Elementary School Teachers' Competencies: In-Service Teachers Training Model for Content, Culture, Technology Integration

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Abstract

Teachers' competencies, in terms of content, culture, and technology, are the main capital for managing 21st-century learning. Despite the importance, these competencies have not been well developed, specifically at the elementary level, indicating the pressing need to develop a training model. Therefore, this study aims to develop a quality INSET CULTECH model for in-service teachers that integrates content, culture, and technology. The study procedures were carried out using a Four-D development method. The training model was content-validated by experts and responses were received from teachers before testing with repeated measurement. The sample population comprised teachers from public elementary schools in Denpasar City. In addition, competencies data before and after participating in INSET CULTECH were analyzed using Repeated Measure ANOVA. The results showed that the quality of the training model developed was in a good category. This study is expected to have an impact on developing competencies in integrating Balinese culture into basic science learning, using mobile technology, and implementing innovative learning with the developed media.

Keywords: *Teacher Training Model, Teacher Competencies, In-Service Teacher Training, Elementary School, Science-Culture-Technology.*

Introduction

The expectations placed on the upcoming generation in the 21st century are beyond the acquisition of academic information. To succeed in an increasingly interconnected and dynamic world, individuals need to have a broad skill set that includes conventional learning abilities and a worldwide perspective. This requires skills in original thought, inventiveness, information navigation, and intercultural communication [1], [2], [3], which are necessary for success. However, the realization of this educational need largely depends on teachers' competencies. Several studies have shown that teachers play a crucial role in forming the educational environment and acting as stimuli for the development of students [4], [5]. The capacity to promote critical thinking, facilitate curiosity, and inculcate a feeling of global citizenship has a direct impact on the standard of instruction given. Therefore, by giving teachers the competencies needed, the next generation can be positioned for success amidst the challenges of the 21st century.

According to previous studies, teachers' competencies can be defined as the ability to teach, which requires possessing relevant knowledge, attitude, and skills that support students in achieving high learning outcomes [6], [7]. The components of teachers' competencies include leadership, willingness to create an environment that is suitable for students' diversity, mastering content being taught, facilitating learning, and reflecting on learning practices implemented [8], [9]. Others include carrying out inquiry-based learning, having technological literacy, and teaching enthusiasm [10], [11], [12], [13]. An equally important component is cultural literacy, which must also be integrated [14], [15], [16], [17], [18].

Despite the importance, these competencies are still a fairly complex problem in various countries, specifically in elementary schools. For example, teachers in China lack technological knowledge (TK), which is essential in the 21st century [19]. In addition, traditional teaching methods still dominate in many

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classrooms in higher education [20]. Teachers in Indonesia also do not take advantage of learning media, leading to poor comprehension of the material presented [21]. Previous studies have shown that learning in public elementary schools has not explored various aspects of life, such as the waste problem [22]. A cultural discontinuity has also been identified in learning along with the weak use of technology as a learning support system [23]. The results of the 2015 Teachers' Competencies Test show that teachers in several schools have not yet reached the Minimum Competencies Standard. The national average for the field of pedagogical and professional competence is only 53.02, which was classified in the poor category [24].

One of the causes of teachers' competencies problems is professional development that has not been maximized [25]. Teachers do not actively participate in professional development but often play the role of passive listeners [26]. In addition, existing programs have also not addressed the problem of integrating content, culture, and technology in learning [27]. Most programs focus solely on a single aspect, such as culture, without adequately supporting the integration of technology into learning activities [28]. This oversight leads to ambiguities that negatively impact teaching quality when cultural and contextual variables are not addressed [29]. Some professional development programs are also counterproductive due to the absence of a comprehensive approach that considers all components of the teaching process [30]. In summary, there is a lack of a professional development model that integrates science, culture, and technology as central themes in teachers training.

Based on these findings, this study was carried out to provide a thorough model for in-service teachers' preparation, focusing on the smooth incorporation of science, culture, and technology into the educational process. The goal of combining these 3 essential pillars is to develop a more comprehensive approach to teaching and learning as well as to transcend conventional educational paradigms. Recognizing the connection between these areas, the model aimed to equip teachers with the tools and techniques necessary to foster not only academic ability in their students but also cultural awareness and technological fluency. Through a multidimensional approach that values diversity, encourages inquiry, and integrates modern technology, this study paves the way for more dynamic and inclusive educational experiences. These experiences are designed to prepare students for success in a globally connected world.

Method

This study was carried out using a research and development method, and the product developed was a model of in-service teachers training, known as INSET CULTECH. The model was designed to incorporate science, culture, and technology in an integrated manner into the learning process. The design process was performed using a 4-D model due to its ability to provide support for the development of training programs [31] in 4 steps, namely define, design, development, and dissemination, as shown in Figure 1. Approval for this study was obtained from the Report Ethics Commission of Study Institute and Community Service at Universitas Pendidikan Ganesha before recruitment. Participants were voluntary and obtained written informed consent. The implementation of the 4-D Model was presented in Figure 1.
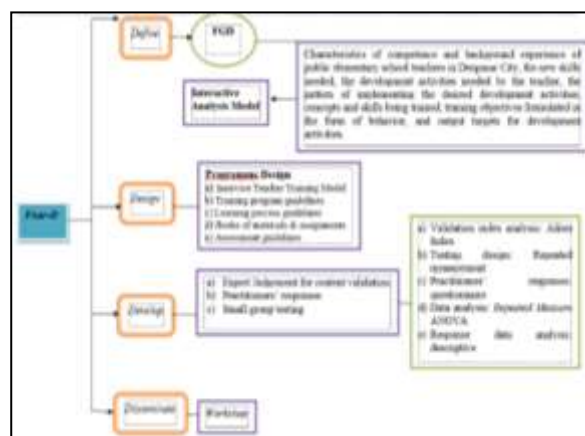
Figure 1. The Implementation of Four-D Model

The collection of data and instruments was carried out using several methods during the development stage, as shown in Table 1.

Table 1. Data Collection Instruments

No	Technique	Instrument	Data
1	FGD	Discussion Guidelines	Characteristics of competence and background experience of public elementary school teachers in Denpasar City, the new skills needed, the development activities needed by teachers, the pattern of implementing the desired development activities, concepts and skills being trained, training objectives formulated in the form of behavior, and output targets for development activities.
2	Questionnaire	Questionnaire	Practitioners' responses to the model and the support system as well as the responses of teachers in INSET CULTECH to the acquisition of competencies.
3	Observation	*Rating scale*	Content validity of model and the support systems, teachers participants' competence.

Content validity of elementary teachers' competencies instrument was analyzed by Aiken, and the coefficient of the instrument was 0.92, or feasible to use. Instrument reliability testing was conducted with inter-rater reliability, and a fully crossed design, and the raters were 3 people. Additionally, Inter-rater reliability analysis was performed using the intra-class correlation (ICC), and 2-way mixed model. The results of the analysis showed that the reliability of the instrument was 0.736, or reliable.

Analysis of content validity of the INSET CULTECH Model and its support system used the Aiken validity index. When the Aiken validity index had a value of less than 0.40, it meant that the validity was low, but when the validity coefficient was 0.80, it meant the validity was high [32]. Teachers's response data to the INSET CULTECH program were analyzed descriptively. At the small group testing, this study used a quasi-experimental design with repeated measurement.

The study question posed was "Is there a statistically significant difference in competencies of public elementary school teachers in Denpasar, Bali, before and after the INSET CULTECH program?". However, to prove the hypothesis, the data obtained were then analyzed by repeated measure ANOVA. This type was used to test for significant differences in measurement data that were repeated. H_0 was rejected when sig. < 0.05, and the analysis process was carried out using the SPSS software.

Results and Discussion

Result

INSET CULTECH had principles, and these included a) guided by the needs of participants, b) the learning process that was adopted was active and problem-centered, c) the relationship between one learner and another learner was parallel, where the trainer was the trainee's study partner, and d) there was the involvement of self-evaluation and feedback at each stage. The INSET CULTECH learning process design lasted for 36 hours.

Training included 4 sessions of activities, and the program learning stages consisted of *presentasi* (presentation), *alami* (practice), and *tunjukkan* (show in class) stages, and these were known as PRATU. The

presentation session was carried out with a duration of 6 hours. Additionally, the second session was the practice stage and show in class for round I. The practice stage activity lasted 8 hours and the show in class stage lasted 2 hours. The third and fourth sessions were practice and show in class stages for rounds II and III.

The activities carried out were similar to the activities in the second session, and training model had 4 supporting components, namely program guidelines, learning process guidelines, material and assignment books, and assessment guidelines. The program guidelines covered the INSET CULTECH model framework, curriculum, participants, and trainers, as well as evaluation. The learning process guideline contained the syllabus, diagrams of the learning process, and learning activity plans. The material and task book contained theories related to cultural involvement in learning, technology involvement in learning, local culture, mobile learning, innovative learning, and assignments. Furthermore, the evaluation guideline included a program evaluation instrument and an evaluation instrument for competence of elementary school teachers. The design of model, explanation of the study sessions, and support tools were presented in Figure 2 and 3.
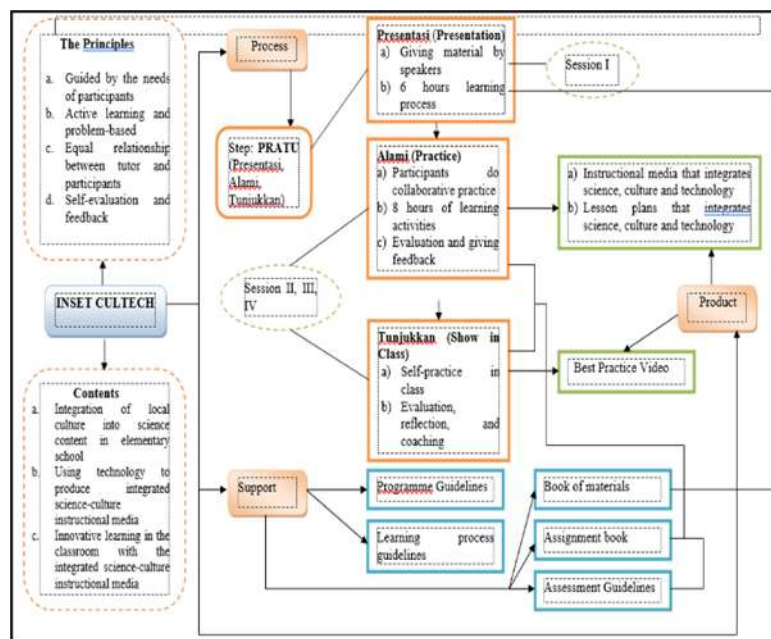

Figure 2. Model of INSET CULTECH Design

Figure 3. The INSET CULTECH Support Tools

The expert validation of the INSET CULTECH model used the agreement of 3 experts which included educational technology, educational science, and Balinese cultural experts. The results of content validity analysis of the INSET CULTECH model and its tools were high validity at p = 5% based on the Aiken table, and the coefficient of validity was > 0.8.

Based on the responses of the practitioners involved, the INSET CULTECH model and its tools were stated to be completed in terms of content and type which were easy to understand and according to the needs of teachers in the field. For the task guide, it was necessary to make more specific work steps to make it easier for the participants to follow.

The INSET CULTECH test involved ten 5th-grade homeroom teachers of elementary school as training participants, and those who took part in training were teachers who had an interest in the topic and were willing to participate in training to the end. These participants consisted of 4 males and 6 females. A total of 9 had bachelor's degrees and one had a master's degree. The period of employment of participants was in the range of 3 years to 13 years.

The data of this study were taken in 2 segments namely, the first segment coming before the INSET CULTECH activity while the second segment was at the stage of showing the INSET CULTECH program. The data for each segment were 3 observation data, and the total number of the data was 6 observations. The data were then analyzed using repeated measure ANOVA with SPSS application, and the repeated measure ANOVA test began with a data normality test. The sig. value for each data was> 0.05 because the sig value > 0.05, and it could be stated that the data were normally distributed. The results of the normality test of the data could be seen in Table 2.

Table 2. Test Of Normality

	Kolmogorov- Smirnov[a]			Shapiro- Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Score before	.139	10	.200*	.950	10	.665
Score before	.231	10	.140	.858	10	.072
Score before	.222	10	.178	.872	10	.105
Score before	.261	10	.052	.854	10	.065
Score before	.227	10	.153	.884	10	.146
Score before	.179	10	.200*	.868	10	.094
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

The results of teachers' competencies data processing was presented in the form of graphs. The graph of competence against the time before and after the intervention was shown in Figure 4.
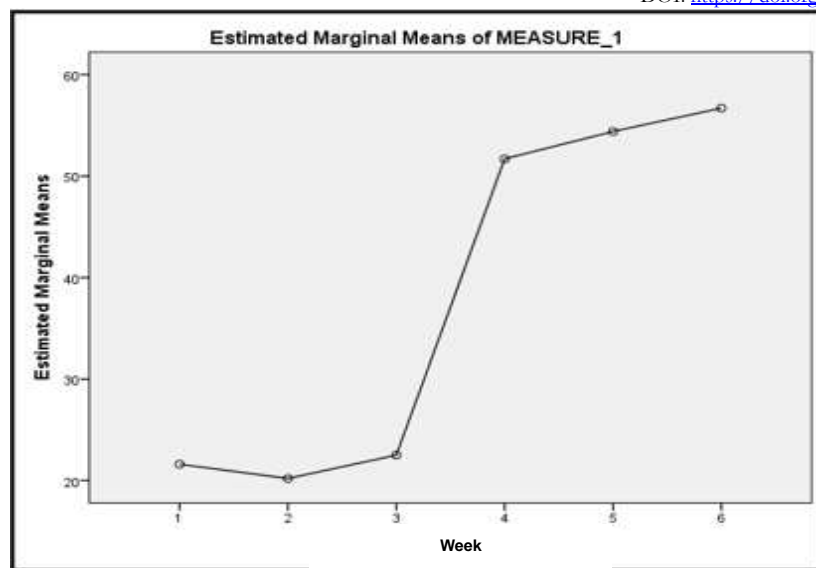
Figure 4. Competencies Plot Before and After the Intervention

Based on the graph, it could be seen that there was an increase in competence of participants after participating in INSET CULTECH. This meant that INSET CULTECH affected the participants' competence.

The results showed the value of sig. < 0.05 meaning H0 was rejected and H1 was accepted. However, the INSET CULTECH program intervention had a significant effect on competence of elementary school teachers in Denpasar, Bali. The results of the statistical calculation of the effect of the intervention with repeated measure ANOVA were as follows.

Table 3. The Results of Repeated Measure ANOVA

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Week	Pillai's Trace	.984	59.624[b]	5.000	5.000	.000
	Wilks' Lambda	.016	59.624[b]	5.000	5.000	.000
	Hotelling's Trace	59.624	59.624[b]	5.000	5.000	.000
	Roy's Largest Root	59.624	59.624[b]	5.000	5.000	.000

Design: Intercept

Within Subjects Design: Minggu

b. Exact statistic

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	Df	Sig.	Epsilon[b]		
					Green house-Geisser	Huynh-Feldt	Lower-bound
Week	.002	44.382	14	.000	.363	.450	.200

Tested the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables was proportional to an identity matrix.

a. Design: Intercept

Within Subjects Design: Week

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	85957.350	1	85957.350	951.382	.000
Error	813.150	9	90.350		

Could be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests were showed in the Tests of Within-Subjects Effects table.

Discussion

The purpose of this study was to determine the effectiveness of the INSET CULTECH program in increasing teachers' competencies after integrating content, culture, and technology into learning practice. Previous studies had examined how teachers training models contributed to creating professional development among teachers, such as through implementing active learning and peer collaboration in improving pedagogical skills [33], [34] but did not contextualize the impact of local cultural elements on technology-integration that were specific for certain settings, where there were participating school from Bali-Indonesia with diverse backgrounds. Moreover, the majority of current studies largely addressed generic teachers' competencies without taking a closer look at the domain-specific skills and knowledge needed to deploy cultural and technological dimensions within curricular programs successfully [7], [8]. Through developing training model that foregrounds content knowledge and draws on local cultural understandings as well use of contemporary digital tools, this study addressed the gap in advocating for better options.

This innovative model showed the importance of teacher quality in driving performance improvement. Teacher trainees were encouraged to enhance various aspects of their performance through training, which served as the initial step in a chain reaction [33]. The INSET program considered the needs and realities as its primary focus, aiming to shape the perspectives and engage teachers as active participants rather than passive recipients of information. Active learning was fostered through problem-solving and collaborative work with peers, rather than passive reception of content. The program emphasized training within comfortable settings, combined with collaborative efforts and active engagement, all of which were crucial components of its success [34]–[36]. However, many studies have ignored the unique learning requirements and circumstances of teachers from diverse cultural backgrounds, which can significantly impact the effectiveness of professional development programs [35], [36]. Although previous studies have emphasized the importance of culturally relevant pedagogies and the integration of local wisdom in contextually specific

education [16], [17], there has been limited focus on how these strategies can be effectively combined with technology to enhance instructional quality. The INSET CULTECH program, utilizing the PRATU model, was specifically designed to address the need for active and collaborative learning among teachers, incorporating both cultural and technological content within a supportive and non-threatening environment. This approach not only filled a gap identified in existing literature but also introduced a new, systematic method for envisioning integrated teacher competencies, namely the Advanced Teacher Competencies Model for 21st-century educational spaces.

The results showed that the INSET CULTECH program indeed was significantly associated with progress in teachers' competencies for integrating culture and technology facets into their teaching practices. The structured program and sequence of PRATU, involving active engagement with the material by teachers led to an increased percentage of educators showing improved skills in culturally responsive teaching as well as technology integration compared to other programs found among studies included [16], [17]. The results from the data showed that teachers who experienced the INSET CULTECH program were considerably skilled in crafting their lessons using contemporary technological tools and local cultural content such as study categories [7], and culturally inclusive pedagogical strategies (CIPS) [13]. Furthermore, the program design allowed for increased active learning and group activities that supported building a conducive environment expressed through changes in competencies among teachers.

The results also showed that the INSET CULTECH program by its design to persuade and engage teachers resulted in an improved efficiency of their administration through feedback mechanisms and collaboration with peers. Regular feedback and reflective discussions with peers about dilemmas experienced during the implementation of innovation in the classroom were perceived by teachers to enhance their confidence as well as enable teachers to operationalize new teaching methods [34], [37]. The study found that teachers who were more actively involved in these forms of collaboration with feedback had greater growth as professionals and were also likely to adopt innovative teaching practices, integrating elements both cultural and technological [38], [39]. This showed that the synergy of active, peer-supported learning and constructive feedback inherent in INSET CULTECH pedagogy was a meaningful way to improve teachers competence and offered one model for more comprehensive professional development across multiple educational paradigms.

The results of the study showed that incorporating cultural and technological aspects in training program such as with INSET CULTECH, could improve teaching efficiencies without affecting core educational content delivery. This result contrasted with previous studies that mentioned the potential overload to teachers when more cultural elements were included in their curriculum [20], [40]. In contrast with these problems, it was found that a strong training system including culturally responsive and technology integration could improve Engagement in learning [16], [17]. These results were consistent with a study that had highlighted the values and benefits of culturally responsive teaching (evidence showing increases in student engagement, and academic achievement) [7], [13].

The results bolstered the contention of Lazorenko and Krasnenko [2], as well as Ningsih and Jha [21] that brief professional development efforts, had little to no impact on long-term teachers growth. While these studies showed that short interventions could not produce any substantial changes, it was found that a program of only 18 actions, as the INSET CULTECH was considered to be regarding scope and duration (James and Brown PT), and could drive high gains with lasting effects. This result aligned well with the study suggesting that professional development models combining active learning and reflection led to more sustained changes in teaching behaviors [35], [41]. INSET CULTECH had multiple components which when combined promote continuous feedback, peer learning, and apply-learn cycles hence nurturing not only contextually grounded but also enduring teaching skills buttressing the need for a multi-level intervention in teachers education.

The report was carried out on a small scale which was only limited to teachers at public elementary schools in Denpasar City. This limitation questioned the degree of generalizability as effectiveness could differ heavily in other regions or even educational settings whose cultural contexts and available technological resources could not be similar [3], [21]. Additionally, natural science subjects were the only target of the

study conducted in this work, and it could into question which other types of discipline applying a similar INSET CULTech model—such as social sciences or language education might also further benefit from both cultural and technological elements integration [6], [8]. Additionally, to understand the generalizability of this program, further implementations over diverse subjects and regions through varied educational settings were also required.

While the 5-day duration of the INSET CULTECH was sufficiently effective in showing immediate enhancements in teachers capacity, building this could appear short-term to determine whether these gains were sustainable over time. By not examining how teachers could have sustained or altered their practice changes in the long term, and this could bear on the degree to which effects of training persist (e.g., [2], [42]). Limitations and future directions were given that this was a pilot study with several limitations (e.g. only two time points were assessed), and could be useful for subsequent reports to use more complete measures of teachers practices to capture the lasting effects on student outcomes over an extended period of implementation. Furthermore, the dissemination of training model via "train-the-trainer" seminars at only 14 schools impeded understanding of its overall scalability and generalizability to other educational contexts. More widespread distribution and diverse implementation approaches like using online modules or regional training hubs could provide further insights into the program's diffusion dynamic as proposed by, for example [20], [39]. However, addressing these limitations could better inform understanding of the INSET CULTECH program and enable improvements to be made for wider use.

The result of our study showed that the integration of regional culture and technology toward teachers preparation using the INSET CULTECH model had a high effect on improving teachers' competencies in delivering local knowledge-rich, culturally responsive instruction with ICT-enhanced content. Future studies must investigate the potential of extending this framework to non-natural sciences disciplines (e.g., social studies, arts, and language education) and explore whether comparable benefits could be derived elsewhere in a similar curriculum domain context by Simamora et al [16]. This could also develop subject-specific modules in the INSET CULTECH program, to make it adaptable/modifiable enough that met the requirements of different disciplines effectively [6], [8]. Such an approach could help yield a more nuanced perspective of what it meant to incorporate cultural content with technology for use in holistic educational practices across the curriculum.

Based on rcommendations, future studies could be carried out using a longitudinal design to assess various students' outcomes and the long-term impact of the INSET CULTECH program on teachers' development. Conducting these longitudinal studies could provide more evidence of the program's effectiveness, particularly in terms of what it teaches, sustains, or changes over time within educational structures [37], [42]. In addition, future studies were expected to evaluate the practicality of implementing the INSET CULTECH program in diverse contexts and locations where access to technology varied or explore scalable strategies that could be adapted to other settings [20][21]. It was also crucial for educators to consider how the program integrated with digital platforms or incorporated learning approaches to enhance accessibility and scalability, ensuring that a broader range of educators could benefit from this innovative training model. Future investigations into these areas had the potential to inform more integrated and efficient professional development program for educators, addressing both current cultural and digital challenges in a timely and relevant manner

Recent studies showed that integrating local culture and technology into pre-service teacher training should be embedded within Maker Heroes' academic activities through the INSET CULTECH program. This integration hd successfully enhanced pre-service teachers' attitudes towards teaching Jingili students, as well as their technological competencies and culturally relevant pedagogical skills. This current study provided direct evidence that such a training model positively impacted the ability to incorporate local cultural elements and contemporary technological tools into teaching, potentially leading to improved students engagement and more relevant learning experiences [16], [17]. The structured PRATU model, along with its emphasis on active learning, facilitated teachers' professional development through peer collaboration, supported by a continuous feedback mechanism. This approach provided a reliable framework for enhancing teachers education systems globally, as reported by [3] and [34]. The findings offered significant evidence that holistic teaching skills could be effectively developed by combining other

professional standards with technology integration, without compromising educational quality or teachers performance. However, addressing the discord between dominant and local cultures was essential for the effective implementation of new pedagogical approaches within professional development program, particularly in culturally diverse regions, such as Bali. While the effects of the program on teachers' competencies were significant, slightly lower estimates were obtained through a 3-year follow-up study or sensitivity analysis. Future studies on these dimensions could provide further insights into the scalability and transferability of the model, ultimately contributing to a more inclusive global teachers training program [37], [42]. In summary, the results revealed the importance of integrating cultural and technological elements into education and supporting the development of a more nuanced model for teachers development that reflected the interdisciplinary nature of 21st-century learners.

Conclusion

In conclusion, the INSET CULTECH program had proven to be a highly effective in-service teachers training model designed to enhance teachers competence in integrating regional culture and technology into learning. Grounded in the principles of Progressivism, Knowles' theory of adult learning, and the theory of in-service training, this program emphasized active learning, problem-solving, and continuous feedback. The structured approach, incorporating a PRATU pattern (presentation, practice, and show), ensured that teachers not only received theoretical knowledge but also engaged in practical applications, leading to substantial improvements in their teaching practices. Experts' evaluations confirmed the high validity of the program, and statistical analyses, such as repeated measure ANOVA, showed significant gains in teachers competence, particularly in integrating cultural elements and mobile technology into basic science learning.

The pedagogical implications of the study implied multiple important insights for educators, curriculum developers, and policymakers to reinforce effective instruction practices that could lead to better educational results. The study began with an emphasis on the necessity of integrating into its curriculum what were called culturally relevant pedagogy strategies. This could integrate local cultural elements to develop learning experiences that were inclusive for all, and lessons could resonate with students and become more relevant and relatable. In culturally diverse populations, this approach could be impactful in the way that it increased student involvement and retention of information. Teachers must be supported to engage local cultural contexts and knowledge as part of teaching practice, provoking a deeper engagement with the learning process including meaningful educational experiences addressing culture. Another conclusion the study reached was that a combination of cultural content and modern technological tools proved to be very beneficial for educational purposes. This approach enabled participants to provide engaging and interactive learning experiences better suited to diverse learners with varying styles and needs. To achieve this, educators must be trained to use technology effectively, integrating it with traditional teaching methodologies in a blended learning environment, where digital tools support student-centered, interactive approaches. Schools and colleges must not only provide the necessary equipment but also introduce professional development opportunities that empower educators to utilize technology more effectively in modern pedagogy. Furthermore, pedagogy that promotes active learning in small groups, with frequent peer feedback, has proven to be substantial. This approach is particularly effective when learners, such as nursing students, engage deeply with the material, reflect on it, and learn collaboratively with others. For learning environments to be truly collaborative, educators need to implement tools that foster a proactive approach to education, encouraging group work, discussions, and hands-on activities in the classroom. Moreover, when activities are designed with the end goals in mind, such as defining quality student interactive behaviors before implementing a math lesson and include opportunities for follow-up (for example, allowing teachers to share successes or discuss challenges), the result is enriched teaching over time. This continuous reflection and adjustment process is key to developing and sustaining effective teaching practices.

The study showed the need for professional development programs that were both culturally and contextually appropriate. Educators require ongoing training that is intrinsic to addressing new educational challenges, rather than viewing it as a one-time event. The evolving approach of program, such as INSET

CULTECH shows the complexity of integrating cultural and technological elements effectively. This complexity partly explains the 40% dropout rate within the first two years. The results also revealed the potential of the INSET CULTECH program to be both tunable and scalable for various educational settings. Curriculum designers and policymakers should consider developing more adaptable training frameworks that can be tailored to the specific needs of different regions, subjects, or school types. This flexibility is expected to allow for broader adoption and inclusion, thereby enhancing the utility of such programs in diverse contexts. By making training systems adaptable and scalable, educators across all contexts could be better supported, leading to more effective and inclusive educational practices. In conclusion, these results suggest that teachers training programs must adopt a more comprehensive vision of professionalism. This vision must combine cultural relevance, technological capabilities, active learning, and continuous professional development to foster well-integrated classroom environments.

Acknowledgements

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