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Journal of Advanced Research in Computing and Applications

Journal homepage:
https://karyailham.com.my/index.php/arca/index
ISSN: 2462-1927

Reimagining Digital Learning Without Internet Access: A Survey of Offline Technology Practices in Sabah Schools

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ARTICLE INFO

Article history:
Received 10 February 2026
Received in revised form 30 May 2026
Accepted 2 June 2026
Available online 19 August 2026

Keywords:
Offline digital learning, rural education, Sabah

ABSTRACT

Rural schools in Sabah, Malaysia, face persistent challenges with internet connectivity, which limits the effectiveness of standard digital learning initiatives implemented by the national education system. This study investigates how teachers in these remote areas utilize offline digital technologies to facilitate daily instruction. The primary objective is to identify the specific types of offline digital tools used, the frequency of their application, and the perceived effectiveness of these practices within rural classrooms. A quantitative survey design was employed for this research, collecting data from a sample of 60 teachers across primary and secondary schools located in the rural districts of Kuala Penyu, Papar, and Sipitang. Data were analyzed using descriptive statistics to determine usage patterns, barriers, and perceived effectiveness. The findings indicate that teachers predominantly rely on pre-downloaded educational videos, offline educational applications, and localized digital repositories stored on portable storage devices such as external hard drives and flash drives. While the integration of these offline tools occurs frequently during lessons, teachers reported only moderate effectiveness due to hardware limitations, lack of technical training, and the time required to manually update content. The study concludes that offline digital practices serve as a necessary bridge for digital learning in connectivity-deprived areas, but they require targeted infrastructural and pedagogical support to maximize their educational impact. These insights provide a practical foundation for policymakers to design context-specific digital interventions for rural Sabah. Furthermore, the research highlights the need for localized professional development to help educators transition from basic offline storage to more interactive offline learning platforms.

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1. Introduction

The Malaysian government has consistently prioritized the integration of digital technology in education to improve teaching and learning outcomes. The Malaysia Education Blueprint 2013-2025 outlines the necessity of using Information and Communication Technology (ICT) to increase access to quality education (Ministry of Education Malaysia, 2013). Building on this foundation, the recent Digital Education Policy 2023-2030 (Dasar Pendidikan Digital) further emphasizes the need to develop digital skills among students and educators, aiming to create a comprehensive digital learning system (Ministry of Education Malaysia, 2023). To support these national goals, platforms such as the Digital Educational Learning Initiative Malaysia (DELIMa) were introduced to provide centralized access to digital tools and resources for schools nationwide [21]. These initiatives reflect a strong national commitment to modernizing education and preparing students for a technology-driven future.

Despite these national policies, the implementation of digital learning faces significant differences between urban and rural areas. Rural schools, particularly in the state of Sabah, continue to experience a clear digital divide characterized by poor infrastructure and unreliable internet connectivity [8]. Studies indicate that while urban centers in Malaysia benefit from high-speed broadband and consistent digital access, students and teachers in remote districts of Sabah often struggle with basic connectivity issues [24]. This lack of infrastructure limits the effectiveness of cloud-based platforms like DELIMa, which require stable internet connections to function properly. Consequently, educators in these remote areas are unable to fully participate in the national digital transformation, creating an equity gap in educational opportunities [5].

The persistent lack of reliable internet in rural Sabah presents a practical problem for teachers who are required to include digital elements in their daily instruction (Yap et al., 2024; Donald & Hashim, 2025). When schools lack consistent connectivity, teachers cannot rely on real-time online resources, live streaming, or cloud-based collaborative tools [23]. Instead, they are forced to adapt and seek alternative methods to deliver digital content [1]. While existing literature extensively documents the challenges of the digital divide and the negative impacts of poor internet on online learning [8,24,36], there is a clear gap in understanding how teachers actively manage their instructional delivery in the absence of internet access. Specifically, the practical strategies and offline digital technologies that teachers employ to bridge this gap are not well studied. Understanding these local, offline adaptations is necessary to support rural educators effectively [5,23].

This study addresses this gap by investigating the offline technology practices of teachers in rural schools across three districts in Sabah: Kuala Penyu, Papar, and Sipitang. These districts contain a high concentration of rural and semi-rural schools that frequently experience connectivity disruptions [5]. The primary objective of this research is to identify the specific types of offline digital tools utilized by teachers, determine the frequency of their application in the classroom, and evaluate the perceived effectiveness of these practices. By focusing on offline digital methods—such as pre-downloaded educational videos, offline applications, and localized digital repositories stored on portable devices—this study shifts the focus from what is lacking (internet access) to what is actively being done (offline adaptation) [11].

The findings of this study will provide practical insights for educational policymakers and school administrators in Sabah and similar rural contexts. By understanding the specific offline tools and strategies currently in use, the Ministry of Education can better adjust its digital interventions to fit the actual infrastructural realities of rural schools. Furthermore, this research contributes to the broader academic literature on digital inclusion by highlighting the role of offline digital technology as a practical teaching bridge in areas lacking internet connectivity [11,35]. Ultimately, documenting

these practices will help in designing targeted professional development programs that equip rural teachers with the skills to maximize the educational value of offline digital resources.

2. Literature Review

2.1 The Digital Divide in Rural Education

The digital divide refers to the gap between individuals who have access to modern information and communication technology and those who do not [31]. In the context of education, this divide creates significant inequalities in learning opportunities, particularly for students in rural and remote areas. Contemporary research categorizes the digital divide into three distinct levels: physical access to technology (first level), digital skills and usage patterns (second level), and the actual educational outcomes derived from technology use (third level) [20]. In rural areas, the first-level divide is the most visible. Schools in remote districts often lack basic physical access to reliable internet and adequate computing devices [8]. However, the second and third levels are equally important. Even when devices are provided, teachers and students frequently lack the digital literacy skills required to use them effectively [22]. Furthermore, the educational outcomes derived from technology are significantly lower in rural settings compared to urban centers, which widens the overall educational gap [33].

In the specific context of rural Sabah, this divide is highly visible due to severe physical infrastructure deficits. The lack of basic infrastructure, such as stable electricity and consistent internet connectivity, directly impacts student engagement and increases the workload for teachers [5]. Teachers in these areas must find alternative ways to deliver the curriculum when standard digital tools fail or are inaccessible [30]. This infrastructural deficit prevents rural students and teachers from participating in standard digital learning initiatives, thereby widening the educational gap between urban and rural populations [31]. Consequently, the digital divide remains a primary barrier to achieving educational equity in developing regions and rural Borneo.

2.2 Offline Digital Technologies as Educational Bridges

To address the lack of internet connectivity, educators in remote areas increasingly rely on offline digital technologies. Offline digital learning involves the use of digital devices and software that do not require an active internet connection to function [4]. Examples include pre-downloaded educational videos, offline educational applications, and localized digital repositories stored on portable storage devices such as external hard drives and flash drives. Specific platforms designed for offline use, such as Kolibri and RACHEL, allow schools to host localized versions of educational websites and digital libraries on a local server without needing external internet access [34]. The pedagogical affordances of these offline tools are significant. According to multimedia learning theory, combining text, audio, and visual elements in digital formats improves student comprehension and retention, even when the content is delivered offline [15].

In practice, these offline tools serve as a practical bridge for schools lacking internet access, allowing teachers to deliver digital content without relying on real-time connectivity [30]. By utilizing these tools, teachers can maintain the integration of technology in their daily instruction, ensuring that students still benefit from interactive and multimedia-rich learning materials [4,14]. In the context of Sabah, teachers frequently use portable storage devices to share curated digital content across classrooms, providing a necessary alternative to cloud-based platforms in connectivity-deprived environments [5]. Thus, offline digital technologies provide a functional and necessary alternative to maintain educational continuity when internet access is unavailable.

2.3 Teacher Adaptation and Pedagogical Strategies

The successful integration of offline digital technologies depends heavily on teacher adaptation and pedagogical strategies. Teachers must possess the knowledge and skills to effectively incorporate these tools into their instructional practices. The Technological Pedagogical Content Knowledge (TPACK) framework explains that teachers need a deep understanding of how technology, pedagogy, and content intersect to design effective learning experiences [18]. When internet access is unavailable, teachers must adapt their pedagogical strategies to maximize the educational value of offline tools [6]. This requires a shift in the teacher's role from a traditional knowledge transmitter to a facilitator of offline digital activities [32]. Research indicates that teacher adaptation involves modifying lesson plans, selecting appropriate offline resources, and managing classroom activities that utilize these digital materials [29].

Beyond formal frameworks, teachers in rural areas often demonstrate high levels of agency and resilience, developing localized strategies to overcome infrastructural limitations and ensure instructional continuity [12,37]. This improvisation allows them to maintain educational standards despite the lack of standard digital infrastructure [7]. Their ability to adapt to local constraints demonstrates the importance of teacher flexibility in remote educational settings. By creating their own offline routines and sharing resources with colleagues, rural teachers actively manage the technological deficits in their schools, proving that pedagogical adaptation is just as important as physical infrastructure [29].

2.4 Challenges and Barriers to Offline Integration

Despite the potential of offline digital technologies, teachers face several challenges and barriers when integrating these tools into their classrooms. These barriers can be categorized into infrastructural and pedagogical challenges. Hardware limitations, such as a lack of sufficient devices, poor battery life, and inadequate storage capacity, frequently restrict the effective use of offline digital resources [10,12]. Pedagogically, teachers often report a lack of targeted technical training specific to offline environments, which limits their confidence and ability to troubleshoot issues with offline software and devices [7]. Standard professional development programs usually focus on online platforms, leaving teachers unprepared for the unique demands of offline digital instruction [29]. This lack of specific training means teachers must rely on trial and error when implementing offline tools.

Administratively and cognitively, teachers also face significant hurdles. There is often a lack of technical support and school leadership guidance to facilitate offline technology use. Another significant barrier is the time and cognitive load required to manually update and manage offline content, such as transferring new educational videos or applications to portable storage devices [27]. This manual process is labor-intensive and detracts from the time teachers can spend on actual instruction and lesson preparation. Furthermore, the digital content available is not always relevant to the local rural context, requiring teachers to spend additional time adapting materials for their specific students [35]. Understanding these specific barriers is necessary to design effective support systems that help rural teachers overcome the practical challenges of offline digital integration [10,27].

3. Methodology

This study employed a quantitative cross-sectional survey design to collect numerical data describing the current practices and perceptions of teachers regarding offline digital technology use [3]. The target population comprised primary and secondary school teachers in the rural districts of Kuala Penyu, Papar, and Sipitang in Sabah, Malaysia, which are characterized by remote geographical locations and frequent poor internet connectivity [36]. A sample of exactly 60 participants was selected using a stratified random sampling technique to ensure fair representation across the three districts, with 20 teachers randomly selected from each location [2]. While larger sample sizes are generally preferred for broad generalizations, a sample of 60 is statistically adequate for an exploratory, localized study focusing on specific rural districts with limited accessible populations [26]. This cross-sectional approach allowed the researchers to gather data at a single point in time, providing a clear snapshot of offline digital technology use and identifying patterns in the types of tools teachers use and the barriers they face in their daily instruction [2,3].

Data were collected using a structured, self-administered questionnaire divided into four sections: demographics, types and frequency of offline tools used, perceived effectiveness on a 5-point Likert scale, and barriers to integration, with items adapted from previously validated instruments [10,27]. Content validity was established through expert review, and a pilot test with 15 teachers yielded a Cronbach's alpha of 0.82, indicating high internal consistency [25]. Following ethical approval, physical questionnaires were distributed during district meetings, while digital versions were sent via WhatsApp to accommodate intermittent internet access, achieving a complete set of 60 responses over four weeks [5]. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 28, utilizing simple frequency and percentage distributions to summarize the demographic profiles, measure the usage patterns of offline tools, and identify the most common barriers faced by the teachers [9,19].

4. Findings and Results

The survey was completed by 60 teachers from rural schools in the districts of Kuala Penyu, Papar, and Sipitang. The sample was evenly distributed across the three districts, with exactly 20 teachers (33.3%) from each location. These 60 participants comprised educators with varying levels of teaching experience, all of whom were actively delivering daily instruction in their respective rural schools. This group provided a clear and representative snapshot of the teaching workforce operating in these connectivity-deprived areas.

The survey asked teachers to identify the specific types of offline digital tools they use in their classrooms. The results indicate that pre-downloaded educational videos are the most commonly used resource, with 54 teachers (90.0%) reporting their use. The second most common tool is offline educational applications, such as offline dictionaries and mathematics software, which are used by 42 teachers (70.0%). Additionally, 38 teachers (63.3%) utilize localized digital repositories, which include collections of worksheets, slides, and e-books. To manage these materials, teachers rely heavily on portable storage devices. A total of 56 teachers (93.3%) reported using personal flash drives to transfer materials from their homes to school computers. Furthermore, 30 teachers (50.0%) use external hard drives to store larger files like full sets of educational videos, and 25 teachers (41.7%) transfer files directly via their smartphones using USB tethering or Bluetooth.

Teachers were also asked to rate the effectiveness of offline digital tools, and the findings highlight high levels of perceived usefulness for student engagement. When combining the responses for "Agree" and "Strongly Agree," 51 teachers (85.0%) indicated that pre-downloaded videos help

students understand complex topics better. Similarly, 48 teachers (80.0%) agreed or strongly agreed that offline applications make learning more interactive. The use of portable storage devices was also viewed positively, with 45 teachers (75.0%) stating that it saves time during lessons, and 42 teachers (70.0%) noting that offline tools keep students focused during class. However, when asked if offline tools fully replace the need for internet access, the agreement dropped significantly, with only 24 teachers (40.0%) agreeing or strongly agreeing with this statement. This indicates that while teachers find offline tools highly effective for specific tasks, they still recognize the limitations of these methods compared to full internet connectivity.

The final section of the survey identified the challenges teachers face when using offline digital technologies. The most frequently reported barrier is hardware limitation, as 52 teachers (86.7%) reported that a lack of sufficient computers or projectors in the classroom is a major problem. The second most common barrier relates to the time required to manage content. Exactly 46 teachers (76.7%) agreed or strongly agreed that manually downloading, organizing, and transferring files to flash drives takes up too much of their personal time. Additionally, 40 teachers (66.7%) reported a lack of specific technical training for offline tools as a significant challenge, noting that most professional development programs only focus on online platforms. Other notable barriers include the relevance of the materials, with 35 teachers (58.3%) stating that digital content is not always relevant to the local rural context, and hardware durability, as 32 teachers (53.3%) reported that poor battery life of devices limits their usage time.

5. Discussion

5.1 The Reliance on Pre-Downloaded Content and Portable Storage

The findings show that teachers in rural Sabah heavily rely on pre-downloaded educational videos and portable storage devices to deliver instruction. With the vast majority of participants using pre-downloaded videos and almost all teachers relying on personal flash drives, it is clear that offline digital repositories are the primary method for technology-enhanced learning in these districts. This aligns with previous research indicating that educators in connectivity-deprived areas use portable storage to bridge the digital divide [5,30]. By storing materials on flash drives and external hard drives, teachers can bypass the need for real-time internet access, ensuring that students still receive multimedia-rich instruction [4]. This high reliance on physical data transfer demonstrates a practical workaround for the lack of broadband infrastructure in rural Borneo.

Furthermore, the use of localized digital repositories by a large proportion of the teachers highlights their active role in curating content for their specific classrooms. Because the internet is unreliable, most teachers must manually collect, organize, and store digital worksheets, slides, and e-books to ensure they have materials ready for daily lessons. This practice demonstrates strong teacher agency, as educators actively create their own offline infrastructure to maintain instructional continuity [37]. Rather than waiting for centralized digital solutions that require constant connectivity, these teachers take direct responsibility for managing their digital resources, proving that localized, teacher-led content management is a necessary adaptation in remote educational settings [29].

5.2 Perceived Effectiveness vs. Limitations of Offline Tools

The survey results indicate that teachers find these offline tools highly effective for student engagement and comprehension. A large majority of participants agreed that pre-downloaded videos help students understand complex topics, while most found offline applications to be highly

interactive. This supports multimedia learning theory, which states that combining visual and audio elements in digital formats improves student comprehension and retention [15]. Even without an active internet connection, the delivery of structured digital media provides a significant improvement over traditional textbook-only instruction. The positive feedback from the teachers confirms that offline tools successfully deliver the pedagogical benefits of digital learning, keeping students focused and engaged during class hours [4].

However, only a small minority of teachers agreed that offline tools fully replace the need for internet access. This discrepancy highlights a clear recognition among rural teachers of the limitations of offline methods. While offline tools can deliver static or pre-packaged content, they cannot facilitate real-time collaboration, live software updates, or access to current global information [31]. This finding reflects the third level of the digital divide, where the depth and quality of digital learning remain restricted compared to fully connected urban schools [20]. Teachers understand that while offline tools are a necessary bridge to prevent a total loss of digital learning, they are not a complete substitute for reliable internet connectivity.

5.3 Infrastructural and Pedagogical Barriers

Despite the high usage and perceived effectiveness of offline tools, teachers face significant barriers that limit their full potential. The most prominent barrier reported was hardware limitation, with an overwhelming majority of teachers citing a lack of sufficient computers and projectors in their classrooms. This physical deficit directly restricts how often and how effectively offline materials can be displayed or used by students [10]. Furthermore, most participants noted that manually downloading and transferring files takes up too much personal time. This manual management of digital content creates a heavy administrative load, detracting from the time teachers can spend on actual lesson preparation and instructional delivery [27]. The physical act of moving data from personal devices to school computers via flash drives is an inefficient process that adds to the daily workload of rural educators.

In addition to hardware and time constraints, pedagogical support remains a significant challenge. A significant majority of teachers reported a lack of specific technical training for offline tools, noting that standard professional development programs focus almost entirely on cloud-based online platforms. This leaves rural educators unprepared to optimize their offline strategies or troubleshoot local device issues [7]. Additionally, more than half of the teachers mentioned that the available digital content is not always relevant to the local rural context, requiring them to spend even more time adapting materials [35]. These barriers show that simply providing offline content is not enough; teachers need better hardware, streamlined content management systems, and targeted training to reduce their workload and improve the quality of offline instruction [29].

6. Conclusion

This study investigated the offline digital technology practices of teachers in rural schools across Kuala Penyu, Papar, and Sipitang in Sabah. The findings reveal that educators heavily rely on pre-downloaded educational videos and portable storage devices to deliver instruction in the absence of reliable internet connectivity. While teachers report that these offline tools are highly effective for student engagement and comprehension, they also recognize that these methods cannot fully replace the benefits of live internet access. The heavy administrative burden of manually managing and transferring digital content, combined with a lack of specific technical training and hardware limitations, significantly restricts the full potential of these offline strategies. Ultimately, offline digital

practices serve as a necessary and practical method to maintain instructional continuity in connectivity-deprived areas, but they require targeted support to be truly effective.

Based on these findings, it is recommended that the Ministry of Education and the Sabah State Education Department develop targeted professional development programs specifically designed for offline digital integration, rather than focusing exclusively on cloud-based platforms. Policymakers should also invest in providing rural schools with adequate hardware, such as sufficient projectors and high-capacity local servers, to reduce the manual workload on teachers. Furthermore, future research should explore the development and implementation of localized, offline-first educational software that requires minimal manual data transfer. By addressing the specific infrastructural and pedagogical barriers faced by rural teachers, educational authorities can ensure that digital learning initiatives are equitable and practically applicable to all students in Sabah.

References

[1] AlSaqqaf, Asmaa, and Ke Hu. "E-learning in Sabah, Malaysia: exploring K12 students' participation, perceptions, and coping strategies during home-based learning." *Discover Education* 4, no. 1 (2025): 313. https://doi.org/10.1007/s44217-025-00754-6

[2] Babbie, Earl R. *The practice of social research*. Cengage Au, 2020.

[3] Creswell, John W., and J. David Creswell. *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.

[4] Crompton, H., & Burke, D. (2018). The use of mobile learning in K-12 education: A systematic review. Journal of Educational Computing Research, 56(6), 914-940.

[5] Donald, K. H., and H. Hashim. "Exploring digital education: Experiential insights of ESL teachers in rural Malaysian schools." *International Journal of Research and Innovation in Social Science* 9, no. 3s (2025): 936-951. https://doi.org/10.47772/IJRISS.2025.903SEDU0067

[6] Ertmer, Peggy A., and Anne T. Ottenbreit-Leftwich. "Teacher technology change: How knowledge, confidence, beliefs, and culture intersect." *Journal of research on Technology in Education* 42, no. 3 (2010): 255-284. https://doi.org/10.1080/15391523.2010.10782551

[7] Ertmer, Peggy A., Anne T. Ottenbreit-Leftwich, Olgun Sadik, Emine Sendurur, and Polat Sendurur. "Teacher beliefs and technology integration practices: A critical relationship." *Computers & education* 59, no. 2 (2012): 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

[8] Fang, Yi Xue, Sarjit S. Gill, Puvaneswaran Kunasekaran, Mohd Roslan Rosnon, Ahmad Tarmizi Talib, and Azureen Abd Aziz. "Digital divide: An inquiry on the native communities of Sabah." *Societies* 12, no. 6 (2022): 148. https://doi.org/10.3390/soc12060148

[9] Field, Andy. *Discovering statistics using IBM SPSS statistics*. Vol. 5. London: sage, 2018.

[10] Inan, Fethi A., and Deborah L. Lowther. "Factors affecting technology integration in K-12 classrooms: A path model." *Educational technology research and development* 58, no. 2 (2010): 137-154. https://doi.org/10.1007/s11423-009-9132-y

[11] Lee, B. N. (2026). Access without internet: Evaluating offline e-learning models in remote primary schools. International Journal of Research and Innovation in Social Science, 10(2), 1376-1384. https://doi.org/10.47772/IJRISS.2026.10200103

[12] Madli, Faerozh, Mat Salleh, Salleh Wahab, Dean Nelson Mojolou, Yuzainy Janin, Ag Kaifah Riyard, Suddin Lada, Christian Wiradendi Wolor, and Khairunisah Kamsin. "The Symbiotic Evolution of AI and Media: A Technological Leap in Knowledge Sharing and Decision-Making." *Journal of Advanced Research Design* 145, no. 1 (2025): 27-41.

[13] Madli, Faerozh Bin, Dean Nelson Mojolou, Nor Afifah Yusof, and Ng Yen Phin. "Symmetry and Asymmetry: A Novel Insight Into the Relationship Between Artificial Intelligence and Business." In *AI Strategies for Social Entrepreneurship and Sustainable Economic Development*, pp. 1-16. IGI Global Scientific Publishing, 2025. https://doi.org/10.4018/979-8-3693-6392-8.ch001

[14] MADLI, F., YU ROHAIZAD, WAHAB MS SALLEH, DN MOJOLOU, M. TAMIN, A. JAFAR, AG KIFLEE, and CHW WOLOR. "The Intersection of Artificial Intelligence, Marketing, and Cancer Awareness: A New Synthesis for Future Leverage." *JOURNAL OF ADVANCED RESEARCH* (2024): 146-156. https://doi.org/10.37934/araset.60.2.146156

[15] Mayer, R. E. (2014). The Cambridge handbook of multimedia learning (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9781139547369

[16] Ministry of Education Malaysia. (2013). Malaysia education blueprint 2013-2025.

[17] Ministry of Education Malaysia. (2023). Dasar pendidikan digital 2023–2030.
[18] Mishra, Punya, and Matthew J. Koehler. "Technological pedagogical content knowledge: A framework for teacher knowledge." *Teachers college record* 108, no. 6 (2006): 1017-1054. https://doi.org/10.1177/016146810610800610
[19] Pallant, J. (2020). SPSS survival manual: A step by step guide to data analysis using IBM SPSS (7th ed.). Allen & Unwin. https://doi.org/10.4324/9781003117407
[20] Robinson, L., S. R. Cotten, H. Ono, A. Quan-Haase, G. Mesch, and W. Chen. "Digital inequalities and why they matter. Information, Communication & Society." (2015): 569-582. https://doi.org/10.1080/1369118X.2015.1012532
[21] Samsudin, Mohd Ali. "Digital learning landscape in Malaysia during the COVID-19 pandemic: The perspective of ecological techno-subsystem theory." Journal of International Cooperation in Education 24, no. 2 (2021): 131-151.
[22] Scheerder, Anique, Alexander Van Deursen, and Jan Van Dijk. "Determinants of Internet skills, uses and outcomes. A systematic review of the second-and third-level digital divide." *Telematics and informatics* 34, no. 8 (2017): 1607-1624. https://doi.org/10.1016/j.tele.2017.07.007
[23] Suppiah Shanmugam, S. Kanageswari, Arsaythamby Veloo, Soo Boon Ng, and Suheysen Revindran. "Exploring the barriers to implementing hybrid learning in rural primary schools." *Cogent Education* 12, no. 1 (2025): 2569691. https://doi.org/10.1080/2331186X.2025.2569691
[24] Surianshah, Sarimah. "Digital divide in education during COVID-19 Pandemic." *Jurnal Ekonomi Malaysia* 55, no. 3 (2021): 103-112. https://doi.org/10.17576/JEM-2021-5503-07
[25] Taber, Keith S. "The use of Cronbach's alpha when developing and reporting research instruments in science education." *Research in science education* 48, no. 6 (2018): 1273-1296. https://doi.org/10.1007/s11165-016-9602-2
[26] Taherdoost, Hamed. "Sampling methods in research methodology; how to choose a sampling technique for research." *How to choose a sampling technique for research (April 10, 2016)* (2016). https://doi.org/10.2139/ssrn.3205035
[27] Teo, Timothy. "Pre-service teachers' attitudes towards computer use: A Singapore survey." *Australasian Journal of Educational Technology* 24, no. 4 (2008). https://doi.org/10.14742/ajet.1201
[28] Shamir-Inbal, Tamar, and Ina Blau. "Which pedagogical parameters predict the general quality of ICT integration from the perspective of elementary school leaders?." *Computers in the Schools* 34, no. 3 (2017): 168-191. https://doi.org/10.1080/07380569.2017.1347427
[29] Tondeur, Jo, Johan Van Braak, Guoyuan Sang, Joke Voogt, Petra Fisser, and Anne Ottenbreit-Leftwich. "Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence." *Computers & education* 59, no. 1 (2012): 134-144. https://doi.org/10.1016/j.compedu.2011.10.009
[30] UNESCO. (2023). Global education monitoring report 2023: Technology in education: A tool on whose terms? UNESCO Publishing.
[31] Van Dijk, Jan. *The digital divide*. John Wiley & Sons, 2020.
[32] Voogt, Joke, Petra Fisser, Natalie Pareja Roblin, Jo Tondeur, and Johan van Braak. "Technological pedagogical content knowledge–a review of the literature." *Journal of computer assisted learning* 29, no. 2 (2013): 109-121. https://doi.org/10.1111/j.1365-2729.2012.00487.x
[33] Warschauer, M. (2004). Technology and social inclusion: Rethinking the digital divide. MIT Press. https://doi.org/10.7551/mitpress/6699.001.0001
[34] West, M. (2012). The implications of mobile learning for education. UNESCO.
[35] Wiebe, Adrienne, Luis Javier Crisostomo, Ruben Feliciano Perez, and Terry Anderson. "Comparative advantages of offline digital technology for remote indigenous classrooms in Guatemala (2019-2020)." *Journal of Learning for Development*9, no. 1 (2022): 55-72. https://doi.org/10.56059/jl4d.v9i1.607
[36] Yap, Phoebe Soong Yee, Priscilla Moses, Phaik Kin Cheah, Mas Nida Md Khambari, Su Luan Wong, and Fu-Yun Yu. "Digital divide: Facilitating conditions and usage of Google classroom for teachers in rural and urban secondary schools in Malaysia." *Journal of ICT in Education* 11, no. 2 (2024): 66-76. https://doi.org/10.37134/jictie.vol11.2.6.2024
[37] Zhao, Yong, and Kenneth A. Frank. "Factors affecting technology uses in schools: An ecological perspective." *American educational research journal* 40, no. 4 (2003): 807-840.