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Implementation of 21st-Century Skills in General Mathematics and Its Impact on Student Performance: Bases for Developing a Self-Learning Module

Christine I. Catyong Pericano[1,*)] & Leonard [2)]
[1)] Cebu Technological University San Francisco Campus, Cebu, Philippines
[2)] Universitas Indraprasta PGRI, Jakarta, Indonesia

Abstract

Mathematics plays a crucial role in the 21st century because it emphasises logical and systematic problem-solving processes. This research evaluated the implementation of 21st-century skills in general mathematics instruction and the mathematics performance of the Cebu Technological University San Francisco Campus students for the Academic Year 2022-2023. The study employed a descriptive-correlational research design, utilising researcher-modified questionnaires anchored from the P21 framework, which were pilot-tested, expert-reviewed, and validated. It involved 203 students and perceived a very satisfactory implementation of the 21st-century skills of critical thinking, communication, problem-solving, collaboration, and perseverance in general mathematics instruction. Also, it assessed the students' mathematics performance using a 30-item multiple choice test and found poor performance in all six topics. The study found a weak but statistically significant relationship between the implementation of 21st-century skills and mathematics performance. Among the skills, collaboration showed the strongest positive relationship with mathematics performance, followed by communication, perseverance, and critical thinking. Surprisingly, problem-solving did not demonstrate a significant relationship, suggesting that other factors may also influence performance. The findings emphasise the importance of these skills in improving mathematics performance and provide a foundation for the development of a contextualised self-learning module in general mathematics. Further research is recommended to validate these findings.

Keywords: 21st century skills, mathematics performance, descriptive-correlational, education in the 21st century

(*) Corresponding Author: catyongc@gmail.com

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INTRODUCTION

Mathematics is indispensable in shaping 21st-century progress due to its prominence in logical and systematic problem-solving processes. According to the OECD's Program for International Student Assessment (PISA) report in 2018, mastering mathematics historically involves performing basic arithmetic skills (Suzette et al., 2024). However, the concept of mathematical performance has changed due to the growing digitisation of many facets of life, placing more emphasis on the capacity for critical thought, sophisticated problem-solving, and active participation in society. This development emphasises the necessity of a more comprehensive skill set that goes beyond basic mathematics.

In this context, the focus of education should move towards equipping students with essential skills that allow them to apply their knowledge across various disciplines

and real-world situations effectively. These abilities—known as 21st-century skills—include communication, problem-solving, critical thinking, collaboration, and perseverance. They are becoming more widely acknowledged as essential to preserving a person's competitiveness in the constantly changing environment of today (Joynes et al., 2019). This concept is not only a reflection of current educational needs but also a response to the demands of modern economies that require individuals to navigate complex global challenges.

During the 2013 Asia-Pacific Education Research Institutes Network (ERI-Net) Phase 1 study of Transversal competencies in Education Policy and Practice, critical thinking, communication, problem-solving, and collaboration are recognised as essential skills of 21st-century economies by all ten countries in the Asia-Pacific region, which includes Australia, Hong Kong, China, India, Japan, the Republic of Korea, Malaysia, Mongolia, the Philippines, and Thailand (Yoko, 2015). Additionally, the concept of personal abilities such as perseverance, which reflects affective traits, was also highlighted as crucial.

The UNICEF classified critical thinking and problem-solving as cognitive skills, communication as an interpersonal skill, and perseverance as a personal skill. These skills are also included in the objectives of Education for Sustainable Development (ESD) and Global Citizenship Education (GCED), mainstreaming them across courses of action, curricular areas, pedagogical practices, and assessments (Chiba et al., 2021).

In the Philippine context, the integration of 21st-century skills into educational policy is evident in the 2002 Basic Education Curriculum, the 2010 Revised Secondary Education Curriculum, and the new K–12 Enhanced Basic Education Curriculum, all of which emphasise the importance of these skills (Abejuela et al., 2022). Furthermore, higher education institutions (HEIs) are expected to develop curricula that not only impart core knowledge but also equip students with the necessary skills for the modern workforce (Pagaran et al., 2022; Capuno et al. (2019; Capuyan et al., 2019).

Martinez (2022) discovered that incorporating 21st-century skills into the teaching of mathematics through innovative strategies can foster curiosity, adaptability, and a lifelong passion for learning among students. However, challenges remain. Etcuban et al. (2019) discovered that many students struggle to grasp abstract mathematical concepts. Valderama (2022) noted that in the 2018 PISA examination, over 50% of Filipino students scored below the lowest competency level. These difficulties were made worse by the COVID-19 epidemic, as many children were left more susceptible to the detrimental effects on their education due to the disruptions to traditional teaching techniques and remote learning, which resulted in lower performance in mathematics and problem-solving abilities.

In response to the challenges faced in mathematics education, this study intends to analyse the implementation of 21st-century skills in general mathematics instruction and their effect on students' performance. The study will offer important insights into how these competencies affect learning outcomes by investigating the relation between students' performance in mathematics and the integration of these skills. The findings will serve as a foundation for the development of a contextualised self-learning module (SLM) designed to support the long-term enhancement of both 21st-century skills and mathematics performance.

This study takes a localised approach, focusing on general mathematics students at Cebu Technological University (CTU) San Francisco Campus. By focusing on this particular environment, the study guarantees that its findings are immediately applicable to the local student body, providing workable answers for both present and future instructional needs. The importance of this study, therefore, resides not only in its ability

to enhance mathematics education but also in its capacity to direct future educational strategies and the creation of specialised learning resources.

METHODS

The study used the descriptive-correlation research design to investigate the relationship between implementing 21st-century skills and the students' mathematics performance. The online and printed survey questionnaires were piloted, expert-reviewed, and used to assess the implementation of 21st-century skills, while the topics were covered in the approved general mathematics course syllabus.

The research was conducted at CTU San Francisco Campus, the sole State University in the Camotes Group of Islands in the Philippines. CTU San Francisco Campus is one of the many satellite campuses of CTU, a leading institution of higher education in Cebu City, Philippines, specialising in Technology, Engineering, and Agriculture. It has been awarded the top university for national and international accredited programs in the Philippines and Asia.

The respondents were the 203 students at CTU San Francisco Campus who took general mathematics during the academic year 2022-2023. These respondents were identified using purposive quota sampling. They utilised modified questionnaires anchored from the Partnership for the 21st Century (P21) Framework containing pertinent items to compile data relating to implementing 21st-century skills. Two separate questionnaires were given to the student respondents.

The first set consisted of two parts: Part I included an informed consent form for voluntary participation, while Part II assessed the implementation of 21st-century skills—critical thinking, communication, problem-solving, collaboration, and perseverance—in mathematics instruction. A clear framework for evaluation was provided by the five-point rating scale, which ranged from 4.21–5.00 (excellent), 3.41-4.20 (very satisfactory), 2.61-3.40 (satisfactory), 1.81-2.60 (unsatisfactory), and 1.00–1.80 (not implemented). The second set measured students' mathematics performance through a 30-item multiple-choice test based on topics from the approved General Mathematics course syllabus. The level of student performance in mathematics was evaluated using a transmuted scoring system. Scores were categorised as follows: 1.0-1.5 (superior), 1.6-2.0 (very good), 2.1-2.5 (good), 2.6-3.0 (fair), and 3.1-5.0 (poor) mathematics performance.

The following procedures were carefully observed while conducting this research. Before the study was conducted, the approved letter request was obtained from the campus director, local research ethics chairman, and college director. The researcher then communicated with the chairpersons of each undergraduate program about the purpose of the study, the confidentiality of the data, and the importance of their answers in achieving the study's objectives. The researcher complied with ethical standards by getting the group respondents' informed consent and putting their welfare first.

In order to examine and interpret the quantitative data, the gathered information was methodically processed using suitable statistical techniques, including weighted mean, frequency, simple percentage, and Spearman's rank correlation. The result provided the foundation for the summary, conclusion, and recommendations. It served as the basis for the development of the contextualised self-learning module, which was crafted after all the findings were thoroughly analysed.

RESULTS & DISCUSSION

Results

This section presents the respondents' perspectives on the implementation of 21st-century skills, including critical thinking, communication, problem-solving, collaboration, and perseverance. It also provides an overview of the students' general mathematics performance, evaluated based on the topics outlined in the approved course syllabus, such as Mathematics in Our World, Mathematical Language and Symbols, Problem-Solving and Reasoning, Data Management, Mathematics of Finance, and Codes. Additionally, this section highlights the relationship between the implementation status of 21st-century skills in general mathematics instruction and the student's mathematics performance.

Status of Implementation of the 21st-Century Skills in General Mathematics Instruction

Critical thinking has been described as an ability to question, acknowledge, and test previously held assumptions; recognise ambiguity; examine, interpret, evaluate, reason, and reflect; make informed judgments and decisions; and clarify, articulate, and justify positions. Critical thinking is a pivotal element within the cognitive skills category. According to Utami et al. (2019), critical thinking skills encompass various aspects such as interpretation, analysis, evaluation, inference, explanation, and self-regulation.

Table 1 shows the respondents' perceptions about the status of implementation of critical thinking skills in general mathematics.

Table 1. Students Critical Thinking Skills

#	Indicator	Mean	Interpretation
1.	Incorporate activities or lessons that allow students to use inductive and deductive reasoning.	3.49	Very Satisfactory
2.	Provide opportunities for students to adapt reasoning strategies when solving math problems.	3.61	Very Satisfactory
3.	Encourage students to explain and justify answers during math discussions or activities.	3.42	Very Satisfactory
4.	Integrate open-ended questions or tasks requiring students to find connections between mathematical concepts.	3.56	Very Satisfactory
5.	Use real-world examples or scenarios to stimulate critical thinking and application of mathematical concepts.	3.38	Satisfactory
6.	Incorporate groups or collaborative activities to allow students to consider different points of view.	3.40	Satisfactory
7.	Provide feedback or guidance on students' learning experiences and processes in math.	3.52	Very Satisfactory
	Aggregate Mean :	3.48	Very Satisfactory

Communication skills are integral to everyday professional interactions; the ability to communicate clearly, effectively, and efficiently is crucial. It is an interpersonal skill that involves the ability to articulate information or ideas clearly through various media, including verbal, non-verbal, and digital channels (Khaparde, 2020). Mastering these skills is vital for fostering understanding, collaboration, and engagement in diverse contexts.

Table 2 shows the respondents' perceptions about the status of implementation of communication skills in general mathematics.

Table 2. Students' Communication Skills

#	Indicator	Mean	Interpretation
1.	Provide opportunities to articulate mathematical thinking/reasoning.	3.55	Very Satisfactory
2.	Encourage students to express mathematical ideas orally and in writing.	3.37	Satisfactory
3.	Engage students in activities utilising diagrams in presenting math concepts.	3.55	Very Satisfactory
4.	Give opportunities to collaborate and discuss math concepts or solutions with peers.	3.76	Very Satisfactory
5.	Allow the use of technology tools or platforms that support the communication of mathematical ideas.	3.58	Very Satisfactory
6.	Assess and evaluate students' communication skills by asking questions for deeper understanding.	3.76	Very Satisfactory
	Aggregate Mean :	3.59	Very Satisfactory

Problem-solving involves critical thinking, decision-making, creativity, and information processing. Rahman (2019) outlines problem-solving as a systematic procedure encompassing deliberate observation and discerning analysis to discover a fitting solution for achieving the intended objective. Students possessing strong problem-solving skills can engage in both analytical and creative thinking (Choudhar et al., 2022).

Table 3 shows the respondents' perceptions about the status of problem-solving skills in general mathematics.

Table 3. Students' Problem-Solving Skills

#	Indicator	Mean	Interpretation
1.	Encourage students to apply problem-solving strategies and creative techniques when solving math problems.	3.39	Very Satisfactory
2.	Present-real world or contextualised and nonfamiliar math problems.	3.23	Satisfactory
3.	Students can seek different perspectives, collaborate with their peers, and solve math together.	3.67	Very Satisfactory
4.	Guide the students by breaking down complex math problems into manageable parts.	3.71	Very Satisfactory
5.	Allow students to ask questions when finding problem-solving approaches.	3.77	Very Satisfactory
6.	Initiated class discussions or reflections to help students understand different problem techniques.	3.66	Very Satisfactory
7.	Assess and evaluate problem-solving skills by asking questions that require the application of mathematical concepts.	3.35	Satisfactory
	Aggregate Mean :	3.54	Very Satisfactory

Collaboration skill denotes an individual's capacity to effectively collaborate with others within a group or team setting, with the objective of attaining mutual goals or accomplishing collective tasks. Collaboration is fundamental and essential and goes beyond any specific profession or domain. It plays a crucial role in various aspects of life, making it valuable in both personal and professional contexts.

Table 4 shows the respondents' perceptions of the implementation of collaboration skills in general mathematics.

Table 4. Students Collaboration Skills

#	Indicator	Mean	Interpretation
1.	Encourage the students to work in diverse teams to solve math problems.	3.68	Very Satisfactory
2.	Assign students with group projects or activities that involve working together to accomplish a math-related goal.	3.89	Very Satisfactory
3.	Engage students in effective communication by sharing ideas with their classmates.	3.80	Very Satisfactory
4.	Provide guidance or strategies to the students on how to be adaptable with others when working towards a common goal.	3.73	Very Satisfactory
5.	Allow students to give feedback, support, and assistance to their classmates	3.89	Very Satisfactory
6.	Assess and evaluate the students' collaborative skills as part of math learning.	3.72	Very Satisfactory
	Aggregate Mean :	3.79	Very Satisfactory

Perseverance skills enable students to become more resilient, determined, and capable individuals. According to Prastiti (2020), students' persistence in working through mathematical problems increased through problem-based learning. It emphasises how goal-setting and self-monitoring skills may be taught to students through problem-based learning, supporting the idea that perseverance skills can be encouraged and learnt in mathematics. Individuals must learn from mistakes and keep working toward their goals in an uncertain world.

Table 5 shows the respondents' perceptions of the implementation of perseverance skills in general mathematics.

Table 5. Students' Perseverance Skills

#	Indicator	Mean	Interpretation
1.	Include activities that promote persistence.	3.69	Very Satisfactory
2.	Provide challenging math activities for students to persevere.	3.69	Very Satisfactory
3.	Encourage students to set goals and work through challenging tasks.	3.78	Very Satisfactory
4.	Incorporate open-ended problems that require sustained efforts.	3.70	Very Satisfactory
5.	Encourage students to manage time effectively amidst difficulties or obstacles in math.	3.64	Very Satisfactory
6.	Engage students in reflective discussions or activities to foster a growth mindset and resilience.	3.79	Very Satisfactory
	Aggregate Mean :	3.72	Very Satisfactory

Table 6 revealed the summarised perception of the status of implementing 21st-century skills in general mathematics.

Table 6. Status of Implementation of 21st Century Skills in General Mathematics Instruction

#	21st -Century Skills	Mean	Interpretation
A.	Critical Thinking	3.48	Very Satisfactory
B.	Communication	3.59	Very Satisfactory
C.	Problem-Solving	3.54	Very Satisfactory
D.	Collaboration	3.79	Very Satisfactory
E.	Perseverance	3.72	Very Satisfactory
	Overall Aggregate Mean :	3.62	Very Satisfactory

Academic Performance Level of the Students in General Mathematics

This section offers a comprehensive analysis of students' performance in general mathematics, a three-unit course designed to enhance students' understanding of the fundamental nature of mathematics, emphasising its practical, cognitive, and aesthetic dimensions. It aims to equip students with the skills to apply mathematical concepts in real-world scenarios, fostering a deeper appreciation for the role of mathematics in everyday life.

Table 7 presents the results on the performance level of students enrolled in general mathematics.

Table 7. Students' Performance Level in General Mathematics

#	Topics in General Mathematics	Mean	Interpretation
A.	Mathematics in our World	3.2	Poor
B.	Mathematical Language and Symbols	3.7	Poor
C.	Problem Solving and Reasoning	3.3	Poor
D.	Data Management	3.4	Poor
E.	Mathematics of Finance	3.3	Poor
F.	Codes	3.3	Poor
	Overall Aggregate Mean :	3.4	Poor

The study hypothesised that the status of implementing 21st-century skills in general mathematics significantly affects students' academic performance (Table 8).

Table 8. Relationship between 21st Century Skills Implementation and Students' Level of Mathematics Performance (alpha = 0.05)

Variables	Computed Spearman's r_s	Critical value	Decision	Interpretation
Critical Thinking	0.1465	0.0371	Reject H_0	Significant
Communication	0.1811	0.0097	Reject H_0	Significant
Problem-Solving	0.0848	0.2289	Accept H_0	Not Significant
Collaboration	0.2746	0.00007	Reject H_0	Significant
Perseverance	0.1981	0.0046	Reject H_0	Significant
Status of 21st-century skills implementation and mathematics performance of the students	0.2067	0.0031	Reject H_0	Significant

Discussions

Critical Thinking Skills

Critical thinking is the ability to question, acknowledge, and test previously held assumptions; recognise ambiguity; examine, interpret, evaluate, reason, and reflect; make informed judgments and decisions; and clarify, articulate, and justify positions. Critical thinking is a pivotal element within the cognitive skills category. These skills encompass various aspects such as interpretation, analysis, evaluation, inference, explanation, and self-regulation (Akcaoğlu et al., 2023; Susiani et al., 2018; Elisanti et al., 2017).

Table 1 features students' viewpoints concerning the status of implementing critical thinking skills into general mathematics. Notably, students' perceptions regarding the integration of essential thinking skills diverged.

Based on the data, providing opportunities for students to adapt reasoning and strategies when solving math problems had the highest total weighted mean value of 3.61, which means this indicator was very satisfactorily implemented.

On the other hand, specific indicators, such as using real-world examples or scenarios to stimulate critical thinking and application of mathematical concepts, earned the lowest mean value of 3.38. This means this indicator was satisfactorily implemented, and the implementation status sometimes meets expectations. The critical thinking skill was very satisfactorily implemented in general mathematics instruction, with an aggregate mean value of 3.48, suggesting that the implementation status meets and often exceeds expectations. These imply that incorporating critical thinking instruction into specific fields like mathematics can notably improve students' development as adept critical thinkers.

Considering the previous findings, Dahari et al. (2019) argue that integrating critical thinking into knowledge acquisition can enhance meaningful learning outcomes. Moreover, Dolapcioglu and Doganay (2020) identified that practices aligned with authentic learning standards, such as comprehension, comparison, proof, proposing novel solutions, and reflection, effectively enhance critical thinking abilities. These findings collectively emphasise the importance of introducing teaching-learning activities to cultivate essential thinking skills in mathematics instruction.

Communication Skills

Employers consistently included communication skills as one of the most commonly requested skills in job postings. Improving and showcasing communication skills can help advance a career and stay competitive in today's job market. Learning about these skills can also help focus on specific areas of communication. The ability to communicate effectively is necessary for both providing and receiving various types of information.

Even though these abilities may be necessary for day-to-day job operations, effective and efficient communication is essential. It is a component of interpersonal skill described in the P21 framework, which refers to the ability to use words effectively to impart information using different forms of media (Bravo et al., 2021). Communication allows us to connect by expressing our needs and sharing our experiences. It enables the sharing of thoughts, information, and emotional expression. These involve listening, speaking, observing, and empathising. Recognising the distinctions between in-person contacts, phone calls, and digital communications, such as social media and email, is also beneficial.

Table 2 shows students' perception of implementing communication skills in general mathematics. The viewpoints of students concerning implementing communication

skills need to be revised; however, the responses indicated that giving opportunities to collaborate and discuss math concepts or solutions with peers, as well as assessing and evaluating students' communication skills by asking questions for deeper understanding, got the highest weighted mean value equal to 3.76, which suggest a very satisfactory implementation of communication skills in mathematics instruction.

The very satisfactory implementation of technology entails that its potential is recognised in facilitating communication and learning experiences in the mathematics classroom. These argue that technology should be harnessed to enhance students' grasp of mathematical concepts and foster their intuitive aptitudes. The aggregate mean of the communication skills is 3.59, interpreted as Very Satisfactory. This suggests that specific to these indicators, the implementation status of communication skills in general mathematics instruction meets and often exceeds expectations. As an HEI, it is vital to develop student's communication skills through constant maneuvering and alignment of communication behaviour (Touloumakos, 2023).

Problem-Solving Skills

Table 3 reveals that the indicator "Allow students to ask questions in finding problem-solving approaches" got the highest mean of 3.77 (Very Satisfactory). In contrast, the indicator "Present-real world or contextualised and nonfamiliar math problems" got the lowest mean of 3.23 (Satisfactory). These indicate that the implementation of assessment and evaluation of problem-solving skills, as well as using contextualised problems.

Facilitating problem-solving skills relies on effective teaching methods and fostering higher-order learning, as emphasised by Zhao et al. (2021). The demand for problem-solving proficiency among students is a pivotal requirement in the modern era, constituting a crucial competency for the 21st century.

Collaboration Skills

Table 4 shows that the indicators "Assign students with group projects or activities that involve working together to accomplish a math-related goal" and "Allow students to give feedback, support, and assistance to their classmates" got the highest mean of 3.89 (Very Satisfactory). However, despite all these indicators being very satisfactorily implemented, it is evident that the students need more encouragement to work in diverse teams to solve math problems because it garnered the lowest mean value of 3.68 (Very Satisfactory).

This suggests that students who seek to promote group work should actively support the diversification of group work methods, especially when dealing with complex mathematical problem-solving or any situation where individual approaches prove too tricky. Diversifying modes of group work can advance mathematical problem-solving. Harper and Crespo (2020) highlight the importance of building a collaborative classroom culture to engage students in severe mathematical work. Moreover, Wayesa (2020) revealed that group discussion is essential for learning math, and group work can help students develop cognitive abilities.

Perseverance Skills

In today's fast-paced and rapidly changing environment, people frequently experience setbacks and challenges in various areas. Perseverance is the capacity to persevere and maintain effort amidst difficulties.

Table 5 shows that the indicator "Engage students in reflective discussions or activities to foster a growth mindset and resilience" got the highest mean of 3.79 (Very Satisfactory). The indicator "Encourage students to manage time effectively amidst difficulties or obstacles in math" got the lowest mean of 3.64 (Very Satisfactory). The data imply that perseverance is vital to 21st-century life skills. It empowers students to thrive in an ever-changing world, tackle challenges, and achieve personal and professional aspirations to become more resilient, determined, and capable.

According to Prastiti (2020), problem-based learning increases students' persistence in working through mathematical problems. It emphasises how goal-setting and self-monitoring skills may be taught to students through problem-based learning, supporting the idea that perseverance skills can be encouraged and learned in mathematics. Individuals must learn from mistakes and work toward their goals in an uncertain world.

Status of Implementation of 21st-Century Skills in General Mathematics Instruction

Recognised as a fundamental subject in 21st-century education, mathematics is pivotal in furnishing students with essential proficiencies for triumph in diverse academic and vocational realms. Mathematics necessitates articulating quantities, correlations, and spatial notions through numerical representations and assorted mathematical instruments.

The status of implementing 21st-century skills in general mathematics resulted in an overall aggregate mean of 3.62, signifying that these 21st-century skills were very satisfactorily implemented within the research environment.

Collaboration garnered the highest weighted mean value of 3.79 among the five skills. It was closely trailed by perseverance, which achieved a mean score of 3.72. Communication skills followed with a mean score of 3.59, and problem-solving skills obtained a mean score of 3.54. Critical thinking skills ranked last, attaining the lowest weighted mean value of 3.48. These results indicated that the students implemented the identified skills in general mathematics. However, skills still need to be excellently implemented, underscoring room for further improvement.

The notion of 21st-century skills is frequently defined by their broad applicability, suggesting that these skills can be employed and transferred across various settings (Van Laar et al., 2020). The recognised 21st-century skills possess significance spanning diverse domains, subjects, and scenarios.

Academic Performance Level of the Students in General Mathematics

Table 7 summarises the student's performance level in general mathematics, particularly mathematics in our world, mathematical language and symbols, problem-solving and reasoning, data management, mathematics of finance, and codes, as evaluated through 30-item multiple-choice test questions.

The performance level of students was evaluated according to the five topics in general mathematics. This accumulated an overall aggregate mean equal to 3.4, which means that the students perform poorly in general mathematics. Mathematics in our world has the highest mean value of 3.2, followed by problem-solving and reasoning, mathematics of finance, and codes, which have a mean value of 3.3. Data management came next with a mean value of 3.4, while mathematical language and symbols got the lowest mean value of 3.7. This emphasises that students need help answering the mathematical language and symbols in particular. It implies that students' performance is crucial in producing high-quality graduates who will serve as outstanding leaders and personnel for the country and thus be accountable for its economic and social progress. Educational services transform learners' knowledge, life skills, and behaviour.

If students need help understanding basic math concepts, this can lead to negative perceptions of math and a lack of integration of math into daily life (Lafuente-Lechuga et al., 2024; Gonzalez et al., 2023). Strategies such as providing more examples using contextual-based learning models and project assignments related to math applications can improve students' perspectives and understanding of math.

Test of Significance of the Relationship

The null hypothesis (H_0) was tested at the 0.05 level of significance to determine whether there was a statistically significant relationship between the implementation of 21st-century skills in general mathematics instruction and the student's mathematics performance.

As indicated in Table 8, among the individual skills, collaboration demonstrated the strongest positive relationship with mathematics performance, as indicated by Spearman's value of 0.2746. This highlights the pivotal role of teamwork and cooperative learning in enhancing students' ability to engage with mathematical concepts. Communication and perseverance also showed a significant positive relationship with mathematics performance, with Spearman's values of 0.1811 and 0.1981, respectively. While the strength of this relationship is weaker than that of collaboration, their significance underscores the importance of effective expression and determination in learning mathematics. Critical thinking also exhibited a significant but weaker relationship, with a Spearman's value of 0.1465. Surprisingly, problem-solving skills, often fundamental in mathematics, did not show significant relations with a Spearman's value of 0.0848. This might indicate that problem-solving requires the support of other skills for improvement.

With a critical p-value of 0.0031 and a computed Spearman's correlation value of 0.2067, the analysis of the significant relationship between the student's performance level in mathematics and the implementation status of 21st-century skills in general mathematics revealed a statistically significant weak relationship. This suggests that students. Success in general mathematics is greatly impacted by the degree to which 21st-century skills are put into practice. It also means that performance in mathematics may potentially be significantly influenced by other variables as well.

Additionally, the creation of an SLM could provide a scalable, flexible solution that aids students in mastering mathematical concepts as well as acquiring the essential 21st-century skills required for success in the modern world.

CONCLUSION

The study discovered that students' performance in mathematics remained low even though the implementation of 21st-century skills—such as communication, problem-solving, critical thinking, perseverance, and teamwork—was deemed very satisfactory. With a correlation coefficient of 0.2067 and a significant p-value of 0.0031, a statistical study employing Spearman's rank correlation showed a weak positive relationship between mathematics performance and the level of 21st-century skills implementation. The weak relationship suggests that improving these skills alone might not be enough to significantly enhance students' performance in mathematics.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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