

Enhancing Teacher Innovation through Digital Literacy, 21st-Century Learning, and Visionary Leadership

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Abstract

This study investigates the relationship between digital literacy, 21st-century learning, and visionary leadership with teacher innovation, aiming to identify strategies to enhance innovation and achieve educational goals. Using a correlational survey method, the study involved 122 permanent foundation teachers (GTY) from private junior high schools in North Bogor District, selected from a population of 171 through simple random sampling and Taro Yamane's formula. Statistical analyses, including regression, correlation, and determination tests, revealed positive relationships between each independent variable and teacher innovation, both individually and in combination: digital literacy ($ry = 0.591$), 21st-century learning ($ry = 0.582$), visionary leadership ($ry = 0.552$), digital literacy and 21st-century learning ($ry = 0.622$), digital literacy and visionary leadership ($ry = 0.597$), 21st-century learning and visionary leadership ($ry = 0.606$), and all three variables together ($ry = 0.625$). The findings indicate that enhancing digital literacy, fostering 21st-century learning, and promoting visionary leadership are key strategies for increasing teacher innovation.

Keywords

Digital Literacy, 21st-Century Learning, Visionary Leadership, Teacher Innovation.

1. Introduction

Education has undergone rapid and dynamic development, reflected in various innovations in teaching methods and a growing curriculum. Education can be interpreted as the process, method, and act of educating that helps individual development. In its implementation, education plays an important role in social change that leads to progress, increasing the ability to analyze to be more critical and innovative. Education is an important factor in the progress of a country. Quality education produces human resources who have the knowledge, skills and attitudes required by the times. To realize quality education, schools with qualified teachers and educators are needed. As an educational institution, schools play an important role in shaping and developing students' potential. At the junior high school (SMP) level, students are in a transition period that requires the support of educators. Educators need to understand the physical, emotional, and social changes that students experience, and provide appropriate guidance. An interesting learning process can increase students' motivation to learn, so innovative and creative teachers are needed.

Innovation is an important thing that educators must have to improve the quality of learning. In practice, teacher innovation can be described in four main aspects: creating new ideas, improving or updating ideas, developing new learning methods, and applying new methods. However, educators' innovativeness still faces various challenges, such as the lack of education quality and irrelevance to labor market needs. Educators need to master specific skills, such as critical thinking, problem-solving skills, communication skills and collaboration skills to support the learning process. One of the factors determining the success of education is educators. Educators are the spearhead of educational success. In 2007, the government issued Permendiknas number 16 which states that educators must have

four competencies: pedagogic, personality, professional and social. An indicator of the quality of educators is their ability to innovate in learning. Educators must create a conducive learning atmosphere so that students can learn actively and meaningfully.

Quality learning can be realized by applying various innovative strategies, models, and methods. Teacher innovation is an effort to develop and implement new ideas in the learning process. Innovation must consider various aspects including the curriculum, student characteristics and the environment. Each school has different challenges in implementing innovations, depending on the condition of the students and the resources they have. Hence, the current teaching and learning process focuses on student activeness. Good communication between teachers and students can improve the effectiveness of learning, especially in the increasingly advanced digital era. The digital era brings significant changes in education, requiring students to have critical thinking and problem-solving skills. Teachers need to improve digital literacy to find relevant and accurate information.

Twenty-first century learning prepares students for success in the digital era, demanding changes not only to the curriculum and social, but also to the teachers themselves. The success of teachers in implementing the learning process is supported by school leaders. Principals have varied leadership styles, which can affect teacher performance. A visionary leadership style can increase teacher motivation, leading to better education quality. A survey conducted among teachers in private junior high schools in North Bogor sub-district showed that 48% of teachers were not fully optimized in creating new ideas, 47% in improving ideas, and 53% experienced obstacles in developing learning methods. These problems indicate that teacher innovation still needs to be improved, influenced by digital literacy, the implementation of 21st century learning, and the principal's visionary leadership style.

1.1 Objectives

The objective of this study is to examine the relationship between digital literacy, 21st-century learning, and visionary leadership with teacher innovation, particularly at the junior high school (SMP) level. This research aims to identify the factors that influence teacher innovation, focusing on how digital literacy enhances the ability to access and use information effectively, how 21st-century learning prepares students with critical skills like communication and problem-solving, and how visionary leadership from school principals can motivate and empower teachers. The study addresses the challenge that many teachers still face in developing innovative teaching methods, despite the increasing demand for quality and relevant education. Through a correlational survey approach involving teachers in North Bogor, the study seeks to highlight how strengthening digital literacy, applying 21st-century pedagogical approaches, and fostering visionary school leadership can significantly support and improve teacher innovations.

2. Literature Review

Innovation

Innovation plays a pivotal role in the field of education, enabling continuous adaptation to societal changes and the evolving demands of the times. According to Thompson et al. (2018), innovation is defined as "the process of creating and implementing new ideas, methods, or tools that result in significant improvements in educational outcomes." Similarly, Ansori and Sari (2020) describe educational innovation as a deliberate effort to introduce new and distinct changes aimed at enhancing capabilities to achieve specific goals effectively. In line with this, Chen and Wong (2019) emphasize that teacher innovation is not solely about generating new concepts, but about making meaningful improvements that enrich students' learning experiences.

At its core, educational innovation involves efforts to enhance various aspects of teaching and learning through intentional change. Agusta et al. (2021) describe innovation as an idea, practice, or object perceived as new by an individual or group. It often entails the renewal or reformation of educational practices in response to prevailing challenges. Khayati and Sarjana (2015) further assert that innovation embodies the values and norms within an organization that promotes creativity as a driver of excellence. Without an innovation-oriented culture, individual behavior is unlikely to result in the development of superior, innovative products.

Teacher innovation specifically refers to the activities undertaken by educators to create novel ideas and apply them through new processes and systems that yield practical benefits. Akbar (2021) outlines the primary targets of educational innovation as students, teachers, curricula, infrastructure, and the broader community. Through such innovations, educational problems are addressed by introducing meaningful and effective changes.

Martinez and Garcia (2021) identify four interrelated dimensions of teacher innovation: generating new teaching ideas, refining or updating existing practices, developing new instructional methods, and applying them in classroom settings. This aligns with the framework proposed by Sholihah et al. (2021), who highlight three key innovation factors: (a) Product; developing new ideas, (b) Process; implementing new methods, and (c) Service; establishing new systems and standards. Ultimately, teacher innovation encompasses the adoption of new knowledge, the creation of novel ideas or products, and their implementation to enhance the quality of educational activities.

Digital Literacy

The current advancement of technology signifies a substantial transformation, shifting lifestyles from conventional patterns to a digitally driven era. According to Silva et al. (2023), digital transformation fundamentally alters how individuals interact with information, thereby creating a demand for new competencies in accessing, evaluating, and utilizing digital content. Turner and Johnson (2021) define digital literacy as “a set of skills that enables individuals to effectively and ethically access, comprehend, analyze, and create digital content.” Sholihah et al. (2021), citing Eisenberg, highlight that literacy comprises a set of skills and knowledge not only for locating, evaluating, and using necessary information but also for filtering out irrelevant content. In agreement, Park and Lee (2022) emphasize that digital literacy involves the critical ability to discern irrelevant data and identify credible sources.

Wilson et al. (2020) argue that digital literacy extends beyond technical proficiency with digital devices; it encompasses a deeper understanding of how technology can support learning and knowledge development. Rohmah (2019) defines digital literacy as the capacity to use information and communication technologies for reading, understanding, writing, and generating new knowledge. Supporting this view, Nakamura and Chen (2022) found that teachers' digital literacy directly impacts their ability to integrate technology effectively into the learning process. Lestariani (2023) outlines digital literacy as comprising the ability to set information-seeking goals, access relevant materials, evaluate the quality and reliability of sources, organize diverse information, apply comprehension to solve problems or answer questions, and create digital content.

Zhang and Liu (2023) identify four essential components of digital literacy for educators: (1) the ability to identify digital information needs; (2) the skills to search for and access digital information; (3) the capacity to evaluate the credibility of digital sources, and; (4) the competence to apply digital information in educational contexts. These components align with Lestariani's (2023) framework, which emphasizes the importance of purposeful information retrieval, source evaluation, and the organization of information for meaningful learning outcomes.

Twenty-first-century learning

Twenty-first-century learning is not merely a conceptual framework, but a transformative approach to education that equips students to navigate the challenges and opportunities of globalization and rapid technological advancement. Trilling and Fadel (2009) assert that 21st-century learning represents a paradigm shift from traditional models toward empowering learners with essential skills for the digital age. Similarly, Rahayu et al. (2022) emphasize that 21st-century learning is a consequence of the continual evolution of society, requiring adaptive changes in educational practices. Van Laar et al. (2017) identify seven core digital competencies necessary for success in the 21st century: technical skills, information management, communication, collaboration, creativity, critical thinking, and problem-solving. These skills reflect the demand for adaptable and digitally literate individuals capable of functioning in dynamic learning and working environments.

As Rahayu et al. (2022) highlight, 21st-century learning demands that teachers adopt creative and innovative pedagogical models that facilitate knowledge construction among students. Educators must implement interactive and engaging strategies that promote active student participation in the learning process. Rotherham and Willingham (2010) argue that the success of 21st-century education depends on three key elements: a balanced curriculum, effective professional instruction, and meaningful assessment. They stress that without the integration of these components, educational reforms are unlikely to achieve the desired outcomes. Baroya (2018) underscores that the 21st-century learning paradigm focuses on students' ability to think critically, contextualize academic content to the real-world settings, utilize information and communication technologies, and collaborate effectively. To prepare students with 21st-century competencies, teachers must be adequately equipped to plan, implement, and evaluate instructional processes.

The Partnership for 21st Century Skills (as cited in Baroya, 2018) outlines core competencies for 21st-century learners, including critical thinking, problem-solving, communication, and collaboration. Additionally, UNESCO (as cited in Junedi et al., 2020, p. 64) has established four foundational pillars of education for the 21st century: (1) learning to know which means acquiring knowledge and understanding, (2) learning to do which refers to applying knowledge in practice, (3) learning to be which relates to developing personal autonomy and identity, and (4) learning to live together that means cultivating social and intercultural understanding. These pillars form the basis of the skills and dispositions essential for navigating the complexities of modern life.

Visionary Leadership

Leadership plays a pivotal role in the success of any organization. An effective leader is not only responsible for decision-making and task coordination but must also possess the ability to motivate teams, inspire innovation, and nurture the potential of organizational members. Taylor et al. (2014) assert that visionary leadership is essential for organizational transformation in an era marked by uncertainty, where leaders are expected to create and communicate a compelling and realistic vision for the future.

Gusli et al. (2021) emphasize that leadership is closely tied to the achievement of organizational goals, including within educational institutions. Leadership significantly shapes, influences, and often determines the trajectory of an organization in reaching its objectives. Westley and Mintzberg (1989) identify three core characteristics of effective visionary leaders: the ability to envision, communicate, and empower. Leadership, therefore, extends beyond a formal role—it serves as the principal driver of organizational culture and direction.

Mukti (2018) argues that visionary leadership is the most desirable leadership style in the context of educational productivity. It is characterized by a forward-thinking focus, positioning leaders as agents of change who are capable of setting strategic priorities, guiding professional development, and fostering a culture of excellence. Visionary leadership is defined as a leader's ability to create, formulate, communicate, socialize, transform, and implement idealistic ideas—either originating from the leader or developed collaboratively with organizational members and stakeholders—as collective aspirations for the future, achieved through a shared commitment (Mukti, 2018).

Similarly, Gusli et al. (2021) describe visionary leadership as a model that gives meaning to collective efforts by providing direction and a sense of purpose grounded in a clearly articulated vision. Fransiska et al. (2020) reinforce this view by stating that visionary leadership requires leaders to take a more proactive role in defining future directions through clear visioning and strategic planning.

According to Mutohar (as cited in Fransiska et al., 2020), visionary leadership refers to the school leader's ability to anticipate various factors, including internal strengths, external opportunities, potential challenges, and emerging threats, in order to advance educational institutions. It also involves influencing others through individual and group interactions, fostering collaboration to achieve predetermined organizational goals effectively and efficiently. Ma'sum (2019) concurs with this perspective, emphasizing that visionary leadership entails the capacity to generate, articulate, communicate, and implement ideal thoughts that arise from either personal insight or collective interaction. These ideals represent the organization's aspirations for the future and require full commitment from all members to be realized.

3. Methods

Research Method and Design

This study employs a survey method with a correlational technique, which falls under the category of quantitative descriptive research. The research is designed to determine whether a relationship exists between variables, the strength of that relationship, and its direction (positive or negative). A survey approach was adopted to capture the distribution of respondents' answers to statements related to each variable, which were then analyzed using correlation coefficients. The survey method enables researchers to investigate both large and small populations by selecting and analyzing a sample to identify the incidence, distribution, and interrelationship of variables. This study examines four variables, consisting of three independent variables: digital literacy (X_1), 21st-century learning (X_2), and visionary leadership (X_3), and one dependent variable, namely innovation (Y). The three independent variables (X_1, X_2, X_3) are

analyzed in relation to the dependent variable (Y). The quantitative research design utilizing correlational analysis techniques was developed based on the research constellation diagram presented below in Figure 1.

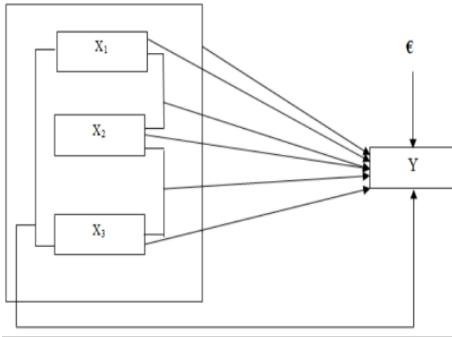


Figure 1. Constellation of the relationship between independent variables (X_1, X_2, X_3) and dependent variable (Y)

Notes:

- a. Variable X_1 : Digital Literacy
- b. Variable X_2 : 21st Century Learning
- c. Variable X_3 : Visionary Leadership
- d. Variable Y : Teacher Innovation
- e. ϵ : Other variables that influence Y but are not studied

Population and Sample

The population of this study consists of 171 teachers with GTY (Permanent Private Teacher) status employed at private junior high schools in the Bogor Utara District. The sample, representing the population, was selected using proportional random sampling, a technique that ensures each subgroup within the population is proportionally represented. The sample size was determined using the Taro Yamane formula, resulting in a final sample of 122 GTY-status teachers.

4. Data Collection

Data for this correlational study were collected using a questionnaire (instrument) designed to obtain direct responses from all participants selected as the research sample. This quantitative study, employing a correlational approach, utilized four instruments to measure the relationships between digital literacy, 21st-century learning, and visionary leadership with innovation among permanent foundation teachers (GTY) at private junior high schools in Bogor Utara District. The questionnaire was administered to the respondents, who also served as the units of analysis, to gather information on their perceptions and experiences related to the variables of digital literacy, 21st-century learning, visionary leadership, and innovation.

5. Results and Discussion

5.1 Descriptive Statistics

Data refer to sets of numbers or symbols collected through research activities. To ensure meaningful analysis, the data obtained must be accurate, meeting the criteria of validity, reliability, and objectivity. The descriptive analysis in this study is based on scores derived from questionnaires measuring teacher innovation (Y), digital literacy (X_1), 21st-century learning (X_2), and visionary leadership (X_3). Data were gathered through the active participation of 122 respondents, all of whom served as the research participants. The data analysis process involves several statistical procedures, including the calculation of the mean, median, mode, standard deviation, variance, maximum and minimum values, range, sample variance, sum, as well as the number and width of class intervals, accompanied by histogram graphs for each of the four research variables.

Teacher Innovation (Y)

Based on respondents' answers, the minimum score for the teacher innovation variable was 82, and the maximum score was 169, resulting in a range of 87. The mean (empirical average) score was 131.090, with a mode of 127. The sample variance (S) was calculated at 299.554, and the standard deviation was 17.307. The data were distributed across 8 class intervals, each with a class width of 11.

Digital Literacy (X₁)

Respondents' scores for digital literacy ranged from a minimum of 83 to a maximum of 175, yielding a range of 92. The mean score was 133.016, with the most frequently occurring score (mode) being 126. The sample variance was 303.305, and the standard deviation was 17.415. The data were grouped into 8 class intervals, each with a width of 12.

21st-Century Learning (X₂)

The lowest score for 21st-century learning was 92, while the highest was 171, giving a range of 79. The mean score was 130.262, and the mode was 105. The sample variance was 306.790, and the standard deviation was 17.515. The data distribution was divided into 8 intervals, each with a class width of 10.

Visionary Leadership (X₃)

Scores for the visionary leadership variable ranged from a minimum of 106 to a maximum of 185, with a range of 72. The mean score was 141.205, and the mode was 136. The sample variance was 315.123, and the standard deviation was 17.751. The data were organized into 8 class intervals, each with a width of 10 (Table 1).

Table 1. Constellation of the relationship between independent variables (X₁, X₂, X₃) and dependent variable (Y)

No.	Variable	Min	Max	Range	Mean	Mode
1	Teacher Innovation (Y)	82	169	87	131.090	127
2	Digital Literacy (X ₁)	83	175	92	133.016	126
3	21 st -century Learning (X ₂)	92	171	79	130.262	105
4	Visionary Leadership (X ₃)	106	185	72	141.205	136

5.2 Normality Test Analysis Using the Lilliefors Test

The normality of residuals was tested using the Lilliefors test for each independent variable in relation to the dependent variable, teacher innovation (Y).

For the residuals of teacher innovation (Y) over digital literacy (X₁), the test yielded a calculated L-value (L_{calculated}) of 0.04489, while the critical L-value (L_{table}) was 0.08021. Since L_{calculated} < L_{table}, the residuals (Y - \hat{Y}_1) are considered to follow a normal distribution, thus satisfying the normality assumption.

For the residuals of teacher innovation (Y) over 21st-century learning (X₂), the L_{calculated} value was 0.04109, with the same L_{table} value of 0.08021. As L_{calculated} < L_{table}, the residuals (Y - \hat{Y}_2) are also considered normally distributed.

For the residuals of teacher innovation (Y) over visionary leadership (X₃), the Lilliefors test produced L_{calculated} = 0.05197, which again is lower than L_{table} = 0.08021. This result confirms that the residuals (Y - \hat{Y}_3) originate from a normally distributed population.

In conclusion, the normality assumption is met for all three independent variables, as all L_{calculated} values are below their corresponding L_{table} thresholds, indicating that the data are suitable for further parametric statistical analysis (Table 2).

Table 2. Results of the normality test (Lilliefors test) for Digital Literacy (X₁), 21st-Century Learning (X₂), and Visionary Leadership (X₃) with Teacher Innovation (Y)

No	Description (error)	Lomaks	L _{table} ($\alpha=0,05$)	L _{table} ($\alpha=0,01$)	Conclusion
1	Normality test of Error Y - \hat{Y}_1	0.04489	0.08021	0.09334	Normal
2	Normality test of Error Y - \hat{Y}_2	0.04109	0.08021	0.09334	Normal
3	Normality test of Error Y - \hat{Y}_3	0.05197	0.08021	0.09334	Normal
The assumption of normality is met when the calculated L _{calculated} < L _{table}					

5.3 Homogeneity Test Using Bartlett's Test

The homogeneity of variance was assessed using Bartlett's test for each grouping of the dependent variable, Teacher Innovation (Y), based on each independent variable.

For Digital Literacy (X₁), the test produced a $\chi^2_{\text{calculated}}$ value of 6.524, which is less than the χ^2_{table} value of 90.531. Since $\chi^2_{\text{calculated}} < \chi^2_{\text{table}}$, the data are considered homogeneous.

For 21st-Century Learning (X₂), the $\chi^2_{\text{calculated}}$ value was 5.296, again lower than the χ^2_{table} of 90.531, indicating homogeneity.

For Visionary Leadership (X₃), the Bartlett's test result was $\chi^2_{\text{calculated}} = 5.991$, which also falls below $\chi^2_{\text{table}} = 90.531$, supporting the conclusion that the data are homogeneous.

Conclusion: All three groupings meet the assumption of homogeneity, as each $\chi^2_{\text{calculated}}$ value is less than the χ^2_{table} threshold. This satisfies the requirement for further parametric analysis (Table 3).

Table 3. Results of the homogeneity test for Digital Literacy (X₁), 21st-Century Learning (X₂), and Visionary Leadership (X₃) with Teacher Innovation (Y)

No	Group	χ^2 value	L _{table} ($\alpha=0.05$)	Conclusion
1	Y - X ₁	6.524	90.531	Normal
2	Y - X ₂	5.296	90.531	Normal
3	Y - X ₃	5.991	90.531	Normal
Homogenous variation if $\chi^2_{\text{calculated}} < \chi^2_{\text{table}}$				

5.4 Correlation Analysis

The Relationship Between Digital Literacy (X₁) and Teacher Innovation (Y)

The findings of this study demonstrate a positive and statistically significant relationship between digital literacy (X₁) and teacher innovation (Y). Based on hypothesis testing, the correlation coefficient ($r_{\gamma 1}$) was found to be 0.591, which falls into the moderate category. The associated probability value was 0.000, which is less than the significance level of 0.05 ($p < 0.05$), indicating that the null hypothesis (H_0) is rejected. This suggests that the observed correlation is statistically significant. Accordingly, the study confirms a meaningful and positive association between the enhancement of digital literacy and increased teacher innovation. This relationship is further supported by the coefficient of determination (R^2) of 0.349, meaning that 34.9% of the variation in teacher innovation can be explained by digital literacy, while the remaining 65.1% is attributed to other factors beyond digital literacy. The regression equation derived from the analysis is $\hat{Y} = 53.003 + 0.587X_1$, which implies that for every one-unit increase in digital literacy, teacher innovation is predicted to increase by 0.587 units.

The Relationship Between 21st-Century Learning (X₂) and Teacher Innovation (Y)

The results of the study reveal a positive and statistically significant relationship between 21st-century learning (X₂) and teacher innovation (Y). Based on hypothesis testing, the correlation coefficient ($r_{\gamma 2}$) was found to be 0.582, which is classified as moderate. The obtained probability value was 0.000, which is less than the significance level of 0.05 ($p < 0.05$), leading to the rejection of the null hypothesis (H_0) and confirming the significance of the correlation. This indicates a meaningful and positive association between strengthening 21st-century learning practices and the enhancement of teacher innovation. The consistency of this relationship is reflected in the coefficient of determination (R^2) of 0.339, suggesting that 33.9% of the variance in teacher innovation can be explained by 21st-century learning, while the remaining 66.1% is influenced by other factors not examined in this model. The resulting regression equation is $\hat{Y} = 56.185 + 0.575X_2$, indicating that for every one-unit increase in 21st-century learning, teacher innovation is predicted to increase by 0.575 units.

The Relationship Between Visionary Leadership (X₃) and Teacher Innovation (Y)

The results of the study indicate a positive and statistically significant relationship between visionary leadership (X₃) and teacher innovation (Y). Based on hypothesis testing, the correlation coefficient between the two variables ($r_{\gamma 3}$) was found to be 0.552, which falls within the moderate category. The p-value obtained was $0.000 < 0.05$, leading to the rejection of the null hypothesis (H_0), and confirming the significance of the correlation. Thus, the study supports the existence of a positive and significant relationship between strengthened visionary leadership and improved teacher innovation. The consistency of teacher innovation associated with visionary leadership is reflected in the

coefficient of determination (R^2) of 0.305, indicating that 30.5% of the variation in teacher innovation is explained by visionary leadership, while the remaining 69.5% is attributed to other external factors. The resulting regression equation, $\hat{Y} = 55.185 + 0.538X_3$, demonstrates that a one-unit increase in visionary leadership corresponds to a 0.538 increase in teacher innovation.

The Relationship Between Digital Literacy (X_1) and 21st-Century Learning (X_2) with Teacher Innovation (Y)

The findings of this study demonstrate a positive relationship between digital literacy and 21st-century learning with the enhancement of teacher innovation. Based on hypothesis testing, the correlation coefficient between digital literacy and 21st-century learning and teacher innovation (r_{y12}) was found to be 0.622, which falls within the strong category. The obtained p-value was 0.000, which is less than the significance level of 0.05, indicating that the null hypothesis (H_0) is rejected. This result confirms that the observed correlation is statistically significant. Therefore, the study supports a positive and significant relationship between the strengthening of digital literacy and 21st-century learning and the improvement of teacher innovation. The consistency of teacher innovation in relation to these two independent variables is reflected in the coefficient of determination (R^2) of 0.387, suggesting that 38.7% of the variance in teacher innovation can be explained by digital literacy and 21st-century learning, while the remaining 61.3% is influenced by other factors outside these two variables. The regression equation derived from this relationship is $\hat{Y} = 44.889 + 0.348X_1 + 0.307X_2$, which can be used to predict teacher innovation. Accordingly, for every 1% increase in digital literacy (X_1), teacher innovation is expected to increase by 0.348, and for every 1% increase in 21st-century learning (X_2), teacher innovation is expected to increase by 0.307, assuming the other variable remains constant.

The Relationship Between Digital Literacy (X_1) and Visionary Leadership (X_3) with Teacher Innovation (Y)

The results of the study indicate a positive relationship between digital literacy and visionary leadership with the enhancement of teacher innovation. Based on hypothesis testing, the correlation coefficient between digital literacy and visionary leadership with teacher innovation (r_{y13}) was found to be 0.597, which is categorized as moderate. The obtained p-value was 0.000, which is less than the significance threshold of 0.05, leading to the rejection of the null hypothesis (H_0). This suggests that the correlation coefficient is statistically significant. Accordingly, the study confirms a positive and significant relationship between digital literacy and visionary leadership with the increase in teacher innovation. The consistency of this relationship is further supported by a coefficient of determination (R^2) of 0.357, indicating that 35.7% of the variance in teacher innovation can be explained by digital literacy and visionary leadership, while the remaining 64.3% is influenced by other external factors. The resulting regression equation is $\hat{Y} = 47.368 + 0.328X_1 + 0.282X_3$, which can be used to predict teacher innovation levels. Therefore, for every 1% increase in digital literacy (X_1), teacher innovation increases by 0.328, and for every 1% increase in visionary leadership (X_3), teacher innovation increases by 0.282, assuming the other variable remains constant.

The Relationship Between 21st-Century Learning (X_2) and Visionary Leadership (X_3) with Teacher Innovation (Y)

The findings of this study indicate a positive relationship between 21st-century learning and visionary leadership with the enhancement of teacher innovation. Based on hypothesis testing, the correlation coefficient between 21st-century learning and visionary leadership with teacher innovation (r_{y23}) was found to be 0.606, which falls into the strong category. The obtained probability value ($p = 0.000$) is less than the significance level of 0.05, leading to the rejection of the null hypothesis (H_0). This confirms that the observed correlation is statistically significant. The consistency of teacher innovation in relation to 21st-century learning and visionary leadership is reflected in the coefficient of determination (R^2) of 0.368, indicating that 36.8% of the variance in teacher innovation can be explained by these two variables. The remaining 63.2% is attributed to other factors beyond 21st-century learning and visionary leadership. The study also produced the following regression equation: $\hat{Y} = 45.679 + 0.379X_2 + 0.255X_3$, which can be used to predict teacher innovation. Accordingly, a 1% increase in 21st-century learning (X_2) contributes to a 0.379 increase in teacher innovation, while a 1% increase in visionary leadership (X_3) contributes to a 0.255 increase, assuming the other variable remains constant.

The Relationship Between Digital Literacy (X_1), 21st-Century Learning (X_2), and Visionary Leadership (X_3) With Teacher Innovation (Y)

The findings of this study indicate a positive relationship between digital literacy, 21st-century learning, and visionary leadership with increased innovation among teachers. Based on hypothesis testing, the correlation coefficient between

these three independent variables and teacher innovation (r_{123}) was found to be 0.625, which falls into the strong category. The probability value obtained was 0.000, which is less than the significance level of 0.05, thus rejecting the null hypothesis (H_0). This indicates that the observed correlation is statistically significant. The consistency of teacher innovation in relation to digital literacy, 21st-century learning, and visionary leadership is reflected in the coefficient of determination (R^2) of 0.391, indicating that 39.1% of the variation in teacher innovation can be explained by the three variables, while the remaining 60.9% is influenced by other factors outside the scope of this study. The resulting regression equation is: $\hat{Y} = 42.336 + 0.162X_1 + 0.290X_2 + 0.208X_3$. This equation can be used to predict teacher innovation, showing that for every 1% increase in digital literacy (X_1), 21st-century learning (X_2), and visionary leadership (X_3), while holding the other variables constant, teacher innovation increases by 0.162, 0.290, and 0.208, respectively.

6. Conclusion

The findings indicate that Digital Literacy (X_1) contributes 34.9% to the improvement of teacher innovation (Y) with a correlation coefficient of 0.591, while 21st-Century Learning (X_2) contributes 33.9% with a correlation coefficient of 0.582, and Visionary Leadership (X_3) contributes 30.5% with a correlation coefficient of 0.552. The combination of Digital Literacy (X_1) and 21st-Century Learning (X_2) accounts for 38.7% of the variance in teacher innovation with a correlation coefficient of 0.622, whereas the combination of Digital Literacy (X_1) and Visionary Leadership (X_3) contributes 35.7% with a correlation coefficient of 0.597. Furthermore, the combination of 21st-Century Learning (X_2) and Visionary Leadership (X_3) contributes 36.8% with a correlation coefficient of 0.606. Overall, the combined influence of Digital Literacy (X_1), 21st-Century Learning (X_2), and Visionary Leadership (X_3) explains 39.1% of the variance in teacher innovation, supported by a correlation coefficient of 0.625. These results demonstrate that increases in each of these variables are predictive of significant improvements in teacher innovation.

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