



Exploring Teachers' Readiness to Integrate ICT in TPACK-Based Learning Enriched with Riau Malay Cultural Values

Arvinalde Amenda^{1*}, Mahdum Mahdum¹, Sumarno Sumarno¹, Suarman Suarman¹

¹Universitas Riau, Pekanbaru, Indonesia

Email: *arvinalde.amenda6907@grad.unri.ac.id

Abstract. This study aims to explore teachers' readiness to integrate Information and Communication Technology (ICT) in learning based on the Technological Pedagogical Content Knowledge (TPACK) framework enriched with Riau Malay cultural values, by considering various demographic factors. This research employed a quantitative approach with a descriptive survey design. The participants consisted of 408 teachers distributed across 10 regencies and 2 cities in Riau Province. Data were collected using a Likert-scale questionnaire measuring ICT utilization in lesson planning, implementation, evaluation, and the integration of Riau Malay culture. The data were analyzed using descriptive and inferential statistics, including independent t-tests, ANOVA, and post hoc tests. The findings indicate that, overall, the level of ICT utilization in TPACK-based learning falls within the high to very high category. No significant differences were found based on gender, school location, educational level, or the availability of ICT facilities. However, significant differences were identified based on subject area, teaching experience, age, and frequency of ICT training. Science teachers, those with 5–10 years of teaching experience, teachers under 40 years old, and those who more frequently participate in ICT training demonstrated higher levels of technology utilization. These findings suggest that professional factors and technological learning experiences play a more dominant role compared to structural factors. This study contributes to enriching the discourse on contextual TPACK integration grounded in local culture, particularly Riau Malay culture. The implications highlight the importance of strengthening continuous and differentiated ICT training programs based on teachers' characteristics to enhance their readiness in integrating technology effectively and contextually in learning.

Keywords: ICT, TPACK, teacher readiness, Riau Malay culture, demographic factors

1. Introduction

The development of Information and Communication Technology (ICT) has brought significant transformation to the field of education, particularly in the learning process in the 21st century [1-4]. This transformation has not only changed the way teachers deliver content, but has also shifted the learning paradigm from teacher-

centered to student-centered approaches. The integration of technology in learning is no longer optional; rather, it has become a fundamental necessity in creating effective, innovative, interactive learning that is relevant to the demands of contemporary development and the characteristics of the digital generation [5-7]. In this context, teachers' ability to integrate technology into the learning process becomes a crucial factor that determines the quality of both the learning process and student outcomes [8].

One conceptual framework widely used to understand technology integration in education is Technological Pedagogical Content Knowledge (TPACK), introduced by Punya Mishra and Matthew Koehler. The TPACK framework emphasizes the importance of synergy among three primary components: technological knowledge, pedagogical knowledge, and content knowledge, in designing effective learning [9-10]. The integration of these three components enables teachers not only to use technology as a supporting tool, but also to optimize it in supporting pedagogical strategies that align with the characteristics of the subject matter and students' needs. Teachers who possess strong TPACK competencies are able to select, adapt, and integrate technology appropriately, making learning more contextual, engaging, and capable of enhancing student participation and understanding [11].

However, the implementation of TPACK in instructional practice is influenced by various factors that affect teachers' readiness. Previous studies have shown that demographic factors such as age, teaching experience, level of education, and training play a significant role in determining the level of ICT utilization among teachers [12]. Teachers with certain levels of experience or those who frequently participate in training tend to demonstrate higher levels of readiness in adopting technology. In addition, internal factors such as motivation, self-efficacy, and attitudes toward technology are also important determinants in the successful integration of ICT in learning [13-14]. Teachers with high confidence in using technology tend to be more innovative and more open to changes in instructional practices.

On the other hand, within the context of Indonesian education, particularly in regions rich in cultural values such as Riau, the integration of technology in learning is not only aimed at improving academic quality but also plays a strategic role in preserving and internalizing local cultural values among younger generations. The rapid flow of globalization and technological advancement has the potential to shift cultural identity if it is not balanced with efforts to integrate local values into the educational process. Therefore, TPACK-based learning approaches need to be developed by incorporating local wisdom, such as Riau Malay culture, so that learning does not lose its cultural identity amidst globalization. This integration is essential to ensure that the use of technology is not solely oriented toward modernity, but also functions as a medium to strengthen cultural identity, character values, and local wisdom through relevant and meaningful learning innovations [15-17].

Although numerous studies have examined the integration of ICT in TPACK-based learning, there remains a research gap regarding how teachers' readiness to integrate ICT is influenced by demographic factors within the context of culturally based learning. Most previous studies tend to focus on general aspects of technology integration without considering cultural dimensions as an integral part of the learning process. In addition, studies that comprehensively examine multiple demographic factors simultaneously within a single research framework are still relatively limited.

Based on this gap, this study aims to explore teachers' readiness to integrate ICT in TPACK-based learning enriched with Riau Malay cultural values by considering various demographic factors, including gender, school location, subject area, level of education, teaching experience, age, training frequency, and the availability of ICT facilities. This study is expected to provide empirical contributions to enrich the discourse on contextual TPACK integration and to serve as a foundation for formulating more effective and sustainable teacher professional development policies and strategies.

2. Research Method

This study employed a quantitative approach with a descriptive survey design aimed at providing a comprehensive overview of teachers' readiness in integrating Information and Communication Technology (ICT) into TPACK-based learning enriched with Riau Malay cultural values. The quantitative approach was chosen because it allows researchers to obtain numerical data that can be analyzed objectively and systematically to describe empirical conditions in the field. Through the survey design, this study was able to reach a large number of respondents, so that the findings are expected to represent the general condition of teachers in Riau Province. In addition, this approach also enables comparisons based on respondents' demographic characteristics to identify variations in the level of ICT utilization in learning.

Research Subjects

The subjects of this study consisted of 408 teachers from various educational levels in Riau Province, distributed across 10 regencies and 2 cities, namely Bengkalis, Indragiri Hilir, Indragiri Hulu, Kampar, Kepulauan Meranti, Kuantan Singingi, Pelalawan, Rokan Hilir, Rokan Hulu, Siak, as well as Pekanbaru City and Dumai. The selection of subjects was carried out using a proportional technique to ensure that each region was represented in balance according to the number of teacher populations in each area. This was important to capture the diversity of geographical, social, and technological access conditions that vary across regions. Thus, the data obtained not only reflect conditions in urban areas but also include suburban and rural regions, which have their own characteristics in the utilization of ICT in learning.

Research Instrument

The instrument used in this study was a closed-ended questionnaire employing a Likert scale, designed to measure the level of ICT utilization in TPACK-based learning. The Likert scale was chosen because it is capable of capturing respondents' perceptions and levels of agreement toward the given statements in a more structured and measurable manner. The questionnaire consisted of two main sections. The first section contained respondents' demographic data, including gender, school location (urban or non-urban), subject area (science and non-science), highest level of education, years of service or teaching experience, age, frequency of ICT training attended, employment status, teacher certification status, and the availability of ICT facilities in schools.

The second section consisted of statements measuring the level of ICT utilization in TPACK-based learning, covering aspects of lesson planning, instructional

implementation, learning evaluation, as well as the integration of Riau Malay culture within technology-based learning processes. Each item in the questionnaire was developed based on indicators relevant to the TPACK framework to ensure alignment between the measured constructs and the research objectives.

Data Collection Technique

The data in this study were collected through the distribution of online questionnaires to teachers across various regions in Riau Province using the digital platform Google Forms. Respondents were asked to complete the questionnaire independently based on their actual experiences in utilizing Information and Communication Technology (ICT) in the learning process. To ensure data accuracy and validity, the researchers first provided a brief explanation regarding the research objectives, data confidentiality, and clear and systematic instructions for completing the questionnaire, so that respondents could provide objective, honest, and accurate responses reflecting actual conditions in the field.

Data Analysis Technique

The collected data were analyzed using both descriptive and inferential statistical techniques. Descriptive analysis was used to describe the data through the calculation of mean scores, percentages, and category distributions to determine the level of ICT utilization in TPACK-based learning. Meanwhile, inferential analysis was conducted to examine differences in ICT utilization levels based on respondents' demographic characteristics. The statistical tests employed included the independent t-test to compare two groups and analysis of variance (ANOVA) to compare more than two groups. If significant differences were identified, post hoc tests were conducted to determine which specific groups differed. All data analysis processes were carried out using statistical software to ensure accuracy in calculations and to enhance the validity and reliability of the research findings.

3. Result & Discussion

The results of this study are presented to provide a comprehensive overview of the level of Information and Communication Technology (ICT) utilization in TPACK-based learning enriched with Riau Malay cultural values. The analysis was conducted not only descriptively to examine the overall level of ICT utilization, but also inferentially to identify differences based on various teachers' demographic characteristics. The variables analyzed include gender, school location, subject area, level of education, years of service, age, frequency of ICT training, and the availability of ICT facilities in schools.

Through this analysis, a deeper understanding is expected regarding the factors influencing teachers' readiness to integrate ICT into TPACK-based learning. In addition, these findings serve as a basis for identifying groups of teachers who require competency enhancement, particularly in the use of technology integrated with local cultural values of Riau Malay culture. The results are presented sequentially based on each variable examined.

Gender

In the context of teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on gender was conducted to identify whether there are differences in the level of technology utilization between male and female teachers. The results of this analysis are presented in Table 1.

Table 1. Level of ICT utilization based on gender

Gender	Mean ICT Score	Category	p
Male	3,28	Very High	0,723
Female	3,26	Very High	

Based on Table 1, the analysis results indicate that there is no significant difference between male and female teachers in ICT utilization within TPACK-based learning enriched with Riau Malay cultural values ($p = 0.723$). The mean ICT utilization score for male teachers is 3.28, while for female teachers it is 3.26, both of which fall into the "very high" category. This finding indicates that teachers' readiness to integrate ICT into TPACK-based learning is not influenced by gender. Both male and female teachers demonstrate relatively equal abilities in utilizing technology to support learning integrated with local cultural values.

School Location

In the context of teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on school location was conducted to identify whether there are differences in the level of technology utilization between schools located in urban and non-urban areas. The results of the analysis are presented in Table 2.

Table 2. Level of ICT utilization based on school location

School Location	Mean ICT Score	Category	p
Non-Urban	3,25	High	0,616
Urban	3,28	Very High	

Based on Table 2, the analysis results indicate that there is no significant difference between teachers who teach in urban and non-urban schools in terms of ICT utilization in TPACK-based learning enriched with Riau Malay cultural values ($p = 0.616$). Teachers in urban schools have a mean score of 3.28, categorized as very high, while teachers in non-urban schools have a mean score of 3.25, categorized as high.

This finding indicates that school location is not a determining factor in teachers' readiness to integrate ICT into learning. The relatively small difference in mean scores suggests that technology utilization has been fairly evenly distributed across regions. This reflects that access to educational technology and support for ICT integration in TPACK-based learning, including those enriched with Riau Malay cultural values, are available in both urban and non-urban schools.

Subject Area

In the context of teachers’ readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on subject area was conducted to identify differences in the level of technology utilization between Science and Non-Science teachers. The results of the analysis are presented in Table 3.

Table 3. Level of ICT utilization based on subject area

Subject Area	Mean ICT Score	Category	p
Non-Science	3.22	High	0,038
Science	3.32	Very High	

Based on Table 3, the analysis results indicate that there is a significant difference between Science and Non-Science teachers in ICT utilization within TPACK-based learning enriched with Riau Malay cultural values ($p = 0.038$). Science teachers have a mean score of 3.32, categorized as very high, while Non-Science teachers have a mean score of 3.22, categorized as high.

This finding indicates that subject area is one of the factors influencing teachers’ readiness to integrate ICT into learning. Science teachers tend to demonstrate higher levels of ICT utilization compared to Non-Science teachers. This may be due to the characteristics of Science learning, which more strongly require the use of visual media, simulations, and digital-based experiments, thereby encouraging greater intensity and proficiency in technology use to support TPACK-based learning integrated with the context of Riau Malay culture.

Educational Level

In the context of teachers’ readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on educational level was conducted to identify whether there are differences in the level of technology utilization between teachers with bachelor’s (S1) and master’s (S2) degrees. The results of the analysis are presented in Table 4.

Table 4. Level of ICT utilization based on educational level

Educational Level	Mean ICT Score	Category	p-value
S1 (Bachelor’s)	3.25	High	0,195
S2 (Master’s)	3.34	Very High	

Based on Table 4, the analysis results indicate that there is no significant difference in ICT utilization based on teachers’ educational level ($p = 0.195$). Teachers with a bachelor’s degree (S1) have a mean score of 3.25, categorized as high, while teachers with a master’s degree (S2) have a mean score of 3.34, categorized as very high.

Although the difference is not statistically significant, this finding suggests a tendency for teachers with a master’s degree to demonstrate higher levels of ICT utilization compared to those with a bachelor’s degree. This indicates that higher educational attainment may contribute to teachers’ readiness to integrate technology

into TPACK-based learning. Teachers with higher educational backgrounds tend to have broader academic experiences, including the use of technology to support instructional processes and the development of digital-based innovations relevant to the context of Riau Malay culture.

Teaching Experience

In the context of teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on teaching experience was conducted to identify differences in the level of technology utilization according to years of service. The results of the analysis are presented in Table 5.

Table 5. Level of ICT utilization based on teaching experience

Teaching Experience	Mean ICT Score	Category	p
< 5 years	3.25	High	0,021
5–10 years	3.39	Very High	
11–20 years	3.25	High	
> 20 years	3.17	High	

Based on Table 5, the analysis results indicate that there is a significant difference in ICT utilization based on teachers' teaching experience ($p = 0.021$). Teachers with 5–10 years of experience have the highest mean score of 3.39, categorized as very high, while teachers with more than 20 years of experience have the lowest mean score of 3.17, categorized as high.

To further identify which group show significant differences, a post hoc test was conducted, and the results are presented in Table 6.

Table 6. Post hoc test of ICT utilization based on teaching experience

Teaching Experience	Comparison Group	p-value
< 5 years	5–10 years	0.079
	11–20 years	0.911
	> 20 years	0.319
5–10 years	< 5 years	0.079
	11–20 years	0.018
	> 20 years	0.004
11–20 years	< 5 years	0.911
	5–10 years	0.018
	> 20 years	0.264
> 20 years	< 5 years	0.319

5–10 years	0.004
11–20 years	0.264

The post hoc results indicate that significant differences occur between teachers with 5–10 years of experience and those with 11–20 years ($p = 0.018$) and more than 20 years ($p = 0.004$). This finding suggests that teaching experience is a factor influencing teachers’ readiness to integrate ICT into learning. Teachers with moderate experience (5–10 years) demonstrate the highest level of ICT utilization. This indicates that this group is in an optimal professional phase, characterized by both pedagogical maturity and strong technological adaptability. In contrast, teachers with longer experience tend to show lower levels of ICT utilization, which may be associated with a tendency to maintain conventional teaching practices and challenges in adapting to technological innovations in TPACK-based learning integrated with the context of Riau Malay culture.

Teacher Age

In the context of teachers’ readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, analysis based on age was conducted to identify differences in technology utilization across age groups. The results of the analysis are presented in Table 7.

Table 7. Level of ICT utilization based on age

Age Group	Mean ICT Score	Category	p
< 30 years	3.34	Very High	0,015
30–39 years	3.33	Very High	
40–49 years	3.21	High	
≥ 50 years	3.15	High	

Based on Table 7, the analysis results indicate that there is a significant difference in ICT utilization based on teachers’ age ($p = 0.015$). Teachers under 30 years old have the highest mean score of 3.34, followed by those aged 30–39 years with a mean of 3.33, both categorized as very high. Meanwhile, teachers aged 40–49 years and those aged 50 years and above show lower mean scores of 3.21 and 3.15, respectively, both categorized as high.

To identify which group show significant differences, a post hoc test was conducted, and the results are presented in Table 8.

Table 8. Post hoc test of ICT utilization based on age

Age Group	Comparison Group	p-value
< 30 years	30–39 years	0.882
	40–49 years	0.073

30–39 years	≥ 50 years	0.023
	< 30 years	0.882
	40–49 years	0.032
40–49 years	≥ 50 years	0.009
	< 30 years	0.073
	30–39 years	0.032
≥ 50 years	≥ 50 years	0.438
	< 30 years	0.023
	30–39 years	0.009
	40–49 years	0.438
Age Group	Comparison Group	p-value

The post hoc results indicate significant differences between several age groups. Teachers under 30 years differ significantly from those aged 50 years and above ($p = 0.023$). In addition, teachers aged 30–39 years also show significant differences compared to those aged 40–49 years ($p = 0.032$) and those aged 50 years and above ($p = 0.009$).

This finding indicates that age is a factor influencing teachers' readiness to integrate ICT into learning. Younger teachers (under 40 years old) tend to demonstrate higher levels of ICT utilization compared to more senior teachers. This suggests that younger teachers have better technological adaptability, which may be associated with more intensive experience in using digital technology and higher levels of digital literacy. In contrast, older teachers tend to face challenges in adopting technological innovations, although they still generally fall within the high category of ICT utilization in TPACK-based learning enriched with Riau Malay cultural values.

ICT Training

In the context of teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, the frequency of ICT training is an important factor analyzed. This analysis aims to identify whether the intensity of training attended by teachers influences the level of ICT utilization in learning. The results are presented in Table 9.

Table 9. Level of ICT utilization based on ICT training

ICT Training Frequency	Mean ICT Score	Category	p
1–2 times	3.21	High	0,009
3–5 times	3.35	Very High	
> 5 times	3.39	Very High	

Based on Table 9, the analysis results indicate that there is a significant difference in ICT utilization based on the frequency of training attended by teachers ($p = 0.009$). Teachers who attended training more than five times have the highest mean score of 3.39, followed by those who attended training 3–5 times with a mean score of 3.35, both categorized as very high. Meanwhile, teachers who attended training only 1–2 times have a lower mean score of 3.21, categorized as high.

To determine which group differ significantly, a post hoc test was conducted, and the results are presented in Table 10.

Table 10. Post hoc test of ICT utilization based on training

Training Frequency	Comparison Group	p-value
1–2 times	3–5 times	0.012
	> 5 times	0.020
3–5 times	1–2 times	0.012
	> 5 times	0.677
> 5 times	1–2 times	0.020
	3–5 times	0.677

The post hoc results indicate that teachers who attended training 3–5 times and more than five times demonstrate significantly higher levels of ICT utilization compared to those who attended training only 1–2 times ($p = 0.012$ and $p = 0.020$). However, no significant difference was found between teachers who attended training 3–5 times and those who attended training more than five times ($p = 0.677$).

This finding confirms that training frequency is a key factor in enhancing teachers’ readiness to integrate ICT into TPACK-based learning. The more frequently teachers participate in training, the higher their level of technology utilization in learning. This indicates that training serves as a means of improving digital competence, self-confidence, and technology-based pedagogical skills. However, the absence of significant differences between moderate and high training groups suggests a possible plateau effect, where increasing training frequency beyond a certain level no longer produces a substantial impact on ICT utilization.

ICT Facilities

In the context of teachers’ readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values, the availability of ICT facilities in schools was analyzed to determine the extent to which infrastructure influences teachers’ level of technology utilization. The results are presented in Table 11.

Table 11. Level of ICT utilization based on ICT facilities

ICT Facilities Availability	Mean ICT Score	Category	p
Limited	3.36	Very High	0,08

Adequate	3.15	High
Complete	3.29	Very High

Based on Table 11, the analysis results indicate that there is no significant difference in ICT utilization based on the availability of ICT facilities in schools ($p = 0.08$). However, descriptively, it appears that teachers working in schools with limited ICT facilities actually have the highest mean score of 3.36, followed by those in schools with complete facilities (3.29), while schools with adequate facilities have the lowest mean score of 3.15.

To identify potential differences between groups, a post hoc test was conducted, and the results are presented in Table 12.

Table 12. Post hoc test of ICT utilization based on ICT facilities

Facilities Availability	Comparison Group	p-value
Limited	Adequate	0.152
	Complete	0.617
Adequate	Limited	0.152
	Complete	0.030
Complete	Limited	0.617
	Adequate	0.030

The post hoc results indicate that a significant difference is found only between the adequate and complete facility groups ($p = 0.030$), where teachers in schools with complete facilities demonstrate higher ICT utilization compared to those in schools with adequate facilities. Meanwhile, differences between limited and adequate facilities ($p = 0.152$) and between limited and complete facilities ($p = 0.617$) are not statistically significant.

This finding indicates that the availability of ICT facilities is not the sole determining factor in the utilization of technology in learning. The fact that teachers in schools with limited facilities still demonstrate high levels of ICT utilization highlights the important role of internal factors, such as motivation, creativity, and teacher self-efficacy in integrating technology into learning. On the other hand, the significant difference between adequate and complete facilities suggests that sufficient infrastructure still contributes to optimizing ICT use. Therefore, ICT integration in TPACK-based learning depends not only on the availability of facilities but also on teachers' readiness and professional capacity to utilize available resources innovatively.

Discussion

The findings of this study provide a comprehensive overview of teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values. Overall, the results indicate that the level of ICT utilization falls within the high to very high category across nearly all demographic groups, suggesting that

teachers have a strong level of readiness to integrate technology into their instructional practices.

From the gender perspective, no significant differences were found between male and female teachers in ICT utilization. This finding is consistent with the study by [18] which suggests that the gender gap in the use of educational technology is gradually diminishing as access and training opportunities become more equitable. This indicates that gender is no longer a primary determinant of technological readiness; rather, it is more strongly influenced by opportunities for learning and experience in using technology.

Furthermore, the absence of significant differences based on school location suggests that access to technology and ICT implementation has become relatively equitable between urban and non-urban schools. This finding supports the view of [19] who emphasize that educational policies and institutional support play a crucial role in ensuring equitable ICT integration, even in geographically disadvantaged areas. This implies that TPACK integration depends not solely on location, but also on the support systems available.

In contrast to these findings, this study reveals that subject area significantly influences ICT utilization, with Science teachers demonstrating higher levels of technology use compared to Non-Science teachers. This result is consistent with the Technological Pedagogical Content Knowledge framework proposed by [20], which emphasizes that technology integration is strongly influenced by the characteristics of the subject content. Science subjects, which require visualization, simulation, and digital experimentation, naturally encourage more intensive use of technology compared to other fields [21-22].

Regarding educational level, although no statistically significant difference was found, there is a tendency for teachers with a master's degree (S2) to demonstrate higher levels of ICT utilization. This finding aligns with [19] who argue that teachers' technological competence is not solely determined by formal education, but also by beliefs, experiences, and engagement in professional development activities.

More notable findings emerge in relation to teaching experience and age. This study shows that teachers with 5–10 years of teaching experience and those under the age of 40 demonstrate higher levels of ICT utilization compared to other groups. These findings reinforce the concept of “digital natives” introduced by Marc Prensky, where younger generations tend to be more adaptive to digital technologies Marc Prensky, where younger generations tend to be more adaptive to digital technologies [23]. Additionally, teachers with moderate experience appear to be in an optimal professional phase, possessing both pedagogical maturity and flexibility in adopting technological innovations.

The training variable demonstrates the strongest influence on ICT utilization. Teachers who participate more frequently in training exhibit significantly higher levels of technology use. This finding is consistent with previous studies [24-27], which highlight that continuous professional development is a key factor in improving the quality of teaching. Interestingly, this study also identifies a potential plateau effect, where increasing the frequency of training beyond a certain point no longer results in significant differences. This suggests that the quality of training may be more important than its quantity.

Meanwhile, the findings related to ICT facilities indicate that infrastructure availability does not significantly influence the level of technology utilization. Even teachers in schools with limited facilities are able to demonstrate high levels of ICT use. This finding is consistent with studies on self-efficacy [28-30], which emphasize that individuals' beliefs in their own abilities play a crucial role in shaping behavior. In this context, teachers' motivation, creativity, and self-efficacy emerge as key factors enabling them to remain innovative despite limited resources [31].

Overall, the findings of this study confirm that teachers' readiness to integrate ICT into TPACK-based learning is influenced not only by external factors such as facilities and location, but also by internal factors such as experience, age, training, and self-efficacy. Effective ICT integration in learning enriched with Riau Malay cultural values requires a synergy between technological competence, pedagogical skills, and an understanding of the local cultural context.

4. Conclusion

This study concludes that teachers' readiness to integrate ICT into TPACK-based learning enriched with Riau Malay cultural values falls within the high to very high category. Factors such as gender, school location, educational level, and the availability of ICT facilities do not show a significant influence on the level of ICT utilization, indicating that access to and the ability to use technology have become relatively equitable. In contrast, factors such as subject area, teaching experience, age, and frequency of training are found to significantly influence ICT utilization. Science teachers, those with 5–10 years of teaching experience, younger teachers, and those who participate more frequently in ICT training demonstrate higher levels of technology utilization. These findings emphasize that professional experience and continuous competency development play a crucial role in enhancing teachers' readiness.

Furthermore, this study reveals that ICT utilization is not solely determined by the availability of facilities, but is also strongly influenced by internal factors such as teachers' motivation, creativity, and self-efficacy. Therefore, efforts to improve ICT integration in learning should focus not only on the provision of infrastructure but also on strengthening teachers' capacity through high-quality, continuous, and contextually relevant training. These findings provide important contributions to the development of TPACK-based learning models integrated with local wisdom, particularly Riau Malay culture, and serve as a foundation for formulating educational policies that support the digital transformation of learning in schools.

Authors' Contributions

All authors contributed significantly to the completion of this study. The first author was responsible for conceptualizing the research, designing the methodology, collecting and analyzing the data, and drafting the manuscript. The co-authors contributed to the refinement of the research design, data interpretation, and critical revision of the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript.

Acknowledgments

The authors would like to express their sincere gratitude to all teachers in Riau Province who participated in this study and contributed valuable data. Appreciation is also extended to the institutions and schools that supported the data collection process. The authors are grateful to colleagues and reviewers for their constructive feedback, which helped improve the quality of this manuscript.

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