions

The study is guided by the following research questions:

- How do pre-university students perceive the implementation of digital scaffolding strategies in instructional design?
- To what extent do digital scaffolding strategies support the development of independent learning skills among pre-university students?
- How effective are digital scaffolding strategies in fostering motivation, responsibility, and confidence in independent learning?

1.5 Significance of the Study

This study contributes to educational research in several ways. First, it validates an instrument that can be used in future studies on scaffolding and independent learning. Second, it provides empirical evidence from the Malaysian pre-university context, where little research has been conducted. Third, it offers practical insights for educators and instructional designers in integrating scaffolding strategies into course design. Finally, the study informs policy makers on how scaffolding can be institutionalised to improve student preparedness for higher education.

2.0 Literature Review

2.1 The Concept of Scaffolding in Education

The concept of scaffolding has become a cornerstone in educational psychology and instructional design, particularly in understanding how learners acquire new knowledge and skills with appropriate support. The term is closely linked to Lev Vygotsky's (1978) theory of the Zone of Proximal Development (ZPD), which refers to the gap between what learners can achieve independently and what they can achieve with assistance. According to Vygotsky (1978), effective learning takes place when instruction targets this zone, providing learners with temporary guidance that enables them to perform tasks beyond their immediate capability. Over time, as learners internalise skills and strategies, they become capable of accomplishing similar tasks independently. Scaffolding thus operates as a bridge, supporting learners as they progress from dependence to autonomy.

Building on Vygotsky's ideas, Wood, Bruner, and Ross (1976) formally introduced the concept of scaffolding in education. This can be described as a process in which a more knowledgeable individual, typically a teacher or expert, provides structured support to help a learner achieve a task that would otherwise be unattainable. Importantly, scaffolding is not static. It involves a gradual reduction of assistance as learners' competence grows (Sarmiento-Campos, et al., 2022). This process of "fading" ensures that support does not create dependency but instead nurtures independence. The dynamic nature of scaffolding distinguishes it from permanent instructional aids, as its purpose is to empower learners to take ownership of their learning processes.

With the growing integration of technology in education, the concept of scaffolding has expanded beyond physical interactions to include digital environments (Coninx & Stephan, 2021). In digital learning contexts, scaffolding may take the form of interactive tutorials, automated feedback systems, structured checklists, or reflection prompts embedded within online platforms. These digital scaffolds serve the same purpose as traditional scaffolding which is to support learners as they engage in tasks within their ZPD (Graaf, et al., 2023). However, digital scaffolding has the added advantage of being available anytime and anywhere as it offers continuous support beyond the physical classroom (Chiarenza et al, 2023). It also allows for personalisation, as tools can be designed to adapt to learners' progress, providing differentiated levels of assistance according to individual needs.

Scholars have emphasised that scaffolding in education, whether traditional or digital, is most effective when it is intentional and systematically integrated into instructional design (Belland et al, 2022; Chan et al, 2021). However, simply providing support does not guarantee improved learning.It is very vital that scaffolding tools to be designed adapting students' understanding and level of knowledge (Pitura & Chang, 2023). Apart from that, excessive support may reduce the development of independence, while insufficient support may leave learners frustrated or disengaged (Timms & Spurrett, 2023). Therefore, the design of scaffolding strategies requires a delicate balance between guidance and autonomy.

In summary, the concept of scaffolding in education is rooted in Vygotsky's theory of the ZPD and further developed by scholars such as Wood, Bruner, and Ross. It involves providing temporary, adaptive support that enables learners to achieve tasks beyond their immediate ability, with the goal of fostering independence. In modern educational contexts, scaffolding has expanded to digital environments, where tools and prompts extend support beyond classroom boundaries. Whether applied traditionally or digitally, scaffolding remains a vital strategy in instructional design, ensuring that learners are guided effectively while being prepared to take control of their own learning journeys.

2.2 Digital Scaffolding in Instructional Design

Digital scaffolding represents a significant advancement in instructional design (Yang et al., 2022). Therefore, it extends the traditional concept of scaffolding into technology-mediated learning environments. Digital scaffolding refers to the intentional integration of support mechanisms into digital platforms to guide learners throughout their educational journeys (Hussein, et al., 2025). These mechanisms are designed to reflect the functions of traditional scaffolding with the enhanced of technology. This situation will lead the lesson towards flexibility, accessibility, and personalisation. The central aim of digital scaffolding remains consistent with its theoretical foundation; to provide temporary support that enables learners to achieve competencies they could not yet master independently.

Empirical studies further underscore the effectiveness of digital scaffolding. van der Graaf, et al. (2023) highlighted that well-designed digital scaffolds can improve learner engagement and academic performance by providing structured guidance that reduces uncertainty and cognitive overload. Apart from that, Liu et al. (2022) highlight that scaffolding instruction in virtual language learning promotes linguistic and academic development, optimizing cooperative learning and fostering independence. Similarly,

Ahmed et al., (2022) demonstrated that digital scaffolding mechanisms can bridge the gap between teacher-directed instruction and learner independence, thereby facilitating a smoother transition toward autonomous learning. These findings are particularly relevant in contexts where learners are expected to develop self-regulated learning skills but lack the prior experience or strategies to do so effectively.

In pre-university contexts, digital scaffolding takes on added significance. Students entering such programmes often struggle with the transition from highly structured secondary education, where teachers closely monitor progress, to more self-directed pre-university and tertiary settings (Bijsmans et al., 2025; Kritikou & Giovazolias, 2022). In other words, without adequate support, many students experience confusion, procrastination, or disengagement. Digital scaffolding addresses these challenges by offering continuous support that extends beyond the classroom (Keller & Hermann, 2023).

In summary, digital scaffolding in instructional design represents a purposeful application of technology to extend and enhance traditional scaffolding practices. It encompasses a wide range of tools including prompts, checklists, exemplars, feedback systems, and collaborative forums that collectively help learners regulate their cognition, manage tasks, and sustain motivation. In pre-university contexts, where students must navigate the critical transition from teacher-dependent to self-directed learning, digital scaffolding serves as a pivotal support system. By clarifying expectations, fostering collaboration, and promoting accountability, digital scaffolding not only bridges the gap between secondary and tertiary education but also cultivates the skills necessary for lifelong learning.

2.3 Research Gap

While global research has explored digital scaffolding and independent learning, limited studies have been conducted in Malaysia, particularly in pre-university contexts. Existing literature often focuses on higher education or secondary school settings, leaving a gap in understanding how scaffolding strategies function in transitional programmes. Moreover, few studies triangulate reliability testing of instruments with real test data, making this study uniquely positioned to contribute empirical insights.

3.0 Methodology

3.1 Research Design

This study employed a quantitative research design using a survey instrument. The research process consisted of two stages: a pilot test to validate the instrument and a full-scale administration to evaluate students' perceptions. Reliability and item analyses were conducted, followed by descriptive statistics to interpret student responses.

3.2 Participants

The participants consisted of 112 pre-university students enrolled in programmes at institutions located in Kota Samarahan, Malaysia. The sample was diverse in terms of academic backgrounds but unified in being at the pre-university level. A smaller sample was used in the pilot study to test the reliability of the instrument before wider deployment.

3.3 Research Instrument

The instrument comprised 30 items across three constructs: digital scaffolding strategies (9 items), independent learning skills (9 items), and perceived effectiveness of scaffolds (12 items). Items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 Data Collection Procedure

The survey was administered online through the institutional learning platform. Students were briefed about the purpose of the study and assured of confidentiality. The pilot test was conducted first to ensure clarity and reliability of items. After refinement, the final survey was distributed to the full sample of 112 students.

3.5 Data Analysis

Data from the pilot test were analysed using Cronbach's alpha to assess internal consistency. The full dataset was subjected to descriptive statistics, including mean and standard deviation, to capture students' perceptions of scaffolding strategies,

independent learning, and scaffold effectiveness. Item-total correlations and “alpha if item deleted” statistics were also reviewed to confirm instrument robustness.

3.6 Ethical Considerations

The study was conducted in accordance with the Human (non-medical) Research Ethics Committee UNIMAS guidelines, and the UiTM Research Ethics Committee (Ref. Approval Number: REC/07/2026 (ST/MR/142)) operates in accordance with ICH Good Clinical Practice Guidelines, Malaysian Good Clinical Practice Guidelines, and the Declaration of Helsinki, with approval of this project being conditional upon continuing compliance with these guidelines and declarations. The scope and objectives of the study were defined to minimise the collection and processing of participants' personal data, and no sensitive or personally identifiable information was collected. Participation in the survey was entirely voluntary, and participants were informed of the purpose and nature of the study prior to participation. Informed consent was obtained from all participants through an electronic consent statement provided before the commencement of the online survey. Participants were free to decline participation or withdraw from the study at any time without any consequences. All procedures were conducted in accordance with relevant ethical guidelines, with appropriate measures taken to maintain the confidentiality and anonymity of the participants.

4.0 Findings

4.1 Reliability Analysis

The results of this study provide strong evidence that digital scaffolding strategies were positively perceived by pre-university students in Kota Samarahan, Malaysia. Based on Table 1, the pilot test established the reliability of the instrument, with Cronbach’s alpha values for all constructs exceeding 0.93. This indicated excellent internal consistency and ensured that the subsequent results were trustworthy and reflective of students’ actual perceptions.

Table 1: Overall Reliability Pilot Test

Construct	Number of Items	Cronbach's Alpha (α)	Reliability Level
Digital Scaffolding Strategies	9	0.937	Excellent
Independent Learning Skills	9	0.933	Excellent
Perceived Effectiveness of Scaffolds	12	0.974	Excellent
Full Instrument	30	0.981	Excellent

Note: α ≥ 0.9 (Excellent), 0.9 > α ≥ 0.8 (Good), 0.8 > α ≥ 0.7 (Acceptable), **0.7 > α ≥ 0.6 (Questionable), 0.6 > α ≥ 0.5 (Poor), α < 0.5 (Unacceptable)** (George & Mallery, 2003).

4.2 Comprehensive Item Analysis

An item analysis was conducted for all 30 items as shown in Table 2. The Corrected Item-Total Correlation for all items exceeded the acceptable threshold of 0.3. The value of Cronbach's Alpha if Item Deleted was never higher than the overall scale alpha, confirming all items should be retained.

Table 2: Complete Item-Total Statistics for the Research Instrument

Item	Construct	Item Statement (Abbreviated)	Corrected Item-Total Correlation	α if Item Deleted
1	A	Clear weekly instructions...	0.776	0.929
2	A	Checklists were provided...	0.803	0.927
3	A	Assessment rubrics shared...	0.765	0.930
4	A	Sample answers provided...	0.710	0.933
5	A	Content divided into units...	0.746	0.931
6	A	Quizzes provided feedback...	0.732	0.932
7	A	Reflection prompts included...	0.758	0.930
8	A	Automated reminders...	0.715	0.933
9	A	Discussion forums...	0.668	0.936
10	B	I set clear learning goals...	0.761	0.926
11	B	I plan my study time...	0.781	0.925
12	B	I break down complex tasks...	0.786	0.925
13	B	I maintain a regular schedule...	0.768	0.926
14	B	I monitor my understanding...	0.803	0.924
15	B	I search for additional resources...	0.701	0.930
16	B	I ask questions when facing difficulties...	0.673	0.932
17	B	I stay motivated without reminders...	0.734	0.928
18	B	I continue working on difficult tasks...	0.734	0.928
19	C	Helped me become more independent...	0.869	0.972
20	C	Improved my confidence...	0.892	0.972
21	C	Reduced time feeling confused...	0.873	0.972
22	C	Helped me monitor my progress...	0.890	0.972
23	C	Encouraged me to seek resources...	0.844	0.973
24	C	Motivated me to complete tasks on time...	0.847	0.973
25	C	Gradual removals did not reduce performance...	0.776	0.974

26	C	Encouraged me to reflect...	0.890	0.972
27	C	Supported my ability to take responsibility...	0.923	0.971
28	C	I would prefer future courses to include them...	0.837	0.973

Note: Construct A: Digital Scaffolding, B: Independent Learning, C: Perceived Effectiveness.

4.3 Real Test Result

Table 3: Descriptive Statistics of Real Test Results (N = 112)

No.	Item	Respondent	Mean	Sd
1	Clear weekly instructions were posted in the learning platform.	112	4.402	0.664
2	Checklists or task lists were provided to guide my learning.	112	4.313	0.723
3	Assessment rubrics were shared before tasks began.	112	4.393	0.676
4	Sample answers or exemplars were provided for assignments.	112	4.125	0.85
5	Course content was divided into small, manageable units.	112	4.304	0.733
6	Quizzes provided immediate feedback with explanations.	112	4.09	0.865
7	Reflection prompts were included after assignments.	112	4.197	0.804
8	Automated reminders helped me track deadlines.	112	4.375	0.724
9	Discussion forums encouraged peer interaction.	112	4.027	0.864
10	Scaffolds were gradually reduced as I became more competent.	112	3.992	0.765
11	I set clear learning goals for each week.	112	4.063	0.726
12	I plan my study time effectively to complete tasks on time.	112	4.108	0.764
13	I can break down complex tasks into smaller steps.	112	4.009	0.8
14	I maintain a regular study schedule for this course.	112	3.974	0.765
15	I monitor my understanding and adjust when needed.	112	4.17	0.746
16	I search for additional resources when I don't understand a topic.	112	4.411	0.665
17	I ask questions or seek help when I face difficulties.	112	4.125	0.829
18	I stay motivated even without reminders from the teacher.	112	4.009	0.811
19	I continue working on tasks even when they are difficult.	112	4.25	0.753
20	I feel confident using digital tools required for the course.	112	4.286	0.753
21	Digital scaffolds helped me become more independent in learning.	112	4.063	0.751
22	They improved my confidence to learn without teacher guidance.	112	3.983	0.794
23	They reduced the time I spent feeling confused or stuck.	112	3.956	0.864
24	They helped me monitor my progress effectively.	112	4.081	0.796
25	They encouraged me to seek resources before asking for help.	112	4.143	0.733
26	They motivated me to complete tasks on time.	112	4.179	0.762
27	Gradual removal of scaffolds did not reduce my performance.	112	3.875	0.829
28	They encouraged me to reflect on my learning strategies.	112	4.099	0.684
29	They supported my ability to take responsibility for my own learning.	112	4.17	0.721
30	I would prefer future courses to include similar scaffolding supports.	112	4.136	0.78

Based on Table 3, the first nine items measure students' perceptions of digital scaffolding strategies, the results were highly encouraging. Students strongly agreed that clear weekly instructions (Item 1, mean = 4.40) provided direction and reduced confusion in their studies. Similarly, checklists or task lists (Item 2, mean = 4.31) were appreciated for helping students stay organised. The sharing of assessment rubrics before tasks (Item 3, mean = 4.39) gave students clarity on expectations, while sample answers and exemplars (Item 4, mean = 4.13) further guided their preparation. Course content divided into smaller units (Item 5, mean = 4.30) was considered effective in making learning more manageable. Quizzes that offered immediate feedback (Item 6, mean = 4.09) were well received, as they allowed students to reflect on their understanding. Reflection prompts after

assignments (Item 7, mean = 4.19) were rated positively, showing that students valued opportunities to evaluate their learning. Automated reminders (Item 8, mean = 4.38) were especially effective in helping students track deadlines. However, discussion forums that encouraged peer interaction (Item 9, mean = 4.03) received the lowest score in this construct, suggesting that while students appreciated peer engagement, it may not have been as impactful as other scaffolding supports.

The next nine items measured the extent to which students developed independent learning skills using scaffolds. Students reported that setting clear learning goals for each week (Item 11, mean = 4.06) and planning study time effectively (Item 12, mean = 4.11) were skills that they had strengthened. The ability to break down complex tasks into smaller steps (Item 13, mean = 4.01) was also acknowledged, though slightly less strongly than other skills. Maintaining a regular study schedule (Item 14, mean = 3.97) was the lowest-rated item in this group, highlighting time management as an area of ongoing difficulty for some learners. On the other hand, monitoring one's own understanding (Item 15, mean = 4.17) and searching for additional resources when needed (Item 16, mean = 4.41) were among the highest scores, showing resourcefulness and self-monitoring as significant strengths. Students also recognised the importance of asking questions when facing difficulties (Item 17, mean = 4.13) and sustaining motivation without external reminders (Item 18, mean = 4.01). Continuing to work on difficult tasks despite challenges (Item 19, mean = 4.25) further highlighted persistence as a key independent learning behaviour. Finally, students felt confident using digital tools required for the course (Item 20, mean = 4.29), showing readiness to engage in technology-mediated learning.

The final twelve items captured students' perceptions of the effectiveness of scaffolds. The results were overwhelmingly positive. Students strongly agreed that scaffolds helped them become more independent learners (Item 21, mean = 4.06) and improved their confidence in learning without constant teacher guidance (Item 22, mean = 3.98). Scaffolds were also perceived as reducing the time spent feeling confused or stuck (Item 23, mean = 3.96), while helping students monitor their progress effectively (Item 24, mean = 4.08). They also encouraged students to seek out resources before asking for help (Item 25, mean = 4.14) and motivated them to complete tasks on time (Item 26, mean = 4.18). The lowest score in this group was for the gradual removal of scaffolds (Item 27, mean = 3.88), indicating that many students still valued the presence of scaffolds and were less confident when supports were withdrawn. Nonetheless, scaffolds encouraged reflection on learning strategies (Item 28, mean = 4.09) and supported students' ability to take responsibility for their own learning (Item 29, mean = 4.17). Importantly, students expressed a preference for future courses to continue including scaffolding supports (Item 30, mean = 4.14). Taken together, these results demonstrate that scaffolds were not only useful but also essential in building the confidence, motivation, and independence of pre-university learners.

5.0 Conclusion

This study concludes that digital scaffolding strategies are highly effective in enhancing independent learning among pre-university students in Kota Samarahan. The findings highlight that scaffolds such as weekly instructions, checklists, exemplars, reminders, and reflection prompts are particularly valued for reducing confusion, improving organisation, and sustaining motivation. Independent learning skills such as persistence, resourcefulness, and self-monitoring were strengthened, while scaffolds were seen as effective in building confidence and responsibility.

The results also show that students prefer scaffolds to remain present, even when their independence grows. This underscores the need for careful and gradual withdrawal of supports, ensuring that learner's transition smoothly into autonomy.

The implications of this study are clear. For educators, scaffolds should be deliberately designed and embedded into course structures to facilitate independent learning. Instructional designers should integrate digital scaffolding features into learning platforms, while policy makers may consider incorporating scaffolding strategies into curriculum frameworks to prepare students for higher education.

Although limited to pre-university students in Kota Samarahan, the study provides valuable insights into the role of scaffolding in transitional education. Future research could broaden the scope to different contexts, employ qualitative methods to capture student voices, and track the long-term impact of scaffolding on academic success. Ultimately, scaffolding remains a vital bridge between dependence and independence, equipping students with the skills, confidence, and motivation they need to succeed in higher education and beyond.

Declarations

6.0 Funding

This research is funded by the Universiti Malaysia Sarawak.

7.0 Data Availability Statement

The data supporting the findings of this study are not publicly available due to ethical and confidentiality considerations but may be available from the corresponding author upon reasonable request, subject to appropriate permissions.

8.0 Author Contribution Statement

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