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Exploring University Pre-Service Teachers' 21st Century Skills: A Survey Study

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ABSTRACT

In the changing educational realm, there is a high demand for pre-service teachers to develop 21st-century skills. These essential skills are composed of the 4C's, which are creativity, collaboration, critical thinking, and communication. This study aims to assess the pre-service teachers' self-perceived 21st-century skills. A quantitative descriptive research design was utilized to garner data from 41 participants via Google Forms. The applied statistics include descriptive techniques such as mean and standard deviation, Pearson's r correlation, and exploratory factor analysis (EFA), using SPSS version. 27. The findings revealed that pre-service educators agreed that they acquire these competencies for 21st-century skills that display moderate to high levels. Among the four domains, collaboration achieved the highest overall mean (M = 3.59, SD = 0.39), indicating high-level interpersonal skills, respect for diverse perspectives, and receptivity to feedback. Creativity (M = 3.29, SD = 0.42) and communication (M = 3.27, SD = 0.49) were perceived positively for idea creation, adaptive communication, and goal organizing. On the other hand, critical thinking has the lowest level of mean rating (M = 3.06, SD = 0.33), with potential in inquiry and information gathering. The correlation analysis reveals significant relationships between the four components of 21st century skills, indicating that these correlations are highly unlikely to have occurred by chance. Also based on the EFA analysis, critical thinking (71.56%) and collaboration (14.29%) are the major factors in explaining 21st-century skills for pre-service teachers. The findings from this study imply that pre-service teachers exhibit readiness in collaborative and adaptive domains, but there is a need to strengthen analytical skills and structured reasoning skills. These results provide an empirical basis for developing targeted intervention programs to enhance critical thinking, clarity of communication, and creative problem-solving competencies. These professional education interventions would support improvement in teacher preparation programs and strengthen alignment with Sustainable Development Goal (SDG) 4 about Quality Education. This promotes inclusive and skills-equipped education for the active participation of the future workforce in the current and future society.

Keywords: 21st century skills, education, pre-service teachers, SDG 4, survey study

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INTRODUCTION

The rapid change in the education sector leads the instructors to be equipped with the essential skills that are more than just content. In the realm of the 21st century, the 4Cs, which include critical thinking, collaboration, communication, and creativity, are important for molding learners to be assigned in the future workforce (Thornhill-Miller et al., 2023; Tohani & Aulia, 2022). With the advent of technological innovations, the education sector must evaluate and refine the abilities of the future educators, who are pre-service teachers (Seufert et al., 2021).

Pre-service teachers are in the priority phase of professional development, who will be prepared to acquire knowledge and a set of essential skills for the delivery of an effective teaching and learning process (Alahmad et al., 2021). The improvement of critical thinking, collaboration, communication, and creativity is achieved through the educational programs, which put the student-centered teaching into an exemplary teaching environment (Bhardwaj et al., 2025). These competencies are necessary for honing not just content knowledge but also for crafting a conducive learning atmosphere supporting innovation, problem-solving, and engagement with various perspectives (Isabirye et al., 2025). These interventions also make alignments with United Nation's Sustainable Development Goal (SDG) 4 by promoting inclusive and relevant education that trains learners for active participation in current and future environment.

Even if recognized as an important domain of essential skills, the recent level of pre-service teachers' proficiency in these areas still needs improvement. There is a demand when it comes to the need to examine how confident pre-service teachers feel in their ability to apply 21st-century skills in a practical classroom environment (Tican & Deniz, 2019). It has been highlighted that literature that explores 21st-century skills of pre-service teachers who will be trainers of 21st-century learners must be conducted to garner data for the development of policies (Yilmaz et al., 2024; Malabanan et al., 2022). By the information provided in the available literature, this study will make it possible to reveal the current situation of the pre-service teachers' awareness about 21st-century skills. The data gathered will contribute to the updating of studies of the curriculum implemented by the pre-service teachers.

This study seeks to evaluate the perceived competence of pre-service teachers in four areas, which include critical thinking, collaboration, communication, and creativity. By the evaluation of the participants' levels of 21st-century skills, this study aims to provide vital data on the areas where future educators may excel and where further development may be done as needed. By the time the pre-service teachers start their teaching careers, possessing the technical knowledge required for effective teaching and the vital skills would enable them to satisfy the required demands of the educational system. This investigation will make this study a source of the required information that can be used to shape the development of policies and updates to the curriculum. This will ensure that pre-service teachers are equipped to foster these important skills in their learners. The results of this study will therefore be a source of information in shaping the future of teacher education programs and education. The findings from this study will be beneficial for teacher education programs to highlight the areas for targeted improvement and provide a wider landscape of the readiness of pre-service teachers to solve challenges of modern education.

OBJECTIVES OF THE STUDY

1. How may the perceived competence of pre-service teachers in the 21st-century skills be quantitatively described in terms of critical thinking, collaboration, communication, and creativity?

2. What are the relationships among the 21st-century skills in terms of critical thinking, collaboration, communication, and creativity?

3. Which components among critical thinking, collaboration, communication, creativity explain the most variance in pre-service teachers perceived 21st-century skills?

4. What program intervention may be proposed as an output of the assessment of pre-service teachers' level of 21st-century skills?

LITERATURE REVIEW

This study is informed by the Constructivist Theory of Learning, which affirms that learning is a construction of knowledge based on interaction with one's learning environment and social context (Vygotsky, 1978). This theory is important in informing pre-service teachers' development of 21st-century skills as they are themselves learners who are engaged in activities such as reflection, problem-solving, and communication within a collaborative learning context. The inclusion of critical thinking skills, collaboration, communication, and creativity in pre-service teacher education is informed by the constructivist theory, as pre-service teachers are active participants in their learning and are encouraged to apply their knowledge to solve challenges in their learning environment. Furthermore, the inclusion of pre-service teacher education can be informed by another theory which is

Social Learning Theory (Bandura, 1977). This theory affirms that pre-service teachers can develop important skills as they are not only learning from their instructors but are also learning from their peers and the wider learning community.

Assuring enough preparation for the modern education quests, the further improvement of 21st-century skills among pre-service teachers is deemed important (Uyar, 2023). The components of 21st-century skills are critical thinking, collaboration, communication, and creativity, which are pillars of a learning environment suitable for the learners' improvement (González-Pérez & Ramírez-Montoya, 2022). Into the continuous flow of the trend of education to the technological realms and recent global difficulties, there is an increasing need for the development of the competencies anchored on the 21st-century skills (Joynes et al., 2019; Van Laar et al., 2017).

Critical thinking is widely known as one of the most important thinking skills for students and instructors, as it encompasses the ability to analyze, evaluate, and combine information in an effective manner (Alsaleh, 2020). According to Sholihah & Lastariwati (2020), critical thinking is a basis for the further enhancement of problem-solving skills, which are needed for resolving current issues in education. According to research by Stavropoulou et al. in 2025, a robust sense of self-efficacy in critical thinking was highlighted, which can pave the way to better problem-solving abilities and higher academic accomplishments. However, the evaluation of arguments critically needs a higher level of cognitive maturity.

Collaboration is a component of 21st-century skills. As studied by Sweet & Michaelsen (2023), effective performance in group scenarios is a key to triumph in academic aspects. According to research by Mattessich & Johnson in 2018, exerted collaboration depends upon respect among members of a group. The study of Mugabekazi et al., in 2025 indicates that there are alternations in learners' interpersonal skills, implying that while certain collaborative skills are basic, others call for further training to ensure coherence and effectiveness in team settings.

Effective communication has emerged in importance with the onset of 21st-century education. As learners are instructed to give input to different discourses, organize outputs, and collaborate with their peers, a sufficient level of communication proficiency is demanded (Gillies, 2019). Research by Hora et al. (2019) supports the notion that systematic communication is challenging for students, specifically in higher academic and professional contexts. Also, Antonopoulou (2024) interpreted the properties of self-regulation and task management as key ingredients of effective communication, which are skills that pre-service teachers could acquire.

Creativity is also an indispensable skill in the modern academe as it drives innovation and flexible problem-solving. The study of Barrett et al., (2021) works on creativity, which emphasizes flexibility and collaboration as a constituent of creative thinking. There are existing challenges, as highlighted by Yadav & Singh (2026), in raising higher-order creative thinking and independent exploration among learners. The growing recognition of creativity as a driver of innovation suggests that fostering creativity in pre-service teachers is critical for future classrooms.

The application of technology in the teaching process has positively changed the development of 21st-century skills, notably in practicing critical thinking, communication, and creativity. Research by Shubina & Kulakli (2019) shows that the utilization of technology in learning can improve creative thinking skills by providing learners with abundant avenues for experiential learning and problem-solving activities. These strategies can offer more dynamic ways for novice teachers to embed their knowledge and skills in a more practical, technology-integrated environment. However, the rapid pace of technological advancement calls for ongoing adaptation in teacher preparation programs.

The existing literature accentuates the growing importance of positively modifying 21st-century skills in pre-service teachers. There is existing evidence regarding the significance of critical thinking, collaboration, communication, and creativity in molding effective educators. But there are also areas that require targeted interventions in assessing evidence, scientific inquiry, and creativity in new contexts. Despite the consensus about their importance, contradictions in the literature regarding the effectiveness of the development of these skills in teacher preparation programs are emerging (Almazroa & Alotaibi, 2023). For example, while the importance of critical thinking skills and collaboration is well recognized, the need to incorporate creativity and effective communication in the context of the current challenges is not well emphasized (Burieva, 2025; Stanikzai, 2023). The contradictions in the literature about the effectiveness of the development of these skills in teacher preparation programs underscore the need for specific interventions about the development of these skills in the context of the current challenges.

In conclusion, while literature about the importance of the development of 21st-century skills is well established, gaps in the literature about the implementation of these skills in different educational settings need to be filled. The purpose of the study was to address the gap in literature about the development of these skills among pre-service teachers with the aim of helping them deal with the complexities of modern education. These literature gaps suggest that further instructional programs and learning experiences focused on these areas are needed to fully equip pre-service teachers for the mitigation of the difficulties they will face in the classroom.

METHODOLOGY

Research Design

The research design used in the study was a quantitative descriptive research design, which aims to give a comprehensive description of the level of 21st-century skills among pre-service teachers. This research design was appropriate for the study because it aims to gather numerical data to measure the participants' competencies in different aspects such as critical thinking, collaboration, communication, and creativity. This research design ensures objectivity by using quantifiable data to analyse the perceived levels of 21st-century skills among the respondents.

Participants/Respondents

This research was carried out in one of the local state universities in the Philippines. The participants were pre-service teachers who were taking the subject Science, Technology, and Society (STS) in the second semester of the academic year 2025-2026. The total number of participants in the research was 41 pre-service teachers. The participants were not selected randomly. Instead, the research utilized the convenience sampling technique. The participants were accessible and were the right participants in the research because they met the inclusion criteria. The inclusion criteria were the participants had to be pre-service teachers taking the subject STS in the specified semester.

Instruments

The research instrument developed for the purpose of this study was based on the research on the 21st-century skills survey developed by Kelly et al. (2019). This tool is based on the assessment of key skills such as collaboration, communication, creativity, and critical thinking. The research instrument was adapted for the purpose of the study based on the requirements of the research design. The tool was pre-tested, and Cronbach's alpha was calculated for every subscale as follows: Collaboration, α=.826; Communication, α=.749; Creativity, α= .751; and Critical Thinking, α=.876. The results show that the tool is highly reliable, and it can be used to measure the participants' skills in these areas. The tool was created using Google forms to make it easy to collect data from the participants.

The research instrument was based on the assessment of 21st-century skills in the context of the educational sector. This tool had to be adapted for the purpose of research based on the requirements of the study. This was done through several stages. Firstly, the research instrument was reviewed based on the requirements of the study. This was done by ensuring that the research instrument was clear and relevant for the purpose of the research. Some of the questions were adapted based on the requirements of research design. Some questions were removed based on their lack of relevance for the purpose of the research. New questions were developed based on the requirements of the research design to ensure the assessment of the four key skills. This was done based on the recommendations of experts in the field of research.

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Data Analysis

The numerical data collected were statistically analyzed using descriptive statistical treatment. using mean and standard deviation to identify trends that could lead to findings representing the participants. Google Forms was utilized to collect data from participants. The data was analyzed using SPSS Version 27 to process the data accurately and efficiently.
Aside from descriptive analysis, Pearson's correlation was also used to assess the relationship between the four 21st-century skills. The skills were: critical thinking, collaboration, communication, and creativity. Pearson's correlation coefficients were used to gain deeper insights into the relationship between these components. By using Pearson's correlation, significant relationships were established between these components.

Moreover, exploratory factor analysis (EFA) was performed using the principal component analysis (PCA) method to assess the underlying structure of the 21st-century skills. By using this method, it was possible to identify the main components of the 21st-century skills. It was also possible to identify the factors that contributed most to the perceptions of pre-service teachers

on 21st-century skills. From the analysis, it was evident that the most significant components were those that related to critical thinking, followed by collaboration, communication, and creativity.

The findings obtained from the analysis were used to identify the perceptions and trends in the participants' competencies in the four 21st-century skills. As shown in Table 1, the following values were utilized for the Likert four-point scale range.

Table 1

Likert Four-Point Scale Range Interpretation

Point	Scale Range	Interpretation
4	3.26 – 4.00	Strongly Agree
3	2.51 – 3.25	Agree
2	1.76 – 2.50	Disagree
1	1.00 – 1.75	Strongly Disagree

Ethical considerations

The participants were made aware of the purpose and significance of the study before the process of data collection began. Ethical clearance was obtained from the ethics committee of the university to conduct the research while adhering to ethical standards. Informed consent was obtained from the participants, and they were made aware of the confidentiality and anonymity of the study. Additionally, the participants were made aware of the fact that the study was voluntary and that they had the right to withdraw from the study at any stage without any consequences.

RESULTS AND DISCUSSION

The following section reveals the results of the study with regards to the pre-service teachers' 21st century skills.

Table 2

Critical Thinking Aspect Results

Critical Thinking Aspect	Mean	SD	Verbal Interpretation
I am confident in my ability to revise drafts and justify revisions with evidence	3.07	0.41	Agree
I am confident in my ability to develop follow-up questions that focus or broaden inquiry	2.99	0.42	Agree
I am confident in my ability to create new, unique, surprising products	3.00	0.62	Agree
I am confident in my ability to identify in detail what needs to be known to answer a science inquiry question	2.95	0.5	Agree
I am confident in my ability to evaluate reasoning and evidence that support an argument	2.95	0.59	Agree
I am confident in my ability to create ideas geared to the intended client or user	3.02	0.47	Agree
I am confident in my ability to develop follow-up questions to gain understanding of the wants and needs of client or product users	3.22	0.47	Agree

I am confident in my ability to combine different elements into a complete product	3.02	0.65	Agree
I am confident in my ability to understand questions that lead to critical thinking	3.20	0.56	Agree
I am confident in my ability to justify choices of evaluation criteria	3.02	0.52	Agree
I am confident in my ability to gather relevant and sufficient information from different sources	3.20	0.46	Agree
Average	3.06	0.33	Agree

Based on the data garnered, the results reveal that pre-service teachers possess an average sense of self-confidence in the critical thinking aspect of 21st-century skills. With an average mean of 3.06, the participants steadily established confidence across numerous scopes of critical thinking. This implies that the participants were generally confident in their ability to take up critical thinking. The highest degree of confidence (M = 3.22; SD = 0.47) was pronounced in the ability to develop follow-up questions to understand the needs of others. This outcome implies that the pre-service teachers are highly empathetic and proficient at the "discovery" phase of problem-solving (Gessala et al., 2025). The early stages of critical thinking require understanding the needs of others. This is reflected by a strong confidence in their capacity to gather sufficient information from diverse sources (M = 3.20; SD = 0.46). This further emphasizes the strength of the participants in terms of their abilities in the discovery stage of critical thinking. From these findings, it is evident that the pre-service teachers were well equipped with the skills that would help them overcome a range of problems.

Overall, the interpretation of the responses is "Agree," hinting that the data also recognizes the distinction in more technical scopes of critical thinking. The scores for Evaluating Evidence and Scientific Inquiry (M = 2.95; SD = 0.5) were at the lower end of the range. Still positive, these findings reveal that the transition from simple data gathering to complex analysis of data's logical integrity is challenging for the intellectual end of the participants (McDowall et al., 2021). Furthermore, the overall high standard deviation received by "creating unique products" (SD: 0.65) shows a gap in creative confidence, where some participants feel highly creative while others remain more conventional. Some participants were highly confident in their creativity, indicating that they could easily come up with innovative ideas. Conversely, others were more conventional in their responses. This is an indication of the range of diversity in terms of creative thinking among the participants. Some participants might require further encouragement to enhance their creative abilities.

The results indicate that pre-service teachers possess a strong foundation in terms of critical thinking. The results also indicate that there is a significant need for improvement in aspects of analysis and creativity, which might require further improvement for these teachers to enhance their capacities for the 21st century. The theoretical implications of the findings are important in the sense that they add strength to the emerging understanding of the importance of critical thinking as a core part of the educational system in the 21st century. It is a widely accepted fact that the ability to think critically is a key skill required for tackling the complexities of the modern world.

Table 3

Collaboration Aspect

Collaboration Aspect	**Mean**	**SD**	**Verbal Interpretation**
I am confident in my ability to be polite and kind to teammates	3.61	0.59	Strongly Agree
I am confident in my ability to acknowledge and respect other perspectives	3.83	0.38	Strongly Agree
I am confident in my ability to follow rules for team meetings	3.63	0.49	Strongly Agree

I am confident in my ability to make sure all team members' ideas are equally valued	3.66	0.48	Strongly Agree
I am confident in my ability to offer assistance to others in their work when needed	3.68	0.47	Strongly Agree
I am confident in my ability to improve my own work when given feedback	3.73	0.45	Strongly Agree
I am confident in my ability to use appropriate body language when presenting	3.32	0.69	Strongly Agree
I am confident in my ability to come physically and mentally prepared each day	3.22	0.65	Agree
I am confident in my ability to follow rules for team decision-making	3.61	0.49	Strongly Agree
Average	3.59	0.39	Strongly Agree

The results from the participants argue that respondents generally display a positive level of their collaborative competencies, as reflected in the mean (M = 3.59; SD = 0.39) with verbal interpretation of "Strongly Agree." This implies that the pre-service teachers are confident in their collaborative competence in teamwork settings. This is in line with the study of Thomas & Brown (2019), which highlights the significance of collaboration in contemporary educational settings.

The statement that got the peak rating, "acknowledge and respect other perspectives" (M = 3.83, SD = 0.38) has the interpretation of "Strongly Agree." This clarifies a high attitude toward openness, which is an indispensable part of collaboration. The high rating implies that the respondents were open to other people's perspectives. This is an important aspect of collaborative competence since openness is vital in creating a positive team environment where everyone respects each other for the team to succeed. In addition, the respondents were confident in their collaborative competence since they were able to receive constructive feedback positively. Also, the high rating for "improving work when given feedback" (M = 3.73, SD = 0.45) and "offering assistance to others" (M = 3.68, SD = 0.47) conveys that respondents recognize constructive feedback with encouragement to further acquire growth and cooperation in a team environment.

On the other hand, lower mean scores were achieved by "coming physically and mentally prepared each day" (M = 3.22, SD = 0.65). Still within the "Agree" range, the item exhibited that while interpersonal respect and behaviors are fundamental, aspects relevant to presentation skills and readiness may depend upon systematic enhancement. These findings imply that although pre-service teachers value respect for one another in a collaborative environment, their presentation skills, which are important in creating a collaborative team environment, may still need to be improved.

It is important to note that the study found that pre-service teachers have a high level of collaborative confidence in their responses to questions about interpersonal respect, open-mindedness to feedback, and open-mindedness to assistance from their peers. However, it is also important to note that this study found that there is a need for developmental interventions in pre-service teachers in matters to do with their own preparation for active participation in collaborative teams (Evans, 2020).

Table 4

Communication Aspect

Communication Aspect	**Mean**	**SD**	**Verbal Interpretation**
I am confident in my ability to use time, and run meetings, efficiently	3.29	0.56	Strongly Agree
I am confident in my ability to organize information well	3.27	0.59	Strongly Agree
I am confident in my ability to track our team's progress toward goals and deadlines	3.44	0.55	Strongly Agree

I am confident in my ability to complete tasks without having to be reminded	3.24	0.7	Agree
I am confident in my ability to present all information clearly, concisely, and logically	3.12	0.6	Agree
Average	3.27	0.49	Strongly Agree

The findings indicate a high degree of self-efficacy in terms of competence in communication, self-management, and accountability, which are essential aspects of 21st-century skills. The high mean garnered (M=3.27; SD = 0.49) was interpreted as "Strongly Agree," displays that perception of participants that they have the communication and systematic skills needed for effective collaboration. These aptitudes are important components of the 21st-century skills, where information, time, and goals are demanded for productivity in the academe.

With the aspects of the 21st-century skills, the greatest rating was achieved by the educators' ability to manage team achievement toward targets (M = 3.44, SD = 0.55). This is a strong indication that pre-service teachers are comfortable with the aspect of accountability in collaboration, as team achievements are central. This result remarks a strong efficacy in purposeful communication and systems, which are necessary for accountability. On the other hand, low mean ratings were received from the pre-service teacher in delivering information logically (M = 3.12, SD = 0.60) and completing work without reminders (M = 3.24, SD = 0.70). These results from the participants are interpreted to be in the "Agree" range, which implies areas for enrichment with a need to focus on structured message relay and independent tasks. These findings indicate areas for development, as a low mean rating is an indication of a low degree of self-efficacy. In general, a high degree of self-efficacy is indicated, as pre-service teachers feel competent in communication and self-management. The high standard deviation for task completion displays differences in students' self-regulation and independence, which are the interplaying elements of 21st-century learning (Wrahatnolo & Munoto, 2018).

Overall, the data from respondent's present proficiency in communication-relevant 21st-century skills but may benefit from specialized mediations that would strengthen coherent expression and independent reliability. Mending these domains can enhance the pre-service teachers' preparedness for changing, team-based, and output-driven situations as components of the modern workforce (Nguyen et al., 2025).

Table 5

Creativity Aspect Results

Creativity Aspect	**Mean**	**SD**	**Verbal Interpretation**
I am confident in my ability to understand how knowledge or insights might transfer to other situations or contexts	3.20	0.51	Agree
I am confident in my ability to find sources of information and inspiration when others do not	3.12	0.60	Agree
I am confident in my ability to help the team solve problems and manage conflicts	3.32	0.57	Strongly Agree
I am confident in my ability to adapt a communication style appropriate for the purpose, task, or audience	3.39	0.59	Strongly Agree
I am confident in my ability to elaborate and improve on ideas	3.41	0.50	Strongly Agree
Average	3.29	0.42	Strongly Agree

In the concept 21st-century skills in creative thinking, the findings revealed a moderate level of self-perceived ability among the respondents. The mean of the creative thinking domain (M = 3.29; SD = 0.42) was strongly agreed by the participants which conveys the notion that participants view themselves as proficient in delivering creative processes that include idea creation, knowledge transfer, and communication. This implies that pre-service teachers are confident in their ability to utilize creative thinking in different situations, which is a critical component of adaptive problem-solving in real-world situations.

The findings of the study have important policy implications. The policy implications revolve around the potential for the study's findings to contribute to the development of the curriculum for teacher training programs. The study's findings suggest that the curriculum for teacher training programs could be improved by placing greater emphasis on the development of the ability to think creatively, communicate effectively, and regulate one's own behaviors. Such a skill set is not only critical for the profession of teaching itself, but it is also a skill set that is critical for the modern workforce. In the modern workforce, the ability to work effectively with others, to be adaptable, and to be innovative is highly valued. (Adeoye & Jimoh, 2023).

Among all components of creative thinking, the participants rated their ability to elaborate and improve ideas as the best. This indicates a strong ability to improve and elaborate ideas, which is a critical component of creative thinking. From the category, the highest mean was achieved by the statement about the ability to elaborate and improve ideas (M = 3.41, SD = 0.50). This presents high level in idea refinement and continual thinking as concepts of innovation. In addition, adapting communication style based on goal, work, or audience (M = 3.39, SD = 0.59) and aiding the team to solve problems and manage conflicts (M = 3.32, SD = 0.57) elucidates confidence in the creative thinking process. These competencies coordinate with the demands of altering environments where individuals must repeatedly recalibrate strategies. This indicates that the participants are confident in terms of the creative thinking process, especially in adapting strategies in different situations. On the contrary, lower means were garnered by statements about transferring knowledge to other contexts (M = 3.20, SD = 0.51) and independently looking for sources of information (M = 3.12, SD = 0.60). Even if within the "Agree" interpretation, the results reveal areas for further development about higher-order creative thinking, such as analogical reasoning and self-directed learning.

The study findings indicate that pre-service teachers possess the fundamental capacities for creative thinking necessary for the 21st century. However, there is scope for growth in aspects where higher-order creativity is required. More emphasis needs to be given to experiential learning with innovation-driven activities for further improvement in the application of creative thinking for innovative problem solutions (Aithal & Aithal, 2023).

Table 6

Correlation of 21st Century Skill Aspects Results

		Critical Thinking	Collaboration	Communication	Creativity
a	Pearson Correlation	1	.496**	.694**	.662**
	Sig. (2-tailed)		.001	.000	.000
	N	41	41	41	41
b	Pearson Correlation	.496**	1	.550**	.504**
	Sig. (2-tailed)	.001		.000	.001
	N	41	41	41	41
c	Pearson Correlation	.694**	.550**	1	.790**
	Sig. (2-tailed)	.000	.000		.000
	N	41	41	41	41
d	Pearson Correlation	.662**	.504**	.790**	1
	Sig. (2-tailed)	.000	.001	.000	

N	41	41	41	41

**. Correlation is significant at the 0.01 level (2-tailed).

The findings from the Pearson correlation analysis describe the relationship between the four components of 21st-century skills: critical thinking, collaboration, communication, and creativity. All correlations are significant at 0.01, which means that it is highly unlikely for these correlations to have happened by chance. A moderate positive correlation is found between critical thinking and collaboration (r = 0.496), which means that people who are good at critical thinking also tend to have good collaborative skills. A strong positive correlation is found between critical thinking and communication (r = 0.694), which means that people who have good critical thinking skills also tend to have good communication skills. A strong positive correlation is also found between critical thinking and creativity (r = 0.662), which points to the fact that people who have good critical thinking skills also tend to have good creativity skills. It also indicates a moderate positive correlation with collaboration (r = 0.550), which suggests that those who are good at collaborating are also good at communicating. There is a moderate positive correlation between collaboration and creativity (r = 0.504), which suggests that good collaboration can also help in developing creativity in people.

The highest correlation coefficient is observed in the correlation between communication and creativity, which is 0.790, indicating a very strong positive correlation, which suggests that those who are good at communicating are also very good at developing their creativity. Overall, it can be summarized that critical thinking, collaboration, communication, and creativity are positively correlated with each other (Tohani & Aulia, 2022). Communication is important for developing creativity in people, and critical thinking is closely associated with communication and creativity. These skills are also interlinked with each other in such a way that developing one skill can help in developing another skill, particularly communication and creativity.

Table 7

Variance of 21st Century Skill Aspects Results

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.862	71.556	71.556	2.862	71.556	71.556
2	.572	14.292	85.848			
3	.360	9.010	94.859			
4	.206	5.141	100.000			

Extraction Method: Principal Component Analysis.

The total variance explained table from the principal component analysis (PCA) shows that there is a distribution of variance in the data. From the analysis, it was found that critical thinking explains 71.56% of the variance. This shows that critical thinking is the most dominant factor in the data, as it explains a larger proportion of the information related to 21st-century skills. The component about collaboration, explains 14.29% of the variance. When added to critical thinking, it explains 85.85% of the total variance. This shows that collaboration plays a critical role in shaping the participants' skills. Communication explains 9.01% of the variance. When added to components 1, 2, and 3, it explains 94.86% of the total variance.

This shows that although it plays a role, it does so to a lesser extent than components 1 and 2. Component 4, representing creativity, explains 5.14% of the variance. When added to components 1, 2, 3, and 4, it explains 100% of the total variance. From the analysis, it was found that critical thinking and collaboration are the dominant factors in shaping the 21st-century skills of pre-service teachers. Thus, in a general sense, it can be summarized that based on the analysis, critical thinking and

collaboration are the major factors in explaining 21st-century skills for pre-service teachers, whereas communication and creativity play a role but to a lesser extent (Valtonen et al., 2021). This implies that even though the participants are good in critical thinking and collaboration, further development in communication and creativity is needed to make them well-rounded in terms of skills in the future.

CONCLUSION

This research also points to the need for critical thinking, collaboration, communication, and creativity as essential skills in teacher preparation. The research findings indicate that pre-service teachers have high self-efficacy for 21st-century skills such as critical thinking, collaboration, communication, and creativity. The core skills are essential for a successful teaching career in the 21st century. The core skills are essential for a successful teaching career in the 21st century. The research contributes to the emerging trend of research on the need to incorporate these skills in teacher preparation programs, as they are essential for shaping teachers who are capable of instilling such skills in their students as well.

However, there are essential areas that need to be developed. Although the research findings indicate that pre-service teachers have high self-efficacy for core skills such as critical thinking, collaboration, communication, and creativity, they have low self-efficacy for skills such as assessing evidence, presenting information, and transferring knowledge.

However, it is important to point out that even though the study has offered important insights into the 21st-century skills of pre-service teachers, there is a need to point out its limitations. Firstly, the study has a small sample size of only 41 participants. Moreover, the fact that the data was self-reported may have led to some potential biases in assessing the participants' actual competencies. Future studies could consider using a large number of participants to draw a wider range of data. Future studies could also consider using longitudinal studies to examine the development of these skills during the course of pre-service teacher training as well as their professional careers.

In conclusion, the study has offered important insights into the role of critical thinking, collaboration, communication, and creativity in teacher preparation. The study has indicated that pre-service teachers were generally well-prepared in these aspects but could benefit from further skill development in these aspects. Moreover, the study has emphasized the need for programmatic interventions and policy recommendations aimed at improving these competencies in teacher education. Future studies could consider exploring the effect of these skills on teachers' effectiveness in the classroom, thus providing further insights into how best to prepare

RECOMMENDATIONS

Based on the findings of the study, several recommendations for developing the 21st-century skills of the pre-service teachers were proposed. Some of these recommendations were based on the challenges identified in the study. The recommendations were intended to help the pre-service teachers enhance their competencies for effective teaching and learning in the contemporary educational environment. For example, though the pre-service teachers were confident in information collection and question formulation, they experienced difficulties in evaluating the reasoning and evidence of others. To enhance their evaluative skills, teacher education programs could consider incorporating activities that require the pre-service teachers to engage in evaluating arguments critically. For example, incorporating case studies or debate sessions would help the pre-service teachers practice their skills in analyzing and evaluating arguments critically. Moreover, incorporating real-life scenarios where the students would be required to evaluate information critically would help them enhance their evaluative skills.

The study found that the pre-service teachers were highly collaborative in nature, particularly in respecting other people's opinions and being supportive of team members. However, there is room for improvement in team preparation and non-verbal communication during presentations. To enhance the team preparation and non-verbal communication skills of the pre-service teachers would benefit from teacher education programs. Regarding communication skills, the study suggested that there is a need for improvement in the presentation of information in a concise manner and the completion of tasks independently. To improve communication skills among pre-service teachers, training programs should focus on strategies that help pre-service teachers organize their thoughts and communicate effectively. The training programs should include workshops on the importance of communication and the use of structured writing. In addition, training pre-service teachers on self-regulation strategies will help them become independent learners and build self-efficacy in completing tasks. Training pre-service teachers on how to set goals and become accountable for their work will enhance their communication and self-regulation skills.

Lastly, while pre-service teachers showed confidence in their creativity, there is a need for improvement in the transfer of knowledge from one context to another. Creativity in teaching is the ability to generate original ideas and apply knowledge in a flexible manner. To enhance the creativity of pre-service teachers, training programs should expose pre-service teachers to inter-disciplinary approaches and cross-subject projects. Incorporating project-based learning strategies that allow students to apply concepts from one subject area to another will enhance the creativity of pre-service teachers. In addition to that, incorporating experiential learning strategies, such as teaching simulations or experiments, will also facilitate adaptive thinking skills and allow for more creative and innovative teaching strategies.

Conflict of Interest

The author does not disclose any potential conflicts of interest, financial or otherwise, that could be perceived to influence the work.

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