

Undergraduate Student' Readiness, Challenges, and Engagement in Digital Learning: A Cross-Sectional Comparative Study of Sarawak and West Borneo

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ABSTRACT: This research examines advanced changes in higher education in Sarawak, Malaysia, and West Kalimantan (West Borneo), Indonesia, revealing high overall student readiness for digital learning. Sarawak students reported a slightly higher mean readiness score ($M=3.88$) compared to their West Kalimantan counterparts ($M = 3.73$), with peer support emerging as particularly influential in Sarawak and self-error correction valued in West Kalimantan. Both groups demonstrated confidence in synchronous technologies and familiarity with learning management systems (LMS), though Sarawak students showed greater reluctance to share ideas online, while West Kalimantan students reported lower LMS proficiency, signaling needs for region-specific pedagogical and technical support. Persistent challenges included limited high-speed internet access (especially in Sarawak), low digital literacy, and environmental distractions, underscoring the necessity for institutional interventions like enhanced connectivity, affordable devices, and digital literacy training. Student engagement remained strong across regions, characterized by proactive behaviors, collaboration, and interactive learning; however, reduced attentiveness in Sarawak and weaker senses of mastery in West Kalimantan highlight areas for refining online environments and support systems. Correlation analyses indicated no significant link between digital readiness and classroom challenges in Sarawak, but a significant association in West Kalimantan; notably, both regions showed a moderate positive relationship between readiness and engagement, emphasizing the role of digital competencies and supportive ecosystems in optimizing student outcomes.

Keywords: digital transformation, engagement, higher education, readiness.

ABSTRAK: Penelitian ini mengkaji perubahan pesat dalam pendidikan tinggi di Sarawak, Malaysia, dan Kalimantan Barat, Indonesia, serta menunjukkan bahwa secara umum mahasiswa memiliki kesiapan yang tinggi dalam mengikuti pembelajaran digital. Mahasiswa

Sarawak melaporkan skor rata-rata kesiapan yang sedikit lebih tinggi ($M = 3\{, \}88\backslash$) dibandingkan dengan mahasiswa Kalimantan Barat ($M = 3\{, \}73\backslash$). Dukungan teman sebaya menjadi faktor yang sangat berpengaruh di Sarawak, sedangkan kemampuan mengoreksi kesalahan secara mandiri lebih diapresiasi oleh mahasiswa di Kalimantan Barat. Kedua kelompok mahasiswa menunjukkan kepercayaan diri dalam menggunakan teknologi pembelajaran sinkron dan memiliki pemahaman yang baik mengenai Learning Management System (LMS). Namun, mahasiswa Sarawak menunjukkan keengganan yang lebih besar untuk berbagi gagasan secara daring, sementara mahasiswa Kalimantan Barat melaporkan tingkat kemahiran penggunaan LMS yang lebih rendah. Hal ini menunjukkan perlunya dukungan pedagogis dan teknis yang disesuaikan dengan kebutuhan masing-masing wilayah. Tantangan yang masih dihadapi meliputi keterbatasan akses internet berkecepatan tinggi, terutama di Sarawak, rendahnya literasi digital, serta gangguan dari lingkungan sekitar. Kondisi ini menegaskan pentingnya intervensi institusional, seperti peningkatan kualitas konektivitas internet, penyediaan perangkat digital yang terjangkau, dan pelatihan literasi digital. Keterlibatan mahasiswa dalam pembelajaran tetap tinggi di kedua wilayah, yang ditandai oleh perilaku proaktif, kolaborasi, dan pembelajaran interaktif. Meskipun demikian, tingkat perhatian yang lebih rendah di Sarawak dan lemahnya rasa penguasaan materi pada mahasiswa di Kalimantan Barat menunjukkan adanya aspek-aspek yang perlu diperbaiki dalam lingkungan pembelajaran daring dan sistem pendukungnya. Analisis korelasi menunjukkan bahwa tidak terdapat hubungan yang signifikan antara kesiapan digital dan tantangan pembelajaran di kelas pada mahasiswa Sarawak, tetapi terdapat hubungan yang signifikan pada mahasiswa Kalimantan Barat. Secara khusus, kedua wilayah menunjukkan hubungan positif dengan kekuatan sedang antara kesiapan digital dan keterlibatan mahasiswa. Hal ini menegaskan pentingnya kompetensi digital dan ekosistem pembelajaran yang suportif dalam mengoptimalkan hasil belajar mahasiswa.

Kata kunci: kesiapan, keterlibatan mahasiswa, pendidikan tinggi, transformasi digital.

INTRODUCTION

The rapid advancement of digital technologies has reshaped higher education worldwide, with Southeast Asia experiencing significant changes in the integration of information and communication technologies into teaching, learning, and institutional management (Hong & Songan, 2011). It has been integrated in use in Indonesia and Malaysia such as digital platforms, online learning, and smart campus initiatives, especially in response to the COVID-19 pandemic, which exposed both opportunities and vulnerabilities in educational systems (Surjawan et al., 2025; Akbari & Pratomo, 2022). In a new era, digital transformation in higher education is necessary to foster both a technological shift and a comprehensive change such as institutional strategies, stakeholder engagement, and pedagogical models, as highlighted by the digital transformation maturity and readiness frameworks (Latifah et al., 2022; Bisri et al., 2025). To explore how perceived usefulness, subjective norms, and behavioral control that influence students' adoption of digital tools, the theories such as the Technology Acceptance Model and the Theory of Planned Behavior are needed (Devisakti et al., 2024).

Student readiness contributes a critical factor in the success of digital transformation; it consists of technological competence, self-directed learning, and adaptability to new learning environments (Weng & Wirda, 2025; Adams et al., 2018). Students' readiness of both Indonesia and Malaysia is demonstrated in a moderate to high level of readiness for blended and online learning, significant disparities exist based on demographic factors such as socioeconomic status, geographic location, and prior digital

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exposure (Adams et al., 2018; Devisakti et al., 2024). For example, the lower-income students from rural seem to have greater challenges to access reliable internet and digital devices, which can hinder their engagement and academic performance (Jafar et al., 2022; Devisakti et al., 2024). The flexible digital learning captures value that requires robust support systems to ensure equitable participation (Latifah et al., 2022b).

There are some challenges such infrastructural limitations, digital literacy gaps, and cultural barriers to technology adoption, despite the promise of digital transformation in the higher education institutions in West Borneo and Sarawak (Latifah et al., 2022a). Another finding underscores the inadequate IT infrastructure, insufficient teacher training, and the digital divide, particularly among marginalized groups ((Jafar et al., 2022). Therefore, it is important to align policy content, context, and stakeholder collaboration to address these challenges effectively (Hazin et al., 2025). Some way to foster the students' sustained engagement, involvement and satisfaction is through providing interactive learning tools and comprehensive support services (Weng & Wirda, 2025).

Likely, a research on digital transformation in education in Indonesian and Malaysian universities has significant gaps remained in particular comparative studies between regions like West Borneo and Sarawak. Most previous studies of digital transformation are more likely to posit a lack of nuanced understanding of cross-border differences in student readiness, challenges, and engagement (Latifah et al., 2022b; Kuntadi et al., 2022) Furthermore, still some researches investigate a long-term impact of digital transformation on educational equity and student outcomes in these regions. By addressing these gaps, it is easy to enhance targeted policies and practices that support inclusive and effective digital transformation in higher education across Southeast Asia.

The transformation of education in the contemporary era is not only providing learning tools but also learning opportunities such as the proliferation of diverse platforms and applications that enable both offline and online learning environments. The effective tools for enhancing students' understanding of complex materials are videos and interactive slides. Furthermore, the teaching media are available in internet that can be accessed by educators to find the extensive information and enriching the learning experience. This technology is very useful to streamline administrative and instructional processes, including remote supervision, collaborative group work, and assessments, making education more practical and efficient.

In Indonesia, educational transformation focuses on three key areas: curriculum innovation, teacher empowerment, and technology integration in classrooms. The Ministry of Education, Culture, Research, and Technology has launched platforms to support learning, aiming to create a grassroots movement that regions across the country can independently utilize. West Kalimantan, a province in Indonesia, is actively supporting this national direction by implementing digitalization-based education. Efforts include providing digital teaching materials, developing applications for administrative and instructional processes, and equipping classrooms with digital tools such as interactive whiteboards. Similarly, Sarawak, a state in Malaysia, shares this aspiration, recognizing the inseparable connection between education and technology. The synergy between education and technology is expected to act as a catalyst for socio-economic transformation, fostering a brighter future for future generations. Governments in both regions are prioritizing human resource development by providing teachers and students

with training in computer skills and coding, equipping them with computational thinking and reasoning skills essential for the future (Nambisan, 2017).

This research focused on the digital transformation of higher education in West Kalimantan, Indonesia, and Sarawak, Malaysia. With government support, educational transformation is becoming a reality, continuously evolving to meet the demands of the modern world. The realization of this transformation is of paramount importance, as education shapes individuals' awareness, skills, and ability to contribute meaningfully to society. The impact of this transformation is a central concern of this research.

The digital transformation of higher education has fundamentally reshaped teaching, learning, and institutional operations, with student readiness emerging as a critical factor for successful adoption. Readiness encompasses not only students' digital skills but also their attitudes, adaptability, and access to technology (Kusmawan, 2025; Althubaiti et al., 2022). Research shows that digital readiness varies significantly across disciplines and demographic groups, with students from technology-oriented faculties generally demonstrating higher proficiency and adaptability than those from humanities or social sciences (Kusmawan, 2025; Althubaiti et al., 2022). Furthermore, factors such as age, gender, and prior internet use influence digital readiness and computer anxiety, which in turn affect students' engagement and academic performance in e-learning environments (Althubaiti et al., 2022).

Despite the potential benefits of digital transformation, students and institutions face substantial challenges. Key barriers include limited access to reliable internet, insufficient digital literacy training, and disparities in digital infrastructure—issues that are particularly pronounced among students from disadvantaged backgrounds (Kusmawan, 2025; Prasad et al., 2024; Althubaiti et al., 2022). Human factors, such as fear of change, lack of experience, and privacy concerns, also hinder the effective adoption of digital tools. The literature highlights that these challenges are not solely technical but are deeply rooted in attitudes and behavioral trends, as described by the tripartite classification of attitude theory. Additionally, the digital divide remains a persistent issue, reinforcing educational inequalities and limiting the democratizing potential of digital transformation (Prasad et al., 2024; Alenezi et al., 2023).

Student engagement in digitally transformed higher education is closely linked to institutional leadership, digital communication platforms, and the quality of the learning environment. Studies indicate that transactional leadership styles are particularly effective in fostering student engagement within highly digitized institutions, as they provide clear structure and support for navigating new technologies. Digital communication tools enhance students' access to learning resources, facilitate collaboration, and support adaptability, aligning with behavioral economics and technology acceptance theories (Petre et al., 2025). However, the literature also notes a gap in longitudinal research assessing the sustained impact of digital transformation on student engagement and learning outcomes, suggesting the need for further studies that integrate behavioral insights with technology adoption models (Petre et al., 2025).

In summary, while digital transformation offers significant opportunities for innovation and inclusivity in higher education, it also presents complex challenges related to student readiness, engagement, and equity. Addressing these issues requires a comprehensive approach that combines technological investment, leadership

development, and ongoing support for digital skills acquisition. Research Questions: 1) What are the attitudes of students' readiness, perceived challenges, and engagement in digital learning in Sarawak, Malaysia, and West Kalimantan, Indonesia? 2) Are there significant differences in students' readiness, perceived challenges, and engagement in digital learning between students in Sarawak, Malaysia, and West Kalimantan, Indonesia? 3) Are there significant relationships among students' readiness, perceived challenges, and engagement in digital learning in Sarawak, Malaysia, and West Kalimantan, Indonesia?

RESEARCH METHOD

Research Design and Data Collection

This study employs a quantitative cross-sectional comparative survey design with an embedded qualitative component to examine students' readiness, challenges, and engagement in digital transformation within higher education. Quantitative data are collected at a single point in time through a structured questionnaire to obtain measurable information about students' perceptions, experiences, and engagement in digital learning environments. The comparative component enables the study to examine differences in these variables across relevant student groups or demographic characteristics. The quantitative data are analyzed statistically to identify patterns, differences, and relationships among the variables.

In addition to the closed-ended survey items, the questionnaire includes open-ended questions to provide contextual and explanatory information about students' experiences. These questions invite participants to describe their preparedness for digital learning, the obstacles they encounter, and the strategies they use to engage with digital learning environments. The open-ended responses are analyzed separately using qualitative thematic analysis to identify recurring themes and contextual explanations. The qualitative component is used to complement and contextualize the quantitative results rather than to replace the primary quantitative design. The quantitative and qualitative results are subsequently integrated during interpretation to provide a more comprehensive understanding of students' experiences of digital transformation in higher education.

Participants

The participants in this study were undergraduate students from higher education institutions in Sarawak, Malaysia, and West Kalimantan, Indonesia who had experience participating in digital or online learning. A total of 243 students participated in the study, consisting of 164 students from Sarawak and 79 students from West Kalimantan. Participants were recruited using a purposive sampling approach based on their experience with digital learning environments. The inclusion of students from the two geographical contexts enabled a cross-sectional comparison of their readiness, perceived challenges, and engagement in digital learning. Data were collected during the same study period using an online questionnaire. Participation was voluntary, and respondents were informed about

the purpose of the study and the use of their responses for research purposes. The participant characteristics were analyzed descriptively to provide contextual information for interpreting the comparative correlation results.

Instruments

Data were collected using a structured online questionnaire designed to measure students' readiness, challenges, and engagement in digital learning. The questionnaire consisted primarily of closed-ended items measured using a Likert-type scale, enabling participants' responses to be quantified and statistically analyzed. The readiness dimension assessed students' technological competence, digital literacy, self-directed learning, learner control, and confidence in managing digital learning tasks. The challenges dimension addressed difficulties experienced in digital learning, including technological limitations, access to digital resources, interaction and communication barriers, and difficulties in managing online learning activities. The engagement dimension measured students' behavioral, cognitive, and motivational involvement in digital learning activities. In addition, several open-ended questions were included to allow participants to describe their experiences, perceived obstacles, and strategies for engaging in digital learning. The open-ended responses were analyzed separately as a supplementary qualitative component. Before the main data collection, the questionnaire was reviewed to ensure the clarity, relevance, and appropriateness of the items for the target participants. The quantitative responses were subsequently coded and analyzed using statistical procedures, including descriptive statistics and Spearman's rho correlation analysis.

Data Analysis

The quantitative data were analyzed using descriptive and inferential statistical procedures. Descriptive statistics were used to summarize students' levels of readiness, perceived challenges, and engagement in digital learning separately for Sarawak, Malaysia ($n = 164$), and West Kalimantan, Indonesia ($n = 79$). Because the study employed a cross-sectional comparative design, inferential tests were conducted to examine differences between the two groups. Where the assumptions for parametric tests were not satisfied, the Mann–Whitney U test was used to compare the distributions of readiness, challenges, and engagement between students in Sarawak and West Kalimantan. Effect sizes were reported alongside statistical significance to indicate the practical magnitude of group differences, and 95% confidence intervals (CIs) were reported where appropriate.

To examine associations among readiness, challenges, and engagement, Spearman's rho correlation coefficients were calculated separately for each study location because the variables were measured using Likert-type scales and the analysis focused on monotonic relationships. Statistical significance was evaluated using a two-tailed alpha level of 0.05, with correlation coefficients interpreted according to their direction and magnitude. To determine whether the strength of corresponding correlations differed significantly between Sarawak and West Kalimantan, a formal test for the difference between independent correlations

was applied where appropriate. This comparison was used to establish whether observed differences in correlation coefficients across the two independent samples represented statistically significant differences rather than differences attributable to sampling variation. The open-ended responses were analyzed separately using thematic analysis to provide contextual explanations for the quantitative results. Given the cross-sectional nature of the study, all statistical relationships and group differences were interpreted as descriptive or associative rather than causal.

RESULT AND DISCUSSION

Descriptive Analysis of Students' Readiness, Challenges, and Engagement

This descriptive analysis results in this section covers three key aspects of students' experiences with digital learning in higher education: readiness, challenges, and engagement. The findings on readiness explore students' confidence in using various digital tools and technologies essential for online learning. The challenges section highlights the barriers students face, including technological, infrastructural, and personal obstacles. Finally, the engagement analysis examines students' participation and proactive behaviors in digital learning environments. These insights provide a comprehensive understanding of the factors influencing students' digital learning experiences.

The students' Digital Readiness

Students' readiness includes (Table 1) their digital literacy, motivation, self-directed learning skills, ability to manage time, and confidence in using virtual learning platforms. These challenges are particularly relevant in rural and remote communities, where differences in technological access and students' preparedness may influence participation, interaction, and learning outcomes. Therefore, examining virtual class challenges and students' readiness in Sarawak and West Borneo is important for developing more effective, inclusive, and context-sensitive online learning practices.

Table 1. Students' Readiness in Digital Learning

Items	Sarawak (Malaysia)		West Borneo (Indonesia)	
	Mean	Std. Deviation	Mean	Std. Deviation
I feel confident in using asynchronous technologies in discussion boards, email, etc.	3.77	.867	3.71	.682
I feel confident in using synchronous technologies: Webex, Collaborate, Adobe Connect, Zoom, etc., to communicate.	3.93	.818	3.76	.683
I can easily ask instructor for help via email, discussion board, or chat.	3.86	.878	3.73	.711
If I feel doubtful, my classmates will give for support (accessing the course, clarification on a topic)	4.10	.732	3.75	.742

In online learning, students may discuss feedback received (assignments, quizzes, discussion, etc.) with the lecturer.	3.88	.898	3.82	.656
I feel confident in operating computer such as creating and editing documents, managing files, and folders.	3.95	.885	3.65	.680
I feel confident in navigating through the course in the Learning Management System such as Moodle, Canvas, Blackboard, etc.	3.88	.871	3.54	.595
I feel confident in participating in course activities such as discussions, quizzes, assignments, and Synchronous sessions.	3.99	.844	3.81	.579
While learning online, I improve from my previous mistakes.	3.80	.921	3.86	.571
I like to share my ideas with ideas others while learning online.	3.64	.899	3.65	.600
Overall Means	3.88		3.73	

Obviously, there was generally no difference between the students' readiness to learn digitally in both regions with West Borneo having a higher overall mean (3.88) compared to Sarawak (3.73). This interpretation is in line with the theory on online learning readiness which views readiness as a multi-dimensional construct comprising of computer or Internet self-efficacy, online communication self-efficacy, learner control, self-directed learning, motivation (Hung et al., 2010; Shayestehfar et al., 2026; Zhong et al., 2023). The pattern is also similar to previous readiness research that revealed that students tend to have a higher level of computer or Internet self-efficacy than of learner control and some communication-related dimensions (Hung et al., 2010; Shayestehfar et al., 2026; Zhong et al., 2023).

For most technical and participation items, the scores were higher in the case of the Sarawak students, particularly for the item on synchronous communication (3.93), on computer operation (3.95), on LMS navigation (3.88), on participation in course activities (3.99), and on peer support (4.10). Bandura's self-efficacy theory is a good explanation of this pattern, and self-efficacy has been widely used in the context of computer, Internet, and LMS use in online learning. Additionally, studies reveal that higher levels of digital technology self-efficacy are correlated with other types of online engagement, such as social, collaborative, cognitive, behavioral, and emotional engagement, thus providing an explanation for why a more positive sense of self-efficacy for digital tools and platforms can be associated with greater readiness for participation in practices online (Getenet et al., 2024). The engagement framework and factor structure of this relationship is presented visually in the online engagement model. The Online Learning Engagement Framework in Table 1 provides a model for how educators could design the same course for online students.

The particularly high score for 'expected support by classmates' (4.10) also indicates the role of Social Learning Theory and Collaborative perspectives. According to the social learning research, collaborative interaction and

observation participation are important affordances of online environment (Li et al., 2023). Likewise, the studies based on the constructivist approach indicate that the interaction between peers, teachers, and social presence positively impacts collaborative learning, engagement, and learning performance (Qureshi et al., 2023; Alismaiel et al., 2022). In addition, online peer learning has been associated with critical reflection and self-assessment, as it can be seen that perceived peer support is not just interpersonal, but academically productive (Altınay, 2017).

The students in West Borneo, however, seemed to do a little better with respect to improving from their previous errors (3.86 versus 3.80), and idea sharing was virtually the same from group to group (3.65 versus 3.64). The trend indicates that the technical confidence is not as strong as reflective adaptation in West Borneo. This understanding aligns with the concepts of self-directed learning and learner development, where the process of making mistakes and improving based on feedback can be seen as a part of self-regulated or self-directed readiness for online learning (Hung et al., 2010; Torun, 2020; Ramazanoğlu et al., 2022). It also accommodates evidence that collaboration in online learning can foster critical reflection and that open and supportive relationships between learners can facilitate the construction of knowledge and personal change regardless of varying technical conditions (Altınay, 2017).

A significant difference for both groups is the relatively lower score for sharing ideas with others online with Sarawak scoring relatively low and almost at the bottom in West Borneo. This is important because online communication self-efficacy has been identified as one of the readiness factors and is found to be lower than general computer self-efficacy and may require special support (Hung et al., 2010; Shayestehfar et al., 2026). The literature on social presence also reveals that the availability of tools enabling interactions does not necessarily lead to meaningful interaction; facilitation is necessary to achieve knowledge co-construction and sustainable transfer (Schaefer et al., 2020).

Both students from Sarawak and West Borneo exhibited overall positive attitudes towards digital learning, with students from Sarawak having a higher mean score in all cases. The finding indicates that both groups are prepared to use online learning at a satisfactory level and students from Sarawak seem to have a better base in the technical and participative aspects of digital learning. This is in line with the online learning readiness theory, which views readiness as a multidimensional construct consisting of computer/Internet self-efficacy, online communication self-efficacy, learner control, self-directed learning, and motivation (Hung et al., 2010; Torun, 2020; Zhong et al., 2023).

The higher scores obtained by Sarawak participants in the synchronous communication, computer operation, LMS navigation, and participation in online activities can be explained using Bandura's self-efficacy theory. The self-efficacy of students who think they are able to use digital tools effectively has been found to positively influence their performance, decrease their anxiety, and improve their engagement with the online learning environment (Huang & Mayer, 2019). The findings from related evidence further validate this interpretation, demonstrating that positive digital technology self-efficacy is associated with several types of

digital engagement, which suggests that increased technical confidence in Sarawak is likely to lead to greater levels of digital engagement.

This very high mean in the Sarawak classmate support indicates the importance of Social Learning Theory and constructivism. Observation, collaboration, and peer interaction are not only technical aspects of the individual online learning process but also influence participation and understanding in the process of online learning (Li et al., 2023; Alismaiel et al., 2022). Peer support is a key indicator of readiness, as collaborative online learning is also shown to facilitate engagement, critical reflection, and co-construction of knowledge, which is an explanation for this (Qureshi et al., 2023; Schaefer et al., 2020; Altınay, 2017).

Even though West Borneo's score of 'learning from mistakes' is slightly higher, this doesn't mean readiness should be judged just on technical competence. Self-directed learning and motivation are found to be just as significant as competence in online courses, and in some cases, self-directed learning is even the most important skill for success in an online class (Torun, 2020; Ramazanoğlu et al., 2022).

Virtual Class Challenges in Sarawak and West Borneo

Virtual classes in Sarawak and West Borneo have expanded opportunities for students to access education across geographical boundaries, but they also present challenges related to internet connectivity, digital infrastructure, access to devices, learning environments, and students' readiness to engage in online learning. These challenges are particularly relevant in rural and remote communities, where differences in technological access and digital literacy can affect participation, interaction, and learning outcomes. Examining the experiences of students and educators in Sarawak and West Borneo is therefore important for understanding how virtual learning can be implemented more effectively and inclusively within the region. The following table discusses the challenges in virtual class among students in Sarawak and West Borneo.

Table 2. Challenges in Virtual Class

Items	Sarawak (Malaysia)		West Borneo (Indonesia)	
	Mean	Std. Deviation	Mean	Std. Deviation
The WIFI internet network greatly aids current digital services.	3.61	1.116	4.10	.810
There is limited broadband data to access learning software.	3.67	.859	3.49	.714
There are too many different online learning methods applied by lecturers with different subjects.	3.51	.988	3.53	.765
I have slow personal computer	2.80	1.173	3.15	1.051
I have no personal computer.	1.82	1.156	3.11	1.155

It is still found the students with the lack of online learning technical skills and knowledge.	3.66	.809	3.61	.668
I feel lazy to learn to use technology	2.16	1.003	2.59	.809
I have a lot of distractions when I'm studying	3.50	1.012	3.29	.865
I have difficulty managing time in my studies	3.15	1.087	3.30	.868
I feel dependent on technology to help my studies	3.63	.947	3.72	.715
Overall Mean	3.15		3.39	

It can be seen in Table 2 that the overall mean of virtual class challenges experienced by the students from West Borneo was slightly higher than the overall mean of the students from Sarawak (3.39 vs 3.15). Many of the common challenges identified in both groups are related to connectivity, digital competencies, the use of different online teaching approaches, distraction, and reliance on technology, consistent with what has been found in the literature, which indicates that online learning barriers typically involve the limitations of infrastructure, the impact of digital divide and the requirements of self-regulation in online learning (Barrot et al., 2021; Jafar et al., 2022; Nassr et al., 2020).

The first pattern has to do with access and infrastructure. The students in both settings agreed that WiFi facilitates current digital services, with a higher mean score for WiFi use in facilitating current digital services in West Borneo (4.10) than in Sarawak (3.61) indicating greater perceived dependence on the internet for the use of current digital services. Meanwhile, the two groups also had significant issues with low broadband data speeds (2.15 for both) and with using slow computers (3.15 for students compared to 1.82 in Sarawak) and most notably of not having a personal computer (3.11 for both compared to 1.82 in Sarawak). This has been observed in the research carried out by Azionya & Nhedzi (2021), Cullinan et al. (2021), Baidoo-Anu et al. (2023), Kumi-Yeboah et al., (2023), and Vishnu et al., (2024) which all indicated that unstable connectivity, limited data, poor device access and socioeconomic inequalities are factors that reduce participation in synchronous learning and widen the digital divide, particularly for students in less advantaged or rural settings.

The second pattern is related to skills, learning management and home study. The means for lack of online learning technical skills, lack of knowledge, and moderate problems with too many online learning methods across subjects, distractions during learning, time management and dependence on technology were similar for both groups (3.66 in Sarawak; 3.61 in West Borneo). Laziness in

learning technology, on the other hand, had the lowest means in both groups, which shows that not being willing is a minor obstacle compared to being ready, trained and consistent in learning. This is consistent with evidence that while students may struggle more with the new online approaches, adapting to those approaches, managing time, staying focused, and navigating platforms, they do not appear to be struggling with the rejection of technology, as digital skills training positively impacted their acceptance and effectiveness with online learning (Barrot et al., 2021; Xia et al., 2022; Vasz kun & Mihalkov Szakács, 2025).

Student Engagement in Digital Learning Technology

Student engagement in digital learning technology refers to students' active involvement, participation, and interaction when using digital tools and platforms for learning. Effective engagement can support motivation, collaboration, learning autonomy, and academic achievement, while limited digital skills, technical difficulties, and lack of motivation may reduce students' participation. Therefore, understanding student engagement is essential for creating meaningful and effective digital learning experiences.

Table 3. Student Engagement in Digital Learning Technology

Items	Sarawak (Malaysia)		West Borneo (Indonesia)	
	Mean	Std. Deviation	Mea	Std. Deviation
I pay attention in online classroom.	3.45	.948	3.67	.524
I adhere to the online learning guidelines established by my institution.	3.76	.684	3.84	.608
I usually complete my assignments on time and send them through email or learning software.	4.02	.767	3.92	.636
I usually participate actively in group discussions.	3.94	.773	3.94	.667
I feel very accomplished at the institution.	3.59	.782	3.44	.635
My classroom is an interesting place to be.	3.96	.801	3.77	.697
I talk to people outside my institution on matters that I learned in class.	3.52	.936	3.51	.658
I try to integrate the acquired knowledge in solving new problems in digital leaning.	3.71	.749	3.66	.552
I try to integrate subjects from different disciplines into my general knowledge.	3.59	.806	3.87	.648
If I do not understand some concepts taught in online learning, I try to solve the problem by consulting with others.	4.18	.767	3.67	.524
Overall Mean	3.77		3.74	

Behavioral Engagement

The pattern that is most consistent in the table is behavioural engagement: both groups scored very high for following institutional guidelines, timely submission of assignments and participation in group discussion, especially in the areas of timely submission of assignments and group discussion. This understanding aligns with the existing research which suggests that behavioral engagement in online learning refers to active participation, following the norms, attendance, responsibility, effort, and completing the tasks (Getenet et al., 2024; Bergdahl et al., 2024; Vezne et al., 2023). While digital technology can facilitate such engagement, it is not the technology itself, but rather pedagogy and course design that will impact the effect (Bond et al., 2020).

The relatively high scores for attention during online class, compliance with learning rules, and completion of learning assignments also are consistent with a body of literature that correlates positive scores for online engagement to successful completion of learning activities and to online course performance (Getenet et al., 2024; Vezne et al., 2023). Concurrently, the moderate, rather than extreme, rating for paying attention indicates that staying engaged - and focused - over time might be more challenging in online environments, even when participation and submission behaviour are high; online activities are likely to facilitate engagement when they help maintain attention and focus (Vermeulen & Volman, 2024). Common indicators of this dimension are also presented in a synthesis table of engagement indicators such as time on task, concentration, effort and responsibility. (Table 5: Student engagement operationalisation by dimension).

Cognitive and Social Engagement

The cognitive profile too is favorable. In both environments, students reported fairly high efforts to apply their knowledge to solve new problems and to connect knowledge across different subjects, as these are related to deep learning, self-regulation, and the amount of effort put into achieving learning goals (Bergdahl et al., 2024; Vezne et al., 2023; Ferrer et al., 2022). For students to integrate subjects across disciplines, the slightly higher mean for the West Borneo may indicate that they are better at doing so, whereas for solving problems based on their acquired knowledge, this slightly higher mean for Sarawak may denote a somewhat stronger applied-learning orientation.

These findings also align with findings from other studies that indicate that the positive attitude, digital literacy, and digital self-efficacy of people in the online context are associated with behavioural, cognitive, collaborative, and emotional engagement (Getenet et al., 2024; Ferrer et al., 2022). In addition, there is also variation across tool and activity, as different technologies seem to support different aspects of engagement, but have not resulted in consistent gains across all outcomes (Getenet et al., 2026; Vermeulen & Volman, 2024). However, it is relevant to note that the fact that students are actively involved in discussions and communicate with each other about what they have learned outside of class is

also noted, as these are all three elements repeatedly identified as key aspects of online involvement (Salas-Pilco et al., 2022; Ferrer et al., 2022; Vezne et al., 2023).

Self-Regulation and Help-Seeking

The item means of consulting others when they do not understand online learning concepts was the highest for Sarawak students (4.18) followed by the West Borneo students (3.67). The pattern is remarkable because, along with goal setting, time management, task strategies, and self-evaluation, help-seeking is a key self-regulated learning strategy in online learning (Lee et al., 2019; Syarif et al., 2025). Compared to face-to-face learners, online learners are required to be stronger in self-regulation skills and help-seeking seems to be particularly crucial for online autonomous learners (Hou et al., 2025; Leeuwen et al., 2020; Jin et al., 2023).

The high completion-rate findings in both groups is also similar to previous studies that found factors such as time management, perseverance, and other SRL strategies to be significant for successful completion and performance in online learning (Broadbent, 2017). The literature also indicates that help-seeking and other types of self-regulation are not uniformly developed with respect to learners, and some students show less proficiency or frequency in seeking help and other self-regulatory behaviours, particularly in less supportive online learning environments (Hou et al., 2025). In general, there is no significant difference between the two regions (Sarawak and West Borneo) in terms of students' digital learning engagement, with the key takeaway being that institutions need to build on their course design, interaction structure, and SRL support to maintain students' digital learning involvement (Getenet et al., 2024; Salas-Pilco et al., 2022).

Relationship among students' readiness, challenges and engagement in digital learning

This section explores the interrelationships among students' readiness for digital learning, the challenges they face in virtual classrooms, and their engagement with digital learning technologies. Understanding these relationships is crucial for identifying factors that influence the success of digital learning initiatives, particularly in the context of tertiary education. Spearman's rho correlation test was employed to examine the strength and direction of these associations. The findings provide insights into whether students' readiness impacts their ability to overcome challenges and maintain engagement and whether challenges in virtual classrooms affect engagement levels. These results help inform strategies for improving digital learning environments by highlighting key areas of focus for educators and institutions.

Table 4. The correlation among readiness, challenges and engagement in digital learning In Sarawak (Malaysia)

			Readiness	Challenges	Engagement
	Readiness	Correlation Coefficient	1.000	-.007	.672**

Spearman's rho		Sig. (2-tailed)	.	.925	.000
		N	164	164	164
	Challenges	Correlation Coefficient	-.007	1.000	-.057
		Sig. (2-tailed)	.925	.	.469
		N	164	164	164
	Engagement	Correlation Coefficient	.672**	-.057	1.000
		Sig. (2-tailed)	.000	.469	.
		N	164	164	164

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

Table 5. The correlation among readiness, challenges and engagement in digital learning in West Borneo (Indonesia)

			Readiness	Challenges	Engagement
Spearman's rho	Readiness	Correlation Coefficient	1.000	.431**	.659**
		Sig. (2-tailed)		.000	.000
		N	79	79	79
	Challenges	Correlation Coefficient	.431**	1.000	.334**
		Sig. (2-tailed)	.000		.003
		N	79	79	79
	Engagement	Correlation Coefficient	.659**	.334**	1.000
		Sig. (2-tailed)	.000	.003	
		N	79	79	79

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

The results of the correlation analyses to investigate relationships between students' readiness, challenges and engagement in digital learning showed similarities and differences between Sarawak, Malaysia and West Kalimantan, Indonesia respectively. According to the theoretical frameworks of Self-Determination Theory (SDT), Social Cognitive Theory (SCT), and online learning readiness, competence, self-efficacy, self-regulation, and environmental support

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are all key factors that shape engagement in digital learning (Hu & Xiao, 2025; Polat, 2024). From these viewpoints, readiness is typically defined as students' technological abilities, digital literacy, self-regulated learning, learner control, and confidence in handling online learning assignments, which influence their capacity to engage in digital spaces (Polat, 2024; Weng & Wirda, 2025).

The table 4 shows no statistically significant correlation between readiness and challenges ($r = -0.007$, $p = 0.925$) for the students in Sarawak, indicating that there was no relationship between the students' level of readiness and the problems that they had faced in the virtual classroom. The result of this study suggests that, in this context, perceived challenges are likely to have been influenced by contextual/environmental factors rather than only personal readiness, aligning with a Social Cognitive Theory perspective that behavior and learning experiences are the product of a person's interaction with the environment (El-Sayad et al., 2021; Bergdahl, 2022). This also mirrors research indicating that technological factors, interactions issues, and inadequate online support – rather than readiness – are responsible for the challenges online learning faces (Wang & Huang, 2024)). The significant positive correlation between readiness and challenges in West Kalimantan ($r = 0.431$, $p < 0.001$) suggests that the higher the readiness score, the higher the challenges reported. This does not mean that being ready led to challenges, but it does indicate that being ready may have made students more cognizant of the challenges or more actively involved in the challenges that were associated with digital learning. This interpretation aligns with Social Cognitive Theory and resilience-based perspectives, which suggest that students with higher levels of self-efficacy and self-regulatory skills are more inclined to address, perceive, and react to learning challenges instead of avoiding them (Hu & Xiao, 2025; Polat, 2024).

One common theme across both study sites was that there was a high level of positive correlation between readiness and engagement. For students in Sarawak, $r = 0.672$, $p < 0.001$, and those in West Kalimantan, $r = 0.659$, $p < 0.001$, the higher their readiness score was, the higher their score was for engagement in digital learning. This pattern aligns well with Self-Determination Theory, which suggests that when students believe they can control learning demands, feel competent in their learning, and are autonomous in making their own choices, they are more likely to engage in learning (Hu & Xiao, 2025; Polat, 2024); Chiu, 2023). Online learning readiness has been demonstrated to foster this sense of competence by fostering digital literacy, self-directed learning, and technological skills, which ultimately lead to increased participation and involvement (Polat, 2024; Weng & Wirda, 2025; Getenet et al., 2024). Additionally, according to the previous studies, readiness helps to self-regulation, satisfaction and involvement in online learning environments, and students with higher digital readiness have more active involvement in online learning environments (Yavuzalp & Bahcivan, 2021; Jiang et al., 2024; Kim et al., 2019), which gives support to this interpretation.

However, there was a difference between the contexts in their relationship to challenges and engagement. In Sarawak, the correlation was very weak,

negative and not statistically significant ($r = -0.057$, $p = 0.469$), suggesting that the problems reported by the students were not statistically significant with their engagement. Theoretically, the difficulties encountered in Sarawak could have served as external factors that prevented increased level of involvement in learning, especially if the difficulty negatively affected relatedness, competence or meaningful interaction in online learning (Salikhova et al., 2020; Wang & Huang, 2024). However, in West Kalimantan the challenges had substantial positive correlation with engagement ($r = 0.334$, $p = 0.003$) but relatively low. This indicates that the more challenging students tended to stay more engaged. Such pattern might indicate a more active coping process, as is suggested in the literature of SRL and resilience (Hu & Xiao, 2025; Polat, 2024; Ji et al., 2022), which is characterized by persistence, strategy use, and self-regulated effort in response to challenges.

In general, the results indicate that readiness was consistently and positively related to engagement in both settings of Sarawak and West Kalimantan, and that the role of challenges varied across settings. The challenges were not significantly related to readiness or engagement in Sarawak, but in West Kalimantan, the challenges were positively related to readiness and engagement. The results align with the framework of the Technology Acceptance Model (TAM), the Self-Determination Theory (SDT), and Social Cognitive Theory (SCT) which indicates that willingness can be viewed as a personal resource in the process of engaging, while the meaning and impact of challenges are more contextually dependent on digital support, interaction opportunities, technological conditions, and the general educational context (Hu & Xiao, 2025; Polat, 2024; El-Sayad et al., 2021; Chiu, 2023). The differences between the two environments also indicate that the engagement and relationships between readiness and perceived challenges are not only influenced by students' individual characteristics, but also by the learning environment and context of digital learning (Bergdahl, 2022; Kim et al., 2019).

CONCLUSION

This study demonstrates that students' readiness, challenges, and engagement in digital learning exhibit both common and context-specific patterns across Sarawak, Malaysia, and West Kalimantan, Indonesia. Students in both contexts generally demonstrated a high level of digital learning readiness, with Sarawak students reporting slightly higher readiness than their West Kalimantan counterparts ($M = 3.88$ vs. $M = 3.73$). Students in both settings showed confidence in using synchronous technologies and familiarity with learning management systems (LMS), although Sarawak students were comparatively less inclined to share ideas online, while students in West Kalimantan reported lower LMS competence, indicating the need for context-specific pedagogical and technical support. Digital learning challenges persisted in settings, particularly limited high-speed internet access, digital competency limitations, and environmental distractions, highlighting the importance of institutional support through improved connectivity, access to appropriate devices, and digital skills development. Engagement levels were generally high in both contexts,

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characterized by proactive participation, collaboration, and interactive learning, although differences in attentiveness and perceived learning accomplishment point to areas for improvement. Correlation analyses further showed a strong positive relationship between readiness and engagement in both Sarawak ($r = .672$, $p < .001$) and West Kalimantan ($r = .659$, $p < .001$), while the relationship between challenges and engagement was context-dependent. Challenges were not significantly associated with engagement in Sarawak ($r = -.057$, $p = .469$), but were significantly and positively associated with engagement in West Kalimantan ($r = .334$, $p = .003$). Overall, the results underscore the importance of strengthening students' digital competencies and creating supportive learning environments while recognizing that the role of digital learning challenges may differ according to local educational and technological contexts. As this study employed a cross-sectional design, the observed relationships should be interpreted as associations rather than causal effects.

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