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PAPER

Empowering Rural Education: Teachers' Adoption of Emerging Technologies Amidst Digital Challenges

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ABSTRACT

This study addressed the need to understand the process of technology adoption among rural schoolteachers despite the digital divide that influences their willingness to adopt emerging technologies as to what needs to be done to enhance teaching effectiveness. This understanding helps gauge the adoption process and identify the Level of Use (LoU) pertaining to technology adoption. The purpose of this study is to investigate the LoU of emerging technology adoption among rural schoolteachers in Sarawak and to what extent their LoU influences them to adopt emerging technologies. This study utilized LoU as one of the diagnostic dimensions of the Concerns-Based Adoption Model (CBAM). This study employed a qualitative research methodology using a multi-method of data collection, including in-depth interviews and document analysis. The result from the interview concluded that rural school teachers were in LoU I – Orientation, LoU III – Mechanical Use, and LoU V – Integration. In the analysis of interview data, three themes emerged pertaining to the extent to which rural school teachers' LoU influences their willingness to adopt emerging technologies in their classroom practice: (i) teachers' collaborative effort; (ii) learning experience; and (iii) professional development. This study can be regarded as a paradigm for rural schools seeking to adopt emerging technologies to augment instructional efficacy and improve pedagogical outcomes.

KEYWORDS

emerging technologies adoption, digital divide, Level of Use (LoU), rural schools

1 INTRODUCTION

The advent of the Industrial Revolution 4.0 (IR 4.0) and the emergence of the latest technologies have impacted all walks of life, including the education ecosystem. The emphasis on digital literacy and successful digitalization at various levels of education are prerequisites for Malaysia's transformation into a digitally driven, high-income nation and regional leader in the digital economy, as highlighted in Malaysia Digital Economic Blueprint, MyDigital (2020), and Digital Education Policy (DEP) (2024). To embrace this change, teachers are required to harness essential information and

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communication (ICT) skills in diverse knowledge and skills. However, in a digitally challenged environment such as rural schools, teachers struggle to facilitate the institutionalization of emerging technology in their instructional practice.

Technology adoption is a complex, inherently social, developmental process moderated by a variety of factors such as teachers' attitude, technological anxieties, experience, lack of experience, and their concerns about the technology adoption process [1], [2], [3]. Therefore, this study aims to investigate emerging technologies adoption among rural school teachers in Sarawak based on Level of Use (LoU) in their instructional practice and to what extent their LoU influences their willingness to adopt emerging technologies using the Concerns-Based Adoption Model (CBAM). By understanding the adoption process from the teachers' point of view, relevant measures can be taken to develop and design pedagogical approaches using information and communication technology (ICT) and emerging technologies in education.

[4] defined emerging technologies as technologies that are "new, innovative, and still in development and are expected to have a large socioeconomic impact," such as education, healthcare, transportation, or the retail industry. [5] outlined five main defining characteristics or attributes of emerging technologies: (i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity. By combining these attributes, emerging educational technologies can be seen as having the potential to change, particularly in the context of education. Virtual reality [6], augmented reality [7], mobile learning devices [8], physical computing tools [9], Internet of Things hardware with sensors [10], and technologies that allow large-scale collaborative learning are examples of emerging technologies [11]. Hence, in this study, we focus on plausible emerging technologies that have demonstrated their potential to improve learning and instruction in rural schools.

Emerging technologies are perceived as potential solutions to educational gaps, acting as tools that allow new approaches to redefine the quality of learning. However, there are a few challenges to adopting this technology in teaching, especially in order to 'bring the world' into the classroom. The digital divide is one of the major challenges in adopting technology in teaching and learning. It is a result of multiple factors, such as lack of access to ICT infrastructure, digital network connectivity, teachers' and students' competencies in ICT [12], [13], [14], and socio-economic disparities [15], [16]. These inequalities have implications for society, especially in rural areas. Rural communities are greatly challenged by digital inequality owing to their geographical location, telecommunication infrastructure and development, and policy and regulation [17], [18]. Therefore, it is crucial to take into account rural teachers' concerns about technology adoption by acknowledging external factors such as the digital divide in relation to ICT access, frequency of use, and the purpose of use to improve the quality of teaching and learning and tighten the performance gap between rural and urban academic achievement.

1.1 Study context and purpose

The objective of this case study is to investigate rural teachers' LoU regarding the adoption of emerging technologies using a CBAM. Their willingness to adopt these technologies in teaching and learning will provide insights into the extent to which LoU influences the adoption of emerging technologies to enhance learning effectiveness in the classroom. The Ministry of Education (MOE) of Malaysia, in its Blueprint 2013–2025, reported that the digital divide contributes to the performance gap between urban and rural schools. Thus, the MOE aims to leverage ICT to improve teaching and learning across Malaysia, regardless of geography,

socioeconomic status, or gender. Addressing specific challenges for rural schools, such as the digital divide and technology adoption in instruction, is crucial for creating a sustainable impact on technology-enabled learning.

The DEP supports this by emphasizing the need for digital literacy and successful digitalization at all education levels. The policy aims to enhance digital literacy among students and teachers, ensuring that all stakeholders are equipped to effectively navigate the digital landscape. The trend of using emerging technologies in teaching is due to their accessibility and ability to empower personalized learning through features such as interactive presentations and content accessible anytime, anywhere. However, the successful implementation of DEP faces challenges, such as the need for more tech-savvy teachers. According to DEP, only 42.1% of teachers have achieved intermediate or advanced levels of digital literacy, while the rest have only basic knowledge. Providing comprehensive training and support for educators is crucial for the effective integration of digital technologies in the classroom.

1.2 Significance of study

This study adds to the body of knowledge on teachers' LoU in adopting emerging technology in rural schools in Malaysia. This will have significant value in contributing to our understanding of teachers' challenges as to why rural school technology adoption persisted despite years of integrating technology in the classroom. The results of the teachers' LoU were interpreted through the lens of Concerns-Based Adoption Model.

In the Malaysian education context, studies on teachers' technology adoption have focused on e-learning [19], [20], computational thinking skills [21], [22], language learning and teaching [23], [24], and curriculum development [25], [26]. Previous studies have highlighted potential specific barriers contributing to teachers' limited success when adopting technology, technology anxiety, and lack of experience. Nevertheless, little attention has been paid to rural teachers' perceptions and concerns regarding the adoption of emerging technologies. Upon understanding teachers' perceptions and concerns, other educators could utilize the findings of this study to foster emerging technology adoption in rural schools.

1.3 Limitations and assumptions

This study focuses on rural schoolteachers' challenges and their LoU regarding the adoption of emerging technologies. The teachers interviewed in this study were from digitally challenged rural schools in Sarawak, and generalizations cannot be made to the entire population of rural teachers nationwide.

1.4 Problem statement

The Malaysia Ministry of Education, in its Audit Report 2018, Series 1 [27], reported that rural schoolteachers' technology adoption persisted despite years of integrating technology in the classroom in Malaysia. The report was based on an assessment of the implementation of 1BestariNet across the country by the Audit Department of Malaysia. The findings regarding the use of virtual learning environments indicated that 36.3% of the schools never achieved the minimum requirement of Frog Virtual Learning Environment (VLE) in 2018, only 0.8% of teachers nationwide had utilized Frog Store in 2018 (pp. 10–90), and there was a huge access gap between

urban and rural school students, as 98% of rural school students never accessed Frog VLE (pp. 10–101).

In the Malaysian Education Blueprint [28], MOE identified the digital divide as one of the contributing factors in the huge gap between urban and rural school achievement. However, in a digitally challenged environment, teachers and students had problems accessing ICT infrastructure, poor digital network connectivity, and a lack of ICT training, leading to low levels of ICT literacy and socioeconomic disparities [29]. This argument of social inclusion in rural schools also impacted rural communities at large, as there are gaps in technology access, skills, and implications for humans, social, and financial [30]. The use of ICT in education is increasing in Malaysia and is continuing to modify strategies employed by both teachers and students in teaching and learning [31]. Therefore, to address this gap, it is important to investigate the challenges faced by rural schoolteachers despite the digital divide and their LoU to ensure successful adoption of emerging technologies and to make the teaching and learning process more meaningful.

Over the years, ICT integration in instructional practice has cast an extrinsic barrier known as the digital divide. In Sarawak, students are grappling with barriers such as limited Internet access, outdated infrastructure, and a lack of digital literacy resources (Horn & Gifford, 2022). This divide not only deprives them of information but also sidelines them from a world of experiential learning and global engagement [32], [33], [34]. Addressing the digital divide in Sarawak's rural schools involves a comprehensive strategy and a focus on teachers—particularly their levels of use—as well as the sociocultural context, which can be a pivotal element of this strategy.

The unstable decisions of technology adoption in rural areas are well known, but there is a lack of understanding of the challenges and their LoUs that influence their willingness to adopt emerging technologies in their instructional practice. Therefore, the understanding of teachers' LoUs and their unique barriers is crucial to foster a more sustainable adoption process that can lead to meaningful integration of technology in rural instructional practices.

This study was guided by two research questions.

1. What are rural schoolteachers' LoUs for the adoption of emerging technologies? and
2. To what extent does the LoU of rural schoolteachers influence their willingness to adopt emerging technologies in their classroom practice?

2 LITERATURE REVIEW

2.1 Digital divide in rural schools in Sarawak

Internet connectivity is high in Malaysia, with 90.1% of Malaysian households having Internet connections [35]. However, not all Malaysians participated equally in this study. Discrepancies remain between urban and rural areas and between states in Malaysia. For example, Internet penetration in Sarawak in Q1 2020 was 108.0%, whereas the national rate was 127.4% [36]. This placed Sarawak between the state with the lowest penetration, Sabah (81.2%), and Kuala Lumpur, with the highest penetration of 249.4%.

It is imperative to address the digital divide, as it is one of the contributing factors to the achievement gap between rural and urban students' performance in public examinations. Sarawak, with its high number of rural schools, is at the losing

end if the digital divide has not been addressed adequately. Therefore, the government of Sarawak is committed to tightening the gap through various ICT and digital technology initiatives to introduce ICTs and improve Internet access in rural areas. A long-running effort in three rural areas, Bario, Long Bedian, and Long Jekitan, where a local university developed community telecenters [37], [38], [39], [40], [41]. The projects known as e-Bario, e-Bedian, and e-Jekitan served as pioneering examples of leveraging educational and technological resources to empower rural communities using Very Small Aperture Terminal (VSAT), call routing, and wireless technology. Despite the geographical isolation and infrastructural limitations of these areas, the initiative has demonstrated a significant commitment to enhancing digital literacy and connectivity.

However, follow-up studies on these initiatives have revealed that teachers in primary and secondary schools have encountered difficulties adopting ICT tools in their instructional practice. The issues encountered included lack of proper training in ICT, lack of digital skills, inadequate and incompatible ICT tools, limited time allocated for incorporating ICT into classroom pedagogy, and a shortfall in consistent technical assistance and equipment maintenance [42], [43], [44], [45], [46]. Therefore, to overcome these challenges, extensive professional development was provided, along with continued technical and financial support to equip primary and secondary school teachers with the knowledge and skills to adopt ICTs as part of their teaching and to increase the effectiveness and sustainability of the projects.

In conclusion, the evidence of the digital divide in Sarawak highlights the interdependence between education and broader societal dynamics. The journey of educational evolution, especially as we approach the IR4.0 era, has pressed teachers to remain agile, meeting the distinct needs of the new generation. Thus, to effectively address the digital divide, it is crucial to consider teachers' specific concerns and actual usage of technologies when adopting emerging technologies in educational settings. By comprehensively understanding the technology adoption process from the teachers' perspective, it is possible to tailor intervention strategies that are directly applicable and beneficial within the unique instructional contexts in which teachers operate. This targeted approach ensures that the development and implementation of such measures are more impactful and responsive to educators' needs.

2.2 Teachers' technology adoption

The Organization for Economic Cooperation and Development (OECD) conducted an extensive study in education and highlighted that while digital technologies are increasingly present in education systems, their effective integration into teaching and learning remains a challenge [47]. Most of the teachers in the study possessed basic digital skills mainly limited to lesson preparation and word processing, presentation, and information tools, and there was a significant gap in their ability to integrate these skills meaningfully into their teaching practices. Previous research has indicated that teachers' use of technology in teaching is related to their beliefs about the value of technology [48], [49], [50], [51].

One of the challenges that the education system must address is the development of digital teaching competence. Teachers continue to have significant deficiencies in the various skills that develop it, which means that we must continue to encourage initial and ongoing training in this area. According to [52], technology-based tasks fail to result in meaningful learning for students because of insufficient teacher training. Studies done by [53], [54], and [55] stated that, in general, teachers are troubled with

self-confidence in using ICT in teaching and learning practices; they are confident in their basic skills but less confident in handling some technical applications. This is because of several factors: (i) restricted access and network connections, (ii) schools with limited technical support, (iii) lack of effective training, (iv) limited time, and (v) lack of teacher competencies [56], [57], [58]. As a result, in order to ensure educational effectiveness, there is a need to address the teachers' concerns based on a lack of practical training for professional development.

Other literature highlights teachers' technology adoption in rural and urban areas [59], [60], [61], [62], [63]. Recent studies have emphasized that teachers' digital teaching competence is significantly influenced by access to resources, training opportunities, and infrastructure, with notable disparities existing between rural and urban areas. [59] found that rural teachers often lag behind urban teachers in digital competence due to limited resources and training. [60] highlighted that factors such as teacher self-efficacy, institutional support, and available technological resources are critical for rural teachers' innovative behavior in integrating technology into teaching. Similarly, [61] analyzed the impact of national ICT policies in Malaysian schools and identified barriers like inadequate infrastructure and training, especially pronounced in rural areas. [62] examined the digital divide between rural and urban schools, revealing that urban schools generally have better access to technology and resources, which suggests that policy interventions are necessary to bridge this gap. Finally, [63] developed ICT teaching techniques emphasizing the need for tailored training programs for teachers to enhance their ICT competencies, particularly in under-resourced settings. These findings collectively underscore the need for more targeted support and policies to ensure equitable access and usage of ICT across different educational settings.

In the Malaysian context, several studies have explored the factors and barriers affecting teachers' integration of ICT in their lessons [64], [65], [66], [67], [68]. [64] emphasized the significance of teachers' perceptions of technology adoption, noting that educators believe educational technology can enhance learners' motivation. Additionally, findings from [68] highlighted limitations in teachers' ICT competencies and other critical factors, such as poor internet connectivity, inadequate availability of computers, and insufficient LCD projectors. These studies underscore the importance of understanding teachers' patterns of technological use and the extent to which these factors influence their willingness to adopt emerging technologies for classroom integration.

2.3 Teachers and change in education

Change in education is inevitable for what has been termed a volatile, uncertain, complex, and ambiguous (VUCA) world. [69] proposed seven categories to differentiate models of educational change. Each category has a different component of change based on the aims of the model. The first model established, called [70] Diffusion of Innovations, focuses on innovation and what attributes the innovation needs to facilitate its acceptance. The second category looks at the environment and what conditions should exist to assist in the adoption of change; this model is called the Conditions of Change by [71]. [72] described the individual as responsible for the change and, as the change agent, is the focus of the third category, while the stages of change are emphasized by [73] in the fourth category, The Change Agent's Guide.

[74] proposed the fifth model, Strategies for Planned Change, that encompassed components outside and inside of the organization undergoing change. These components later became the focal point in the sixth category: the Systemic Change in

Education model developed by [75]. This model was later expanded by [76]. The CBAM developed by [77] examines the intended adopter to understand the concerns he or she has when attempting to implement an innovation. The focus on the LoU is a key factor in understanding why or why not an individual will not accept, adopt, or abandon the innovation for that institution.

2.4 CBAM – level of use

Concerns-Based Adoption Model is a useful tool to address the introduction of an innovation, the concerns regarding the change in educational settings, and the investigation of the reasons for newly adopted programs that did not meet the success criteria set by the developers. CBAM explains the concerns of the individual in adopting new innovation through the use of three diagnostic tools: the Stages of Concerns Questionnaire (SoCQ), the innovation configurations map (IC map), and the levels of use (LoU) matrix.

Levels of Use (LoU) is a diagnostic dimension of CBAM and presents behavioral profiles of eight different approaches to using innovation [78]. Levels of Use describe specific stages that display varying patterns and types of innovation utilization by individuals and groups. These stages depict an individual's progression to mastering new skills and diverse applications of innovation. Given that LoU is behavior-focused, it has been feasible to create operational definitions for the actions (refer to Table 1). Each stage is characterized by a spectrum of behaviors. In this study, LoU exhibited teachers' behavior and patterns in utilizing emerging technologies in their instructional practice. Additionally, the LoU portrays the extent of teachers' adoption of emerging technologies beyond their classrooms.

[79] mentioned a crucial part of developing the Levels of Use (LoU) definitions was establishing the Decision Points that set each level apart. Each LoU is designed to be independent of the others. Despite logical sequencing, each level should be seen as distinct and standalone. Every Decision Point serves as a unique behavioral marker for a specific LoU. By matching behaviors to these Decision Points, it becomes straightforward to identify and define each LoU. These Decision Points also serve as the main roadmap for the flow and structure of the LoU interview.

Table 1. Operational definitions for LoU

Level of Use		Operational Definitions
0	Nonuse	State in which the user has little or no knowledge of the innovation, is not involved with the innovation, and is doing nothing toward becoming involved.
Decision Point A: Takes action to learn more detailed information about the innovation		
I	Orientation	State in which the user has acquired or is acquiring information about the innovation and/or has explored or is exploring its value orientation and its demands upon the user and the user system.
Decision Point B: Makes a decision to use the innovation by establishing a time to begin.		
II	Preparation	State in which the user is preparing for the first use of the innovation.
Decision Point C: Makes user-oriented changes.		
III	Mechanical Use	State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.

(Continued)

Table 1. Operational definitions for LoU *(Continued)*

Level of Use		Operational Definitions
Decision Point D-1: Establishes a routine pattern of use.		
IVA	Routine	Use of the innovation is stabilized. Few, if any, changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
Decision Point D-2: Changes use of the innovation in order to increase client outcomes, based on formal or informal evaluation.		
IVB	Refinement	State in which the user varies the use of the innovation to increase the impact on clients within the immediate sphere of influence. Variations are based on knowledge of both short- and long-term consequences for clients.
Decision Point E: Initiates change in use of the innovation for the benefit of clients, based on input from and in coordination with colleagues.		
V	Integration	State in which the user is combining their own efforts to use the innovation with the related activities of colleagues to achieve a collective effect on clients within their common sphere of influence.
Decision Point F: Begins exploring alternatives or major modifications to the innovation presently in use.		
VI	Renewal	State in which the user reevaluates the quality of use of the innovation, seeks major modifications or alternatives to the present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.

Source: Hall et al. (2006).

In summary, each Decision Point pinpoints a crucial behavior that sets that LoU apart from the others. The definitions for each level and their corresponding Decision Points enable a clear differentiation between each behavioral profile or pattern of use.

3 METHODS

3.1 Research design

A qualitative multiple case study method was employed in this study to investigate the challenges faced by teachers despite the digital divide and their LoU that exhibited teachers' behavior and patterns in utilizing emerging technologies. The cross-case analysis utilized content analysis to navigate the case study data [80].

Informants: This study adopted a method of purposive sampling with criterion-based case selection to select the schools and participants. The primary selection criteria of the sample were as follows:

- Identified as User and Non-User of emerging technologies
- Obtained Advanced, Intermediate, and Basic Levels in Digital Competency Mastery Level of Teachers

The researchers interviewed six participants. The number of participants in the study was determined by the point of data saturation, which was reached when no new themes emerged from the data analysis [80], [81], and [82]. Therefore, to ensure a comprehensive representation of the LoU of emerging technologies across the curriculum, participants were selected from various rural schools, genders, teaching experiences, academic qualifications, and subjects taught. The demographic details of the participants are presented in Table 2. To maintain confidentiality, the participants' real names were replaced with Cases 1 through 6.

Table 2. Teachers' demographics for the LoU dimension

	Digital Competency Mastery Level	Academic Qualification	Subject Area
Case 1	Intermediate	Diploma	English Language
Case 2	Basic	Diploma	Iban Language
Case 3	Basic	Graduate	Moral Education
Case 4	Advanced	Diploma	Science
Case 5	Advanced	Graduate	Physics
Case 6	Intermediate	Graduate	Islamic Education

3.2 Data collection and analysis

To address the two research questions, the researcher used multi-method data collection. The primary method of data collection was in-depth interviews. Another method used for triangulation was document analysis to ensure that the data were valid and reliable [83], [84]. LoU is measured using qualitative methodology by utilizing structured interviews known as the LoU Interview Protocol. The interview is organized around the Decision Points and the branching chart (see Figure 1). These questions were posed for each path followed in the course of the interview. The conversation starts by openly asking the interviewee to identify as either a user or non-user. Then, the LoU interviewer commences the interview by asking questions related to the degree to which each of these key elements is present.

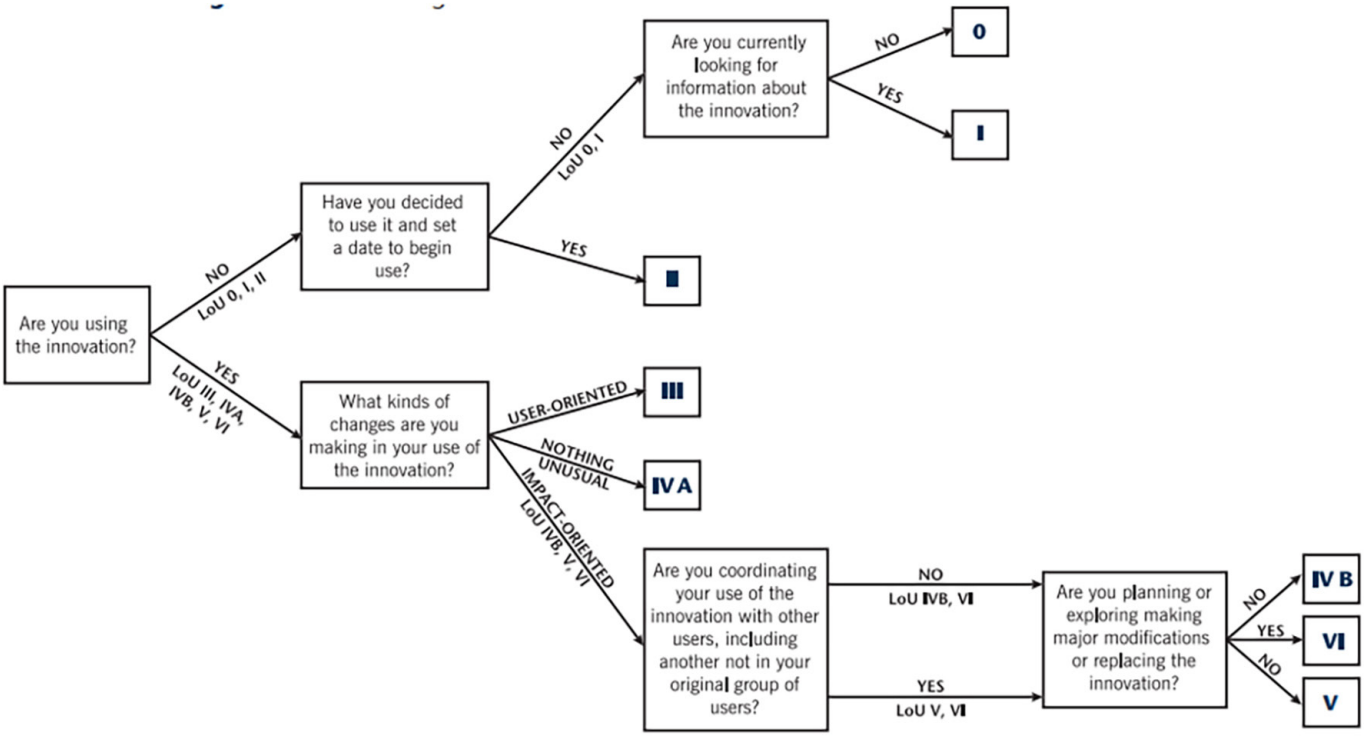

Fig. 1. The branching chart

Source: Hall et al. (2006).

During the interviews, a short briefing on the purpose of the study and the flow of the interviews was clarified to the informants. The researcher transcribed each interview verbatim. The transcripts were then analyzed manually to determine

codes, categories, and themes using Atlas. ti. The data was said to reach its saturation points where the data was repeated and no new codes emerged [84].

3.3 Trustworthiness

The most common criteria used to evaluate qualitative research are credibility, dependability, confirmability, and transferability in quantitative research [80]. By addressing similar issues, [80] constructs correspond to the criteria employed by the positivist investigator: (a) credibility (in preference to internal validity); (b) transferability (in preference to external validity/generalizability); (c) dependability (in preference to reliability); and (d) confirmability (in preference to objectivity).

Upon completion of the interviews, the audio was transcribed verbatim in the Malay language, and later, the spoken texts were converted into the English language. There were a total of six sets of transcripts, each corresponding to an interview conducted using the questions outlined in the basic interview protocol. The script was sent for peer checking, as suggested by [85], [86], and [87], asking that they verify the content for accuracy. Furthermore, participants were asked to rewrite, add, or write notes on the transcripts. Some participants added additional information, but none altered their original statements. With the final themes and subthemes established, a senior lecturer in educational technology was asked to collect a small portion of the data and apply the codes of the themes and subthemes to check the reliability and accuracy of the coding.

The English language transcripts were uploaded to the Atlas.ti software, and its Code Manager identified and coded the specific segments of the transcribed text into data segments, thus facilitating thematic analysis. In addition, the Code Manager also possesses an auto-coding utility, designed to reduce redundancy by programmatically identifying and tagging recurrent terminological expressions. Therefore, manual verification is important to ensure accuracy and context.

4 RESULTS AND DISCUSSION

4.1 Rural school teacher's level of use

The first research question identified teachers' LoU of emerging technology adoption in their instructional practice. Findings related to the LoU of emerging technologies among teachers revealed a positive trend toward technology adoption, although there is still room for growth. Four out of the six teachers were already users of emerging technologies, primarily falling under LoU V – Integration and LoU III – Mechanical use. This suggests that most teachers actively engage with technology in their teaching practices, albeit to varying degrees. The distributions of Users and Non-users are presented in Table 3.

Table 3. Overall result of users and non-users

Category	Overall LoU	Type of Use	Case ID
Users	V	Integration	Cases 4, 5, and 6
	III	Mechanical use	Case 1
Non-users	I	Orientation	Cases 2 and 3

To address the second research question, the focus of the study was on teachers who had reached the integration level, specifically LoU V – integration. Therefore, it is important to verify Decision Point E, where teachers initiate changes in the use of emerging technologies for the benefit of their students, based on input from and in coordination with colleagues. To prompt the teachers' integration level to adopt emerging technologies in their instructional practice, they were asked about their collaborative efforts to probe the Performing Category, Acquiring Information Category, Sharing Category, Assessing Category, and Planning Category. Three themes emerged: teachers' collaboration, learning experience, and professional development.

4.2 Analysis of interview data

In the analysis of interview data, three themes emerged pertaining to the extent to which the LoU of rural schoolteachers influences their willingness to adopt emerging technologies in their classroom practice. The three themes were (i) teachers' collaborative effort, (ii) learning experience, and (iii) professional development.

Teachers' Collaborative Effort: Individuals who have reached LoU V – Integration actively engage in collaborative efforts with their colleagues to maximize the impact of emerging technologies on students. They coordinated and changed their usage in conjunction with other colleagues. For those at the LoU V – Integration level (Cases 4, 5, and 6), the focus is not merely on the use of technology but also on collaborative efforts that contribute to a more effective and dynamic instructional environment. This finding is consistent with that of Al Masarweh (2018). These teachers not only implement technology in their own classrooms but also extend their knowledge through sharing and collective planning. Their active roles in professional development sessions, planning for the long-term use of technology, and fostering a culture of collective improvement signify a high level of technological engagement. These teachers serve as role models and catalysts for broader institutional change.

This study also delves into various categories to probe teachers' collaborative efforts. Teachers at the LoU V – Integration level actively collaborate with their peers, sometimes across different schools, to improve their practice. Whether through Professional Learning Communities, intra-school discussions, or specialized training sessions, these teachers are proactive not only in acquiring new information but also in planning its implementation in the long term. This highlights the importance of a supportive and collaborative environment for the successful integration of emerging technologies. Furthermore, teachers at higher LoU levels not only actively seek information but also have specific objectives for doing so. This often translates into more concrete and long-term planning activities, ranging from in-service training to the assignment of specialized roles within the panel to guide technology integration.

Nonetheless, it is equally important to consider the two non-users (Cases 2 and 3) at the LoU I – Orientation level. Although not yet active, their placement at the orientation stage suggests a willingness to learn and potentially adopt emerging technologies in the future. It may be beneficial to understand the barriers they face in adopting technology, whether logistical, conceptual, or based on a lack of support or training.

In summary, most teachers in this study are progressing well in adopting emerging technologies, but the extent of progress varies based on their level of use, collaborative efforts, and planning strategies. The presence of non-users suggests the need for targeted support and resources to bring everyone up to speed. The findings

emphasize the role of collaborative efforts and long-term planning in achieving a higher level of technological integration in educational settings. Therefore, school leadership and policymakers should do well to foster these elements as part of a holistic strategy for technology adoption.

Learning experience: In Case 1, the teacher's reliance on emerging technologies decreased because of unstable internet connections in her rural school. Despite this limitation, she made an interesting observation: her students were able to independently utilize the internet to seek information and expand their knowledge. This demonstrates that the students were resourceful and capable of self-directed learning, even without relying solely on the teacher.

On the other hand, Case 2, as a Non-User had to abandon the use of emerging technologies in her rural school classroom due to poor internet connectivity and a lack of devices, especially among students from low socio-economic backgrounds. However, she noticed that students who had better access to the internet were highly motivated by the interactive nature of emerging technologies. These tools facilitated a quicker understanding of the subject matter and engaged students more effectively.

These cases collectively highlight the influence of internet connectivity and access to devices on the adoption and effectiveness of emerging technologies in rural school settings. While limitations may exist, such as unstable connections or lack of resources, it is recognized that under more favorable conditions, emerging technologies can greatly enhance teaching and learning experiences, fostering independent learning, motivation, engagement, and immediate feedback for students.

Overall, these cases demonstrate the versatility of emerging educational technologies. Whether facilitating interactive learning experiences, providing logistical support and real-time analytics in remote teaching, or serving as specialized instructional aids, emerging technologies play a multifaceted role that can be customized to fit various educational needs. Moreover, the cases illustrate that the benefits are not just isolated to the student or the teacher but are comprehensive. They enhance teaching and learning processes, making education more interactive, efficient, and tailored to individual needs.

Professional Development: Professional development plays a crucial role in increasing teachers' LoU of emerging technologies. These findings are consistent with those of [87]. Professional development enhances teachers' technology adoption through skill enhancement, confidence building, knowledge of best practices, and access to support and resources. Furthermore, professional development helps teachers understand how emerging technologies align with curriculum goals and learning outcomes.

For those at the LoU V – Integration level (Cases 4, 5, and 6), the focus is not merely on the use of technology, but they also play active roles in professional development sessions, planning for the long-term use of technology, and fostering a culture of collective improvement, signifying high levels of technological engagement. These teachers serve as role models and catalysts for broader institutional change.

5 CONCLUSION

In the analysis of interview data, (i) three themes emerged pertaining to the extent to which rural school teachers' LoU influences their willingness to adopt emerging technologies in their classroom practice, teachers' collaborative effort; (ii) learning experience; and (iii) professional development. The study revealed that

teachers perceive emerging educational technologies as beneficial, noting that these tools significantly boost student motivation, especially in reading fluency. However, challenges such as the digital divide and time management issues pose significant barriers to effective technology integration. Teachers expressed a strong need for more training and support to help students who struggle and to improve their own teaching practices. Collaborative efforts among teachers were seen as a positive aspect, helping them address student challenges more effectively. The findings highlight the importance of addressing teachers' concerns and the need for tailored professional development, particularly in digitally challenged rural environments. The study's limitations include its focus on rural schools, suggesting future research should involve a broader range of school settings to gain more diverse insights.

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