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Bridging the digital divide: Assessing teacher readiness for technology integration in madrasah ibtidaiyah

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ABSTRACT

The swift evolution of educational technology has revolutionized learning accessibility, presenting unique challenges and opportunities, especially in remote areas. This study probes the technological readiness of Madrasah Ibtidaiyah (MI) teachers in these marginalized regions, using a quantitative ex post facto research design. A sample of 112 teachers, randomly selected, provided data via Google Forms and questionnaires, analyzed using two-way ANOVA and cluster analysis in SPSS 23. The research aimed to categorize teachers into five technology readiness profiles: explorers, pioneers, skeptics, paranoids, and slow adopters, based on optimism, innovativeness, discomfort, and insecurity. However, findings revealed only three distinct groups: explorers, pioneers, and slow adopters. Explorers showed high technological confidence but limited innovation engagement, while pioneers, despite readiness, faced challenges like scarce resources and insufficient tech knowledge. Slow adopters, largely older teachers, lagged in embracing new technologies. This lag can be attributed to adverse conditions and inadequate infrastructure, preventing full exploitation of digital tools in education. The study highlights the crucial need to overcome these barriers to enhance technology integration in MI schools, thereby improving educational outcomes in underdeveloped areas.

1. Introduction

The development of science and technology plays a significant role in encouraging renewal efforts with the help of technology, resulting in the teaching and learning process in class being easier [1], [2]. The advancement of science and technology must also be able to follow the flow of globalization because using technology is crucial for the success of the learning process [3]. In this case, 21st-century skills are capital teachers and students must master [4], [5]. In Indonesia, in terms of infrastructure, the government continues to provide support and make efforts to equalize the development of telecommunications network infrastructure [6]. However, in learning, all these opportunities cannot be utilized optimally to improve students' education and competencies. Specifically, in some regions of West Nusa Tenggara, e-learning in schools can run well. However, in the Pekat Sub-district, it is still shallow internet use, even though the network in some villages has been met. It is proven by the percentage value of internet usage, 18.8%; internet utilization is relatively tiny compared to other provinces in Indonesia [7]. Moreover, a teacher must be able to create changes to realize quality students since the teacher is the primary actor in the success of learning, so it is necessary to have an understanding of digital technology [8]–[10]. Digital tools expand and improve the ability of teachers to meet various roles and responsibilities [11], [12]. Technology makes all tasks faster and more efficient [13]. The teacher can also design multiple learning media [14], but the

progress of the times is not directly proportional to the teacher's progress [15]. In addition, one of the factors influencing student learning interest is how the teacher teaches [16]. Nevertheless, this opportunity cannot be adequately utilized by the teacher of *Madrasah Ibtidaiyah* (MI) due to various obstacles, comprising not evenly distributed infrastructure, inadequate facilities and facilities, and the lack of teacher knowledge in using learning technology.

The limited ability of MI teachers to utilize learning technology causes them to be far behind with technological developments. Also, the lack of readiness of human resources (HR) and still uneven internet networks in Indonesia make it difficult for schools to access online learning [17], [18]. Teachers' interest in utilizing learning media is lacking in West Nusa Tenggara. One of the factors that cause this lack of interest is that the teacher cannot use the learning media. It happens because of teachers' inconvenience in using technology and teaching tendencies in traditional ways [19]. In this case, the teacher's readiness to face technology development as much as possible solves problems in *Madrasah Ibtidaiyah* [20], [21]. Teachers who are ready to use technology or have a good understanding of designing, implementing, and managing learning can then improve the quality of education [22], [23]. Readiness refers to the extent to which the teacher shows willingness and confidence in taking over their teaching. The teacher's readiness is very helpful in increasing students' self-confidence in online learning [24], [25]. Thus, it indicates that the utilization of technology tremendously influences the quality of education. Hence, MI schools must adopt technology to be more developed and advanced. E-learning technology will also motivate the teachers and students community [26]. For this reason, turning the face-to-face learning process into distance learning and technology integration in learning is vital [27], [28]. This research is expected to find out teacher readiness for technology integration to apply technology so that it can provide further action so that teachers can use technology better.

2. Method

This study used quantitative methods to test the objective theory by checking the relationship between variables (objectivity), which were measured using numbers and assessed by employing statistical analysis to verify the theory and explain whether the theory will predict interesting phenomena [29]. The research design utilized the theory of the *Technology Readiness Index* (TRI) to determine the readiness of *Madrasah Ibtidaiyah* teachers in Pekat Sub-district, West Nusa Tenggara, in using learning technology and utilizing new technology to achieve learning goals and in completing school work tasks. This research was conducted in three stages: *first* was building an understanding with the principal and teachers to take data or observations. At this stage, the researchers collected various data related to school problems as supporting data so that it became a reference when distributing questionnaires and further discussions. *The second* was to collect data using a questionnaire that included four aspects of TRI adopted from the model [30]. Of the 14 schools, 112 samples were distributed offline and online in each sample area using Google Forms. *Third*, the results of input at this stage would be conveyed as a result of research to the interested parties in the school, where from the study results, information would be given from various aspects to advance quality in utilizing digital technology in MI in Pekat Sub-district, West Nusa Tenggara. The description of the research model can be seen in the Fig. 1. Each aspect comprises four statements: OPT for Optimism, INN for Innovation, DIS for Discomfort, and INS for Insecurity.

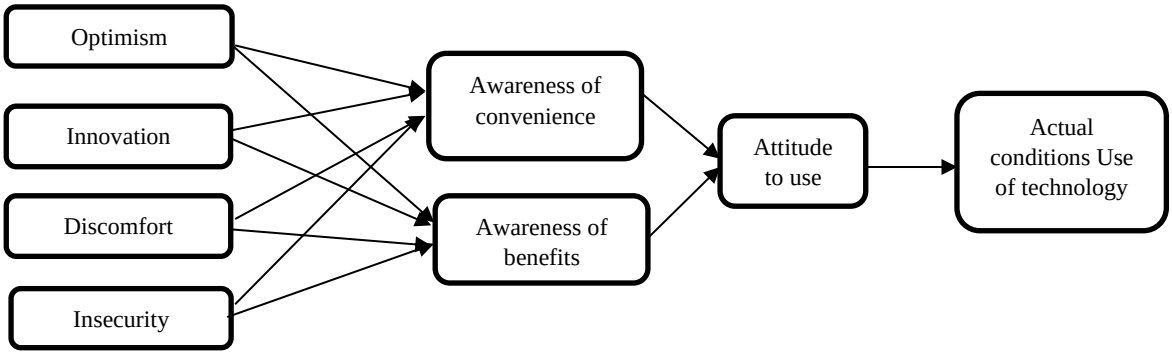

Fig. 1. Research model diagram

3. Results and Discussion

Regarding technology readiness, teachers had different values calculated by the ANOVA test. This analysis aims to determine the teacher readiness level in utilizing learning technology.

3.1. Two-Way ANOVA Test

Table 1 shows that teachers had different values in all aspects of technology readiness. The standard deviation was relatively high, meaning the distribution level was low or relatively evenly distributed to all teachers. From these results, it can be said that, in general, teachers had the right level of technology readiness. However, more details can be seen in the cluster test results, and the effect of demographics can be seen in the next section.

Table 1. Descriptive statistics

	Mean	Std. Deviation	OPT	INN	DIS	INS	TR	Cronbach Alpha
OPT	14.16	2.801	1	507**	.233* .013	.219* .020	.634**	790
INN	11.94	2.905	.507**	1	.333**	.446**	.753**	762
DIS	11.35	3.019	.233*	.333**	1	.744**	.783**	753
INS	11.29	3.195	.219* .020	.446**	.744**	1	.821**	739
TR	48.73	8.954	0.634**	0.754**	0.783**	0.821**	1	741

3.2. Univariate Test

This analysis was carried out with a mean total score (scales 1 to 5) as a dependent variable and a demographic variable as an independent variable. Two aspects of this analysis were the influence of demographic variables and their interactions. The impact study results are presented in Table 2.

Table 2. Univariate Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5381.223[a]	46	116.983	2.161	.002	.605
Intercept	112270.186	1	112270.186	2073.912	.000	.970
EXPERIENCE	360.424	2	180.212	3.329	.042	.093
CERTIFICATION	43.962	1	43.962	.812	.371	.012
STATUS	.000	0	.	.	.	.000
REGENCY	1567.144	13	120.550	2.227	.018	.308
EXPERIENCE * CERTIFICATION	80.924	2	40.462	.747	.478	.022
EXPERIENCE * STATUS	.000	0	.	.	.	.000
EXPERIENCE * REGENCY	1924.333	18	106.907	1.975	.024	.354
CERTIFICATION * STATUS	.000	0	.	.	.	.000
REGENCY * CERTIFICATION	876.145	9	97.349	1.798	.085	.199
STATUS * REGENCY	.000	0	.	.	.	.000
EXPERIENCE * CERTIFICATION * STATUS	.000	0	.	.	.	.000
EXPERIENCE * CERTIFICATION * REGENCY	.000	0	.	.	.	.000
EXPERIENCE * STATUS * REGENCY	.000	0	.	.	.	.000
CERTIFICATION * STATUS * REGENCY	.000	0	.	.	.	.000
EXPERIENCE * CERTIFICATION * STATUS * REGENCY	.000	0	.	.	.	.000
Error	3518.742	65	54.134			
Total	274880.000	112				
Corrected Total	8899.964	111				

[a]. R Squared = .605 (Adjusted R Squared = .325)

Meanwhile, Fig. 2 to Fig. 3 show the interaction between demographic variables. Table 2 displays that the model was relatively good (*R-squared = .605*). There was not a single demographic variable affecting TR (*P-value = 0.05*). Thus, both experience and certification of TR had a good effect (sig. = 0.93 and 0.12). Further analysis was to find interactions between demographic variables. This analysis was conducted to find an interaction: experience* teaching and interaction experience*certification and Interaction experience*status. It can be seen in Fig. 2 for this result. It can be seen that there was an interaction between experience and teaching and experience and certification; however, there was no interaction between expertise and status in Fig. 2. It is proven by the results obtained in Fig. 2, where there were no interaction results.

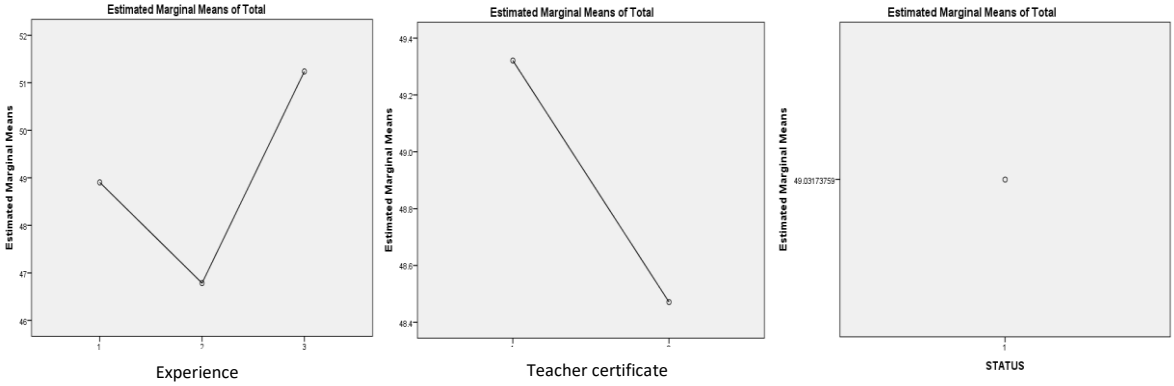

Fig. 2. Experience*teaching, teacher certification and status.

3.3. Cluster Analysis

In the cluster method, the desired number of clusters was first determined. After the number of clusters was known, the clustering process was carried out without following the hierarchy process. The method is called the K-Means Cluster. The results of this method obtained an optimal number of clusters, i.e., three, see Table 3. The era of industrial revolution 4.0 demands rapid change [31]. It starts from changes in various aspects of education, especially those related to digital technology, that teachers and students must master to support the teaching and learning process more sophisticated and modern. Teachers must also empower themselves professionally to utilize technology in learning practices [32]. In addition, network elements must be clear to achieve e-learning successfully since the appropriate network architecture will help teachers better catalyze and motivate students in the learning process. In this case, readiness is an essential factor in the success of the adoption of e-learning mode to gain knowledge [33]. Thus, knowledge, skills, and experience are crucial in accepting and implementing e-learning [34]. With digital technology tools in learning, it can help schools to automate internal processes and improve communication between students [35]. In addition, implementing e-learning learning requires the readiness of students, teachers, and infrastructure, and it is expected that all schools can apply e-learning [36].

This readiness is related to the ability of teachers and students to use and manage all technology systems utilized in the distance learning process [37]. To successfully apply e-learning, schools as a place to learn must first assess their electronic readiness to integrate technology [38]. Distance has become a critical part of the current education system [39]. In this study, descriptive statistics showed that teachers had a relatively good value in aspects of optimism and innovation in the sense that teachers had technological readiness with relatively equitable distribution [40]. The results also revealed that the teacher had a high level of readiness for the utilization of technology [41], whereas, at the level of discomfort and security, many occurred due to the unpreparedness of facilities, not supported infrastructure, and lack of understanding of teachers related to technology [42] digital learning, so they tended to teach with conventional methods [43]. Achieving e-learning needs some improvement to enhance the learning system if one wants to apply online learning, especially the communication network facilities and infrastructure that provide insight into technological advances [44]. The completeness of technology-based facilities can also help students in completing school assignments given by the teacher to the maximum [45]. Further, the adoption and utilization of digital technology learning considerably significantly the index of the success of a school [46].

Table 3. Final Cluster Centers

	Cluster		
	1	**2**	**3**
Zscore (OPT1)	-.42434	.03776	1.48098
Zscore (OPT2)	-.33600	.01272	1.21963
Zscore (OPT3)	-.31165	-.07384	1.36532
Zscore (OPT4)	-.25481	-.18249	1.45008
Zscore (INN1)	-.22091	-.05177	.96625
Zscore (INN2)	.08135	-.53651	1.16275
Zscore (INN3)	.11388	-.61895	1.26663
Zscore (INN4)	-.07306	-.24769	.94979
Zscore (DIS1)	.01810	-.48217	1.25035
Zscore (DIS2)	.42391	-.79260	.58385
Zscore (DIS3)	.16307	-.63279	1.12083
Zscore (DIS4)	.05294	-.43856	1.00109
Zscore (INS1)	.29274	-.80155	1.09802
Zscore (INS2)	.23401	-.65547	.91796
Zscore (INS3)	.32662	-.81655	1.01253
Zscore (INS4)	.22792	-.66797	.97488

Table 3 can be converted into a diagram showing the cluster's tendencies and characteristics. Fig. 3 depicts the conversion results from Table 3. The Ministry of Education and Culture has also encouraged technology adoption in learning. It aims to speed up the learning process and help teachers and students interact more with learning [47]. In this respect, the adoption and integration of learning technology are essential in accessing knowledge and compensating for the development of the increasingly advanced era [48]. However, the results obtained revealed that not all regions in Indonesia have been reached by network infrastructure. In addition, the adoption and utilization of digital technology in the education system have provided opportunities that have never happened before. Still, it does not always lead to a proportional increase in student learning outcomes [49]. It is because the availability of supporting facilities, such as gadgets and hardware for the learning process, is also still an obstacle. Also, some teachers still do not have access to these facilities, especially those born before the technology era. Thus, some teachers had difficulty applying technological devices. The availability of stable internet networks is still not evenly distributed in several regions [50].

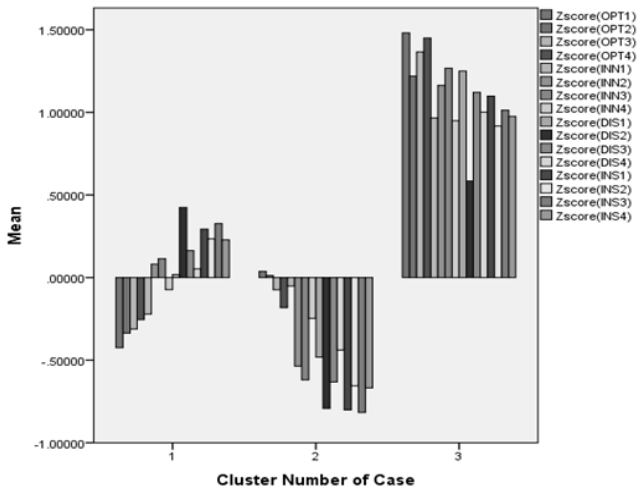

Fig. 3. Cluster diagram

Based on the analysis of data found in the univariate test results, there was no tendency leading to the demographic variable on each Technology Readiness Index (TRI) indicator. Although there was no tendency to influence demographic variables and indicators, it cannot be denied that changes in learning can occur from regular face-to-face to online. However, in the application of online knowledge, demographic positions need to be considered in each region, considering that the Indonesian state has a vast mountainous and island region, and on average, remote areas have not been reached with infrastructure and supporting facilities. In this case, *Madrasah Ibtidaiyah* (MI) in outermost and least developed regions for the utilization of technology in learning was still fairly lag, and even teachers were still dominant teaching with the old (conventional) system. In the use of

learning technology, only some schools, more prevalent on average, were not running distance learning. Hence, the Technology Readiness Index (TRI) has not been very influential in the Pekat Sub-district, West Nusa Tenggara (NTB), both at the MI and elementary levels. It was caused by a lack of teacher knowledge and age factor and was still bound by the use of conventional media [51]. However, technology learning material can increase student motivation [52].

Judging from learning motivation, technology readiness can increase student motivation to learn [53]. Learning motivation also affects the effectiveness of student learning through computer self-efficacy [54]. In the theory of motivation, the application of learning technology in the Pekat Sub-district has not yet been supported. The culture of distance learning has not become part of Indonesian life [55]. Thus, determining the readiness of *Madrasah Ibtidaiyah* teachers in Pekat Sub-district, West Nusa Tenggara (NTB), to utilize technology can be measured through four aspects of the Technology Readiness Index (TRI) indicator. This model was used to determine the tendency of teachers to utilize technology in learning. Thus, in the K-Means analysis results, several groups of teacher readiness were obtained with different characteristics in using technology. Meanwhile, classifications based on cluster tests based on technological segments aimed to form five groups of enthusiasm of *Madrasah Ibtidaiyah* (MI) teachers in using technology: explorer, pioneer, skeptical, paranoid, and slow segments. Of the five groups, it was determined based on four aspects of TRI: optimistic, innovative, discomfort, and insecurity, Table 4. Hence, departing from the four aspects above, it can be correlated according to a relatively low and high pair, which has been grouped based on the Technology Readiness Index (TRI) score. Among the indicator aspects, it is shown that the grouping of teacher readiness levels can be calculated with TR statistics and its components and discuss the segmentation scheme (using the K-Means cluster analysis of the TR score), consisting of five segments. The following presents a summary of the cluster based on the technology segment model, which was adopted from five teachers' readiness groups in utilizing technology: explorers, pioneers, skeptics, paranoids, and slow. Based on the cluster test results, five classifications were adopted concerning three clusters, which can be seen in a relatively high TR value. It was revealed that there were only three groups among teachers: explorers, pioneers, and slow.

Table 4. Adoption of Technology Segmentation

Technology segmentation	Optimistic	Innovation	Discomfort	Insecurity	Cluster
Explorer	High	High	Low	Low	2
Pioneer	High	High	High	High	3
Skeptical	Low	Low	Low	Low	-
Paranoid	High	Low	High	High	-
Slow	Low	Low	High	High	1

The formation of each cluster can be seen in the segmentation of adopted technology. Thus, in this case, only three groups were found among the teachers: explorers, pioneers, and slow, in using technology. In the explorer group, teachers had high confidence in using technology and limited learning innovations. Meanwhile, it is known that digital technology will be one of the solutions in moving education towards quality change.

> "*We desire to utilize technology, but because of lack of facilities and infrastructure, it does not support in utilizing technology in our school, and even for the network, it still does not support in our school*."

> "*We are still teaching here on average with the face system, yes, even though one has a cellphone, yes back again, there are also students who do not have a cellphone. Thus, we keep doing face-to-face learning as usual*. "

In the pioneer group, teachers also had readiness or confidence in the benefits of technology in schools and were ready to become pioneers in utilizing a new technology. However, it was due to limited facilities and infrastructure that did not support and lack of teacher knowledge in using technology that teachers experienced difficulties.

> "*It is quite smooth for the network, but for the use of technology, it is not yet very ready because there is still a lack of teacher knowledge related to the use of technology. Also, even though some teachers have cell phones, students sometimes do not have a cellphone. The obstacle is like that; on average, the teachers have not used technology in learning*."

"*Then, there is no manager who goes down directly in applying learning technology in our school, and supporting tools are also still lacking*."

In slow groups, this group had a high level of delay in the utilization of technology because basically, in this group, the older age of a teacher, the slower in utilizing technology. Or, as they were not introduced early on to technology, they would be far behind, so the teacher would be slow to understand the use of technology for learning. Then, the skeptic and paranoid groups were not included in the teacher group since there were only three high values based on the cluster test. Based on teacher values, there was confidence in utilizing technology in teaching and learning, but there was a limited infrastructure and a lack of teacher knowledge about technology.

4. Conclusion

It is important to acknowledge the limitations of this study. The research was conducted in a specific geographic region, and the findings may not fully represent the diverse conditions in other areas. Furthermore, the study focused primarily on teacher readiness, and additional research may be needed to explore student readiness and other aspects of technology integration.

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Declarations

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