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Primary School Teachers' Transformation: Building a Paradigm of Future Science and Technology

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ABSTRACT

This research aims to assess the proportion of teachers who have undergone a paradigm shift in the fields of science and technology at primary schools in Bogor City. The methodology employed involves hypothesis testing using a one-sample Z proportion technique. The findings reveal that the proportion of teachers who have experienced transformation does not significantly differ from the expected figure of 60%. The observed proportion stands at 0.73, indicating that a majority of teachers have achieved the anticipated transformation. However, the calculated |Z| value of 1.49 is insufficient to reject the null hypothesis (H0). These results suggest a positive trend in transformation, yet highlight the lack of adequate statistical evidence to assert a significant difference from expectations. This research offers insights into the educational conditions in Bogor City's primary schools and their implications for the professional development of teachers in science and technology. The study underscores the critical role of educators in the digital age and emphasizes the urgent need for systemic reforms to address existing educational disparities. It is essential for the government and educational institutions to prioritise professional development programs aimed at enhancing teachers' competencies in science and technology, while ensuring that educational policies reflect the necessity for ongoing training and support in these areas.

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Introduction

In the 21st century, the educational landscape is undergoing significant transformation driven by rapid advancements in digital technology. The emergence of digital learning has revolutionized traditional teaching paradigms, presenting new opportunities to enhance

access, engagement, and effectiveness in education. As we navigate this digital era, it becomes increasingly vital to understand and harness the power of digital learning to address the diverse needs and challenges faced by learners in contemporary society (Redhana, 2024; Kalolo, 2019).

In today's globalized context, science and technology serve as crucial foundations in education. According to Cerqua et al. (2014) and Zapp (2021), students will be better equipped to tackle future challenges when they possess a solid grounding in science and technology. Science and technology play a pivotal role in shaping critical and creative mindsets, which are essential for solving complex problems in everyday life. A study by Zapp (2021) and Wang et al. (2023), indicates that countries integrating science and technology into their educational curricula tend to exhibit higher levels of innovation and improved global competitiveness.

In recent years, the educational realm has witnessed a profound transformation propelled by rapid advancements in digital technology. The advent of digital learning has revolutionized traditional teaching paradigms, offering new opportunities to enhance access, engagement, and effectiveness in education. Digital learning facilitates better interaction between educators and learners through the utilizations of innovative technologies. As we engage in this digital era, it is imperative to comprehend and leverage the power of digital learning, encompassing software development, including desktop and mobile applications, web development, e-commerce, data science and analytics, the Internet of Things (IoT), and Artificial Intelligence (AI) (Anderson & Dron, 2011; Munir et al., 2022). The significance of technology in education has evolved in a rapidly changing digital era. The utilization of web-based applications and learning tools has transformed the manner in which students and teachers interact in contemporary classrooms (Alvauziah et al., 2024).

Constructing a future science paradigm is a complex process that necessitates fundamental changes in thinking and approaches to knowledge. In the context of primary education, this paradigm should not only focus on existing scientific theories but also on practical applications relevant to contemporary developments. According to Cerqua et al. (2014), effective science education must integrate scientific knowledge with practical skills required to address global challenges, such as climate change and the ever-evolving technology landscape.

The importance of the science paradigm in primary education lies in its capacity to cultivate critical and analytical thinking among students. A study by Bybee (2013) and Graesser et al. (2018) illustrates how robust scientific education can empower children to become better problem solvers and decision-makers. Considering the difficulties that future generations will encounter, this becomes increasingly imperative. Furthermore, the science paradigm aids students in recognizing the relevance of science to their own social and cultural backgrounds, thereby enhancing their understanding of the importance of science in everyday life. Additionally, science education plays a crucial role in fostering awareness of the significance of science in daily life. Effective science education must connect scientific concepts with students' everyday experiences (Duit & Treagust, 2003; Bilican et al., 2015).

Teachers are key actors in the transformation of education, including the application of science and technology. The quality of education is significantly influenced by teachers' competence and understanding of the material being taught (Ingersoll, 2001; Nikola, 2021). Scientists and engineers in the classroom can motivate their students to learn more about the world by providing examples of critical thinking and problem-solving skills. Therefore, to cultivate a new generation prepared to tackle future challenges, it is crucial to shift teachers' mindsets towards a science and technology-oriented perspective.

It is essential for educators to play a vital role in shaping students' views on scientific opportunities in the future. In addition to imparting knowledge, teachers also serve as catalysts, motivating and inspiring their students to pursue scientific education. Students are more engaged and enthusiastic about learning science when their instructors possess a strong understanding of the subject and employ creative approaches in the classroom (Koca, 2016; Johnson, 2017). Consequently, modern scientific perspectives must be understood and embraced by educators.

Wyman et al. (2023), found that education is merely one area where technology has triggered disruptive developments on a global scale. Even in classrooms, technology has become an essential component of modern life. We anticipate that children will find learning more engaging and dynamic, and teachers will be able to accomplish more with the assistance of technology. Indeed, e-learning is crucial for facilitating independent study, group work, and dialogue among educators, parents, and students (Nugroho & Wahyono, 2020).

Transforming the education system in Indonesia poses significant challenges due to its vast, dispersed, and complex nature. Considering its uniqueness, Indonesia has wisely chosen to employ technical means to encourage policy implementation. In Bogor City, the obstacles faced in implementing the future scientific paradigm in primary schools are considerable. Many educators remain confined to conventional pedagogical approaches that are less engaging for students. Teachers' proficiency in utilizing, mastering, and advancing learning through information technology needs enhancement. This indicates a pressing need for initiatives to provide the necessary knowledge and skills for educators to adopt the forthcoming scientific paradigm (Dewi & Hilman, 2019). Several studies have found that many state primary school teachers struggle to implement technology in the learning process (Lumban Gaol & Simanjuntak, 2023).

Based on the identification of the transformation of primary school teachers in Bogor City in establishing the future science and technology paradigm, an in-depth analysis of existing studies is required. Thus, this research aims to explore the transformation of future science paradigm implementation among primary school teachers, focusing on the teachers of State Primary School in Bogor. Through a data-driven and analytical approach, this study aims to make a significant contribution to the advancement of science and technology education at the primary school level

Teacher transformation refers to changes in the way of thinking, attitudes, and teaching practices undertaken by teachers to enhance learning effectiveness. The transformation explored from the perceptions of teachers at State Primary School in Bogor City consists of: teachers' understanding of contemporary science and technology concepts, their ability to integrate science and technology into learning, awareness of the importance of science and technology in daily life, and their capacity to develop critical and creative thinking skills. This transformation involves ongoing professional development, where teachers not only update their knowledge but also apply innovative and relevant teaching methods in line with contemporary developments (Fullan, 2013). In the context of science and technology, this transformation also encompasses teachers' ability to integrate technology into the teaching and learning process, enabling students to learn in a more interactive and engaging manner.

How is the implementation of teachers' perceptions of the future science paradigm? The implementation of teachers' perceptions of the future science paradigm can be observed through how they adopt and apply science and technology concepts in their daily teaching. This includes teachers' understanding of the importance of science and technology in the

curriculum, as well as their ability to develop critical and creative thinking skills in students. Research by Hattie (2012) shows that educators with a strong understanding of science and technology can foster a conducive learning environment for discovery and innovation. Therefore, it is essential to analyze teachers' perceptions and how they are applied in educational practices in Bogor City.

The research question of this study, how is the proportion of teachers who experience a transformation in the future science paradigm differs from the expected proportion of 60%. This questions will be tested through data analysis collected from questionnaires distributed to teachers at one of the State Primary School in Bogor City. By employing statistical methods, it is anticipated that the extent of the proportion of teachers who have experienced transformation in their understanding and application of science and technology in their teaching can be determined.

There are two objectives of this research, the first is to identify the extent to which teachers at one of the state primary school in Bogor City have undergone transformation in the context of science and technology. This includes an analysis of changes in understanding, attitudes, and teaching practices applied by teachers. By understanding this level of transformation, it is hoped to provide a clear picture of teachers' readiness to face educational challenges in the digital era. The second objective of this research is to analyze teachers' perceptions of the future science paradigm. By understanding how teachers view the importance of science and technology in education, it is anticipated that factors influencing their attitudes and practices in teaching can be identified. This research also aims to provide recommendations for the development of more effective teacher training programs.

This research is expected to contribute to the development of education at State Primary School in Bogor City specifically, and more broadly for education in Bogor City in enhancing the quality of science and technology teaching in primary schools. By understanding the level of teacher transformation, appropriate strategies can be formulated to enhance teachers' competencies and understanding in this field. The findings of this research are anticipated to provide input for education policymakers in Bogor City. By understanding the barriers and needs of educators in implementing the science and technology paradigm, more focused policies can be developed to advance education in this area. It is crucial to have an education system aligned with contemporary demands and societal needs. Therefore, this research is expected to significantly enhance educational advancement in Bogor City and Indonesia as a whole.

This research presents a unique examination of the transformation of science and technology education among primary school teachers in Bogor City. Unlike previous studies that broadly address the integration of technology in education, this study focuses on quantifying the proportion of teachers who have undergone a paradigm shift in their pedagogical approaches amidst the digital era. The application of the one-sample Z proportion technique to assess the extent and effectiveness of teachers' transformation represents a novel methodological contribution. By identifying specific dimensions of teacher transformation such as their understanding of contemporary science, their ability to integrate technology into learning, and their awareness of its practical relevance this research fills a gap in the literature on local educational practices and offers actionable insights tailored to the Indonesian Education.

The findings of this research carry profound implications for educational policy, teacher training, and curriculum development. The identified gap between the anticipated and observed levels of teacher transformation highlights a pressing need for targeted professional development programs that specifically empower primary school educators in science and

technology. This research underscores the role of teachers as not only knowledge transmitters but as vital catalysts for change who can inspire and engage young learners in the sciences. Educational institutions and policymakers must implement robust training frameworks that enhance teachers' competencies in digital technologies and pedagogical strategies relevant to contemporary scientific challenges. Additionally, by promoting a science paradigm that integrates practical applications with students' cultural and social contexts, this study advocates for educational reforms that foster critical thinking, creativity, and problem-solving skills among students, preparing them to thrive in an increasingly complex and technologically driven world. Ultimately, the research calls for an educational response that bridges existing disparities and prepares both educators and students for the demands of the future.

Method

This research employs a descriptive quantitative methodology, as outlined by Sugiyono (2020), where descriptive quantitative research evaluates data by articulating the information collected through significant numerical representation. This research seeks to describe and evaluate data collected from questionnaires. This technique is chosen because it can provide a comprehensive understanding of educators' beliefs and practices regarding science and technology. The results of this research are expected to provide objective and reliable information through statistical analysis.

The subjects of this research are all primary school teachers in one of The State Primary School in Bogor City, with diverse educational backgrounds and teaching experiences. This research employs saturated sampling, where all individuals from the population are included as samples. By using this technique, it is hoped that relevant respondents can be obtained, providing accurate information regarding the transformation of the future science paradigm.

The instrument used for data collection is a questionnaire specifically designed to measure teachers' perceptions and practices related to science and technology. This questionnaire consists of several sections, including questions about an in-depth understanding of contemporary science and technology concepts, the ability to integrate technology into learning, skills in research and development, awareness of the importance of science and technology in daily life, and the ability to develop critical and creative thinking skills. The response options for this questionnaire consist of five levels, namely: 1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree, and 5. Strongly Agree. The use of a 1-5 Likert scale allows researchers to measure the level of agreement or disagreement of respondents with the provided statements.

Data collection is conducted through a questionnaire that has clear and measurable items, containing indicators that represent the transformation of building the future science and technology paradigm, which consists of five indicators: teachers' understanding of contemporary science and technology concepts, the ability to integrate science and technology into learning, awareness of the importance of science and technology in daily life, and the ability to develop critical and creative thinking skills.

The questionnaire will be distributed directly to respondents, initially distributing it to 20 teachers at state primary schools in Bogor for instrument testing to obtain the validity and reliability of the questionnaire. Subsequently, the validated and reliable questionnaire will be directly distributed to teachers in the research population. This data collection process will be conducted with due regard to research ethics, including obtaining consent from respondents to participate in the study. After the data collection through the questionnaire is

completed, the data will be analyzed to obtain relevant results. Before further analysis, the questionnaire will undergo validity and reliability testing to ensure that the instrument accurately measures the target construct. Validity assessment will be conducted through Pearson Product Moment correlation analysis, while reliability assessment will be performed by calculating Cronbach's Alpha coefficient. Testing will be conducted using SPSS.

The obtained data will be analyzed using descriptive statistics to provide an overview of the characteristics of respondents and the results of the questionnaire. This analysis will include calculating the mean, frequency, and percentage of each item in the questionnaire. Hypothesis testing will be conducted to determine whether there is a difference between the proportion of teachers at Population who experience a transformation in the future science paradigm and the expected proportion of 60%. This test will be conducted using a one-sample Z proportion test. The one-sample Z proportion test is used to test hypotheses regarding population proportions based on data from a single sample. The following are the steps for hypothesis testing: Formulating the hypothesis: Null hypothesis (H0): The proportion of teachers who experience a transformation in the future science paradigm is equal to 60% ($p0 = 0.6$), alternative hypothesis (H1): The proportion of teachers who experience a transformation in the future science paradigm differs from 60% ($p0 \neq 0.6$).

The next steps, calculate the sample proportion. From the population and sample, we know that n = 30. The number of teachers who experience transformation observed from (x) = 22 and those who do not experience it = 8. Determine the expected proportion, according to the hypothesis, which is 60% (0.6) calculate by the Z value formula After that, determine the critical value or P-Value. After obtaining the Z value, compare it with the critical Z value at a significance level of $\alpha = 0.05$, where for $\alpha = 0.05$ for a two-tailed test, the critical Z value is 1.96. The decision-making criteria are: if $|Z| > 1.96$, then reject the null hypothesis. This means there is sufficient evidence to state that the proportion of teachers experiencing transformation significantly differs from the expected proportion. Conversely, if $|Z| \leq 1.96$, fail to reject the null hypothesis. This means there is not enough evidence to claim that the observed proportion significantly differs from the expected proportion.

Results and Discussion

From the validity test results, the initial research instrument included 38 statements, consisting of 9 statements representing the indicator of in-depth and contemporary science and technology concepts, 7 statements representing the integration of technology in learning, 6 statements representing skills in research and development, 6 statements representing awareness of the importance of science and technology in daily life, and 10 statements representing the ability to develop critical and creative thinking skills. A total of 34 statements were found to be valid, while 4 statements, including statements 1, 2, 4, and 14, were deemed invalid (dropped) and removed from the instrument. Subsequently, the 34 valid items underwent reliability testing using SPSS software, yielding a Cronbach’s Alpha value of 0.823.

A Cronbach's Alpha value of 0.823 indicates that the tested instrument has strong reliability. A value above 0.8 signifies exceptional internal consistency (George & Mallery, 2019). In other words, the items within the instrument correlate well, indicating that they consistently measure the same construct. Based on this analysis, it can be concluded that the instrument used for data collection possesses good reliability, making it dependable for further research.

The respondent data in this research consists of 34 teachers, with a gender proportion of 75.9% female and 24.1% male. The average teaching experience of the respondents is 11.5 years, with the majority holding a Bachelor's degree at 82.8% and a Master's degree at 17.2%.

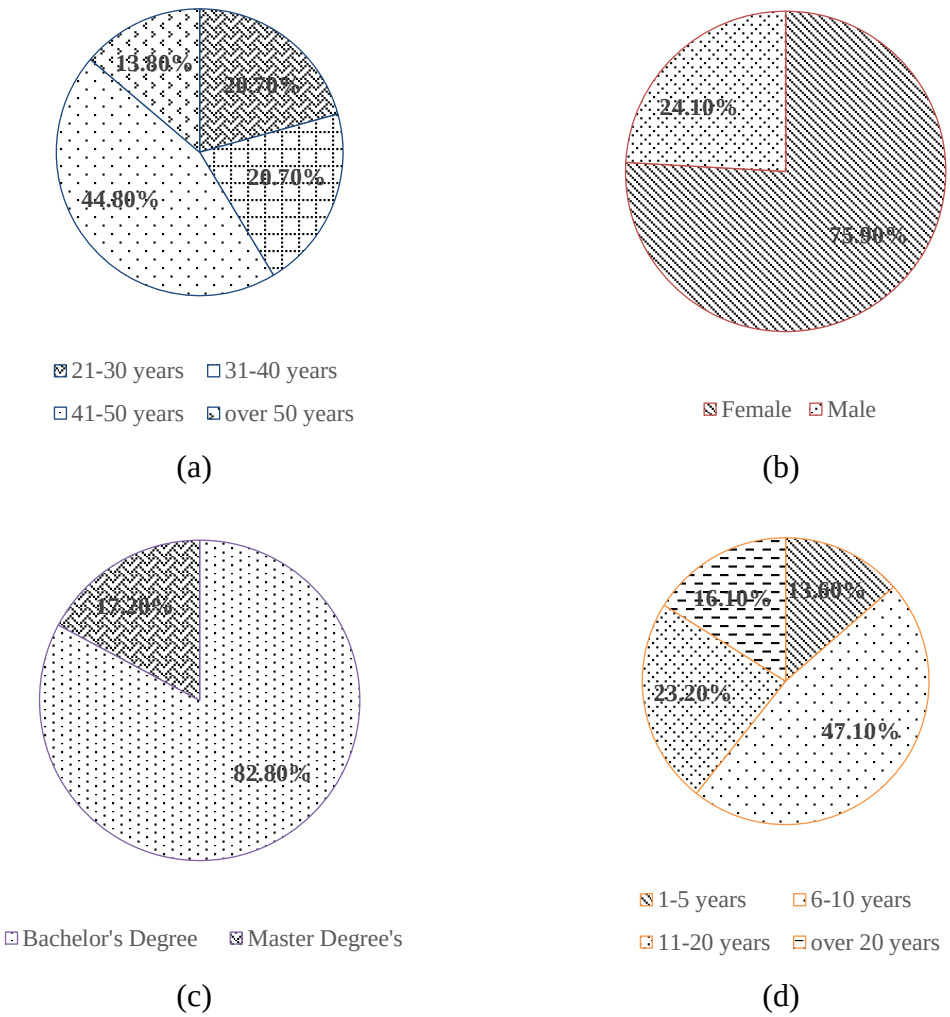

Figure 1. Description of Data Respondent
(a) Ages, (b) Gender, (c) Education Level, (d) Work Experience

Subsequently, descriptive statistical analysis was conducted. Descriptive statistical analysis is a fundamental step in research aimed at providing an overview of the characteristics of the collected data. In the context of this study, analysis was performed on five indicators related to teachers' abilities to respond to and apply science and technology in the learning process. The indicators analyzed include: 1) Understanding of In-Depth and Contemporary Science and Technology Concepts, 2) Ability to Integrate Technology into Learning, 3) Skills in Research and Development, 4) Awareness of the Importance of Science and Technology in Daily Life, and 5) Ability to Develop Critical and Creative Thinking Skills. The purpose of this descriptive statistical analysis is to summaries and describe the data obtained from respondents to facilitate understanding related to teachers' abilities and awareness in the context of science and technology. Through this analysis, the

results obtained will not only indicate the level of teacher competency in each indicator but also provide insights into the variation and consistency in respondents' answers. Thus, descriptive statistical analysis serves as an essential tool in assessing the current state of teacher competency, which in turn can serve as a foundation for recommendations and more effective intervention planning in professional development for teachers. The results of the analysis are presented in Table 1.

Table 1. Descriptive Statistics of Research Data

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Indicator_1	30	20	28	24.33	2.412	5.816
Indicator_2	30	20	29	24.47	2.488	6.189
Indicator_3	30	14	27	20.43	3.014	9.082
Indicator_4	30	19	28	23.30	2.575	6.631
Indicator_5	30	33	46	39.97	3.728	13.895
Valid N (listwise)	30					

From Table 1, the SPSS descriptive statistical output can be interpreted as follows: For Indicator 1 (understanding of in-depth and contemporary science and technology concepts), the minimum score is 20, the maximum is 28, and the mean (average) is 24.33. The average score obtained indicates that, in general, teachers possess a good understanding of science and technology concepts, although not reaching the maximum score. Standard Deviation: 2.412. The relatively small standard deviation suggests that teachers' understanding scores tend to cluster around the mean, indicating consistency among respondents. Variance: 5.816. The small variance indicates minimal fluctuation in understanding concepts among teachers.

For Indicator 2, (ability to integrate technology into learning), the minimum score is 20, the maximum is 29, and the mean is 24.47, which is slightly higher than the first indicator, indicating that teachers feel more competent in integrating technology into the learning process. The average understanding of science and technology concepts and the ability to integrate technology into learning are at commendable levels (around 24-25), indicating adequate understanding. The variance is slightly higher than the first indicator, indicating variation in results, but still within reasonable limits. Teacher technology skills could improve teaching learning activity and foster students' higher order thinking skills (Apriyanti et al., 2014; Ghavifekr et al., 2014). It is essential for educators to enhance their technological skills beyond those of their student's, as leveraging technology is crucial for improving educational quality in today's digital landscape (Sadriani et al., 2023). Thus, this skills intercorrelated with indicator 5 which teacher have ability to develop critical and creative thinking skills. But it has to be concerned is disconnect between rapid technological advancements and teachers' ability to adapt, resulting in a significant gap between educators and learners; students quickly embrace digital platforms, while many educators cling to outdated, traditional methods (Latif, 2020).

For Indicator 3, (skills in research and development), the minimum score is 14, the maximum is 27, and the mean is 20.43, indicating that the average skills of teachers in research and development are below the previous two indicators and may represent a weaker area in teacher competency. However, the skills in research and development received a lower score of 20.43, indicating that this area requires attention in professional development program for teachers. Teacher-researchers have deficiencies in selecting appropriate tools for data analysis and interpretation, encoding both quantitative and qualitative data, and deriving insights from software-generated outcomes. They exhibited diminished proficiency

in disseminating their finalised action research (Oestar & Marzo, 2022; Tatto, 2023). The lower this skills on the teacher, the lower research skills in the students (Bapanova, 2023).

For Indicator 4, (awareness of the importance of science and technology in daily life), the minimum score is 19, the maximum is 28, and the mean is 23.30, indicating that, on average, teachers have a good awareness of the importance of science and technology, although not as strong as the average ability to integrate technology into learning. For Indicator 5, (ability to develop critical and creative thinking skills), the minimum score is 33, the maximum is 46, and the mean is 39.97, indicating a significantly higher average compared to the previous four indicators, showing that teachers possess very good abilities in developing critical and creative thinking skills. These findings align with the research that describe which asserts that the development of skills such as creativity, collaboration, and communication is increasingly important in the primary education curriculum (Raj et al., 2022; Hojjati et al., 2021). The skills in critical and creative thinking, recorded the highest average (39.97), indicating that teachers are quite capable of developing these skills in their teaching. These findings are particularly important as critical and creative thinking skills are key to preparing students to face the increasingly complex challenges of the world.

While, the average teaching experience of 11.5 years indicates that respondents are sufficiently experienced, which can positively impact their understanding and pedagogical implementation in science and technology education. The majority of respondents hold a Bachelor's degree, with a smaller percentage holding a Master's degree, signaling the need for further training for those wishing to enhance their professional competencies. This results in a line with the study that shows the teaching experience of teacher could influence teaching and learning results because it is related to teacher knowledge and it is also influence to teaching effectiveness, but significant results regarding educational background have not yet been seen (Donkoh, 2017; Kini & Podolsky, 2016). It is needed training program which could improve the teacher competencies. The effectiveness of training program, which are relevant to the training needs of teachers seeking to improve their competencies (Gümüs, 2022; Dange & Siddaraju, 2020).

The descriptive analysis of respondent data, comprising 34 teachers pays special attention to gender, teaching experience, and their educational backgrounds. The dominant proportion is female (75.9%); thus, it is important to consider the potential differences in approaches between male and female teachers in teaching science and technology. Based on the descriptive analysis, it can be described that teachers' abilities to integrate technology and their understanding of science and technology concepts are quite good, with averages approaching the highest levels in each indicator. Skills in research and development represent a weak point, while the ability to develop critical and creative thinking skills demonstrates high potential. The variation in skills and understanding indicates that there is room for improvement, particularly in providing training and professional development to enhance the weaker aspects. These results are crucial for guiding teacher development programs to focus more on areas that require attention and improvement. This assessment provides a clear picture of the state of teacher competency and can serve as a basis for planning interventions to improve the quality of education.

Hypothesis testing uses a one-sample Z proportion test, conducted to test the null hypothesis and alternative hypothesis previously formulated, namely: H0: The proportion of teachers who experience a transformation in the future science paradigm is equal to the expected proportion of 60%, and H1: The proportion of teachers who experience a transformation in the future science paradigm differs from the expected proportion of 60%.

Thus, the expected proportion is 60% (0.6). From the observational data obtained from the questionnaire instrument, the observed proportion is 0.73.

Table 2. Observed Proportion Experiencing Transformation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	8	26.7	26.7	26.7
	1	22	73.3	73.3	100.0
	Total	30	100.0	100.0	

The observed proportion (p) is calculated as follows: p = 0.73, expected proportion (p0) = 0.6, sample size (n) = 30. Based on the analysis conducted for the Z proportion test, a value of |Z| equal to 1.49 was obtained. By setting a significance level of Î± = 0.05, the critical Z value used is 1.96. According to the decision-making criteria, if |Z| is greater than 1.96, then the null hypothesis (H0) will be rejected, indicating sufficient evidence to state that the proportion of teachers experiencing transformation significantly differs from the expected proportion. Conversely, if |Z| is less than or equal to 1.96, the null hypothesis cannot be rejected, meaning there is not enough evidence to indicate a significant difference in the observed proportion.

In this case, since the obtained |Z| value (1.49) is smaller than the critical Z value (1.96), the decision made is to not reject the null hypothesis (H0). Thus, it can be concluded that there is not enough evidence to indicate that the proportion of teachers who experience a transformation in the future science paradigm differs from 60%. This indicates that the proportion of teachers experiencing this transformation is not significantly different from the expected proportion. The results of the validity test yielded 34 valid statements from the initial 38 statements, indicating that the instrument used in this research is adequate for measuring the intended construct. The removal of 4 invalid items (statements 1, 2, 4, and 14) is a crucial step to ensure that the instrument reflects relevant aspects. The good validity level serves as an important asset for more accurate research results (Ary et al., 2018). s

The obtained Cronbach's Alpha value of 0.823 indicates that the research instrument has excellent reliability. A value above 0.8 suggests that the items within the instrument correlate well and consistently measure the same construct. This indicates that this instrument can be relied upon for use in further research, fostering confidence that the data collected from respondents will accurately depict teachers' competencies in the context of integrating science and technology into education. The results from Cohen et al. (2017) assert that validity and reliability are keys to obtaining accurate research results. Furthermore, Morrison et al. (2013) explain how the integration of technology in education requires valid instruments as a means to assess educators' understanding and competencies.

The hypothesis testing results using the one-sample Z proportion test indicate that the proportion of teachers experiencing a transformation in the future science paradigm does not significantly differ from the expected proportion (60%). The observed proportion of 0.73 indicates that the majority of teachers experience the desired transformation; however, when tested using the Z test, the obtained |Z| value (1.49) is insufficient to reject the null hypothesis (H0). This suggests that, despite a positive trend, there is not enough statistical evidence to assert that the proportion significantly differs from the expected value.

Conclusion

This research provides valuable insights into teachers' competencies in integrating science and technology into education. While the findings indicate that most teachers have adopted some degree of transformation in their pedagogical approaches, attention must still

be focused on the existing weaknesses in research and development competencies. Therefore, educational institutions must design targeted and effective professional development programs to address these challenges and prepare teachers to meet current educational objectives, empowering them as key stakeholders in the learning process within the digital era. These results reveal challenges in transforming the science and technology paradigm in education. It may be necessary to conduct further interventions to support and enhance the expected paradigm shifts among teachers. Increased participation in training, workshops, and mentoring may improve understanding and implementation of science and technology in the classroom

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