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Research Article

21st-Century Teaching Competencies, Learning Skills and Science Content Knowledge of STEM Students Among the DepEd Schools in the Province of Capiz: A Basis for Enhancement Program

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ABSTRACT

The mixed-method research design was used to determine the level of 21st-century teaching competencies, learning skills, and science content knowledge of STEM 12 students in the province of Capiz for the school year 2023-2024. The participants of this study were the 306 STEM 12 students from a total population of 1, 446 in the province of Capiz selected through stratified random sampling using the Raosoft sample size calculator. The research instruments used in this study were the 21st-century teaching competencies questionnaire, 21st-century learning skills questionnaire, and a science content knowledge test with the demographic profile of the respondents. The questionnaires were composed of**:** A 70-item researcher-made 21st-century teaching competencies questionnaire; 120-item 21st-century learning skills and an 80-item science content knowledge test adopted from Competency Based Assessment – DepEd (School Division of Capiz, 2021). Another instrument used in this study was the Focus Group Discussion (FGD) Guide. It was conducted to gather qualitative data for triangulation with the quantitative data gathered. Mean, frequency, percentage, and standard deviation were used for descriptive data analysis, while analysis of variance and Pearson r were used for inferential data analysis at 0.05 level of significance. The results show that STEM 12 teachers exhibited a high level of 21st-century teaching competencies across various aspects, such as magnifying meaning, elevating experience, amplifying agency, curating curriculum, busting barriers, teaching technology, and revamping roles. Similarly, STEM 12 students demonstrate a very high level of 21st-century learning skills, with critical thinking rated as high and other skills like creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills rated as very high. Regarding science content knowledge, STEM 12 students were found to have a high level of understanding, with General Biology I rated as high and

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General Physics I rated as moderately high. Notably, the study identified significant relationships between 21st-century learning skills and teaching competencies, as well as between 21st-century learning skills and science content knowledge. However, no significant relationship was observed between 21st-century teaching competencies and science content knowledge.

Based on the results, an enhancement program will be implemented to sustain and enhance the 21st-century teaching competencies of teachers, learning skills, and science content knowledge of students.

Keywords: *21st-Century Teaching Competencies, 21st-Century Learning Skills, Science Content Knowledge*

Introduction

Approaching a time of great change, the collective insights of centuries of experience and knowledge will become accessible to anyone, anywhere in the world. Today's world is characterized by rapid change and constantly evolving technology, which has a significant impact not only on people's lives but also on the educational system. Schools serve as hubs for teachers and students to connect with the world and understand the challenges that modern society faces. Therefore, both teachers and students need to have the necessary 21st-century skills to cope with the challenges of today's world.

The 21st-century teaching competencies represent diverse skills necessary for effective modern education. These competencies enable educators to magnify meaning by connecting content to real-world applications, fostering relevance and student engagement (Zhao, 2015). Teachers elevate experience through hands-on, experiential learning that deepens content understanding (Lombardi, 2016) while amplifying agency empowers students to take ownership of their educational journey (Lee & Hannafin, 2016). By curating a curriculum tailored to diverse backgrounds, teachers create inclusive environments that address students' varied needs (Renzulli, 2017). Overcoming educational obstacles, or busting barriers, ensures equitable access through differentiated instruction (Brown, 2019) while teaching technology equips students with digital fluency by integrating relevant tech tools (Trust & Pektas, 2018). The evolving role of educators as facilitators, or revamping the teacher's role, transforms them from content gatekeepers to guides for student-directed learning (Fullan & Quinn, 2016).

Alongside these competencies, learning skills—including the "4Cs" of critical thinking, creativity, collaboration, and communication—are essential for student success in a dynamic world. Critical thinking involves analyzing and evaluating information objectively to make informed decisions, while creativity encourages generating new ideas and solutions beyond conventional approaches (Paul & Elder, 2019; Runco & Jaeger, 2019). Collaboration involves working effectively with others, fostering teamwork and shared responsibility, while communication includes the clear exchange of ideas through written, verbal, and digital platforms (Johnson & Johnson, 2018; Hargie, 2021). In addition to the 4Cs, literacy skills in information, media, and technology are also crucial. Information literacy enables students to locate, assess, and responsibly use information; media literacy promotes critical engagement with media and an understanding of its influence on perception (Eisenberg, 2018; Potter, 2020); and technology literacy equips learners to navigate digital tools and platforms, fostering adaptability in tech-driven environments (Hobbs & Coiro, 2019).

Other valuable skills—flexibility, leadership, initiative, productivity, and social skills—further support adaptability and teamwork. Flexibility and leadership are essential for adapting to new challenges and guiding others toward shared goals (DeRue et al., 2017;

Northouse, 2019). The initiative reflects a proactive ability to take charge and act independently, while productivity encompasses effective time management and efficient task completion (Duckworth et al., 2018; Csikszentmihalyi, 2016). Social skills, including positive interpersonal interactions, empathy, and conflict resolution, are crucial for collaborative learning and problem-solving (Goleman, 2017).

Science content knowledge in foundational fields such as physics (e.g., force, energy) and biology (e.g., ecosystems, biological processes) supports these competencies, preparing students to apply scientific principles in various contexts (Bybee, 2018). Together, these skills equip educators and learners to succeed in complex, technology-driven environments.

The 21st-century learning skills are a set of abilities and qualities that can be learned or taught to enhance thinking, learning, working, and living in the modern world. These skills include critical thinking, collaboration, communication, creativity, information, media, and technology literacy, flexibility, leadership, initiative, productivity, and social skills (Hummel, 2022). According to Education Reform (2016), 21st-century skills are a broad set of knowledge, skills, work habits, and character traits that are believed by educators, school reformers, college professors, employers, and others to be critically important to success in the 21st-century world.

The rapid changes brought about by the 21st-century world have undoubtedly affected our educational system, leading to the creation of facile solutions to complex problems. Teachers and students now have access to technology, which plays a crucial role in providing high-quality education throughout the community and the rest of the world.

There is a considerable emphasis on the integration of new technologies in teaching and learning (Ilomäki & Lakkala, 2018). These technologies include laptops, whiteboards, smartboards, mobile devices, and online learning platforms (Staddon, 2020). According to Demir and Akpinar (2018), mobile devices such as smartphones and tablets continue to transform our lives as they allow connectivity, communication, and collaboration in an ever-changing world. Teachers and learners can gain new knowledge, skills, and experiences through the use of digital technologies in the classroom (Demir & Akpinar, 2018). The use of technology broadens our perspectives and frees us from the internet's unstoppable ideas.

However, as the 21st-century world expands the horizons of educators and students, it creates a deep divide among educational stakeholders. The question arises whether both teachers and students possess the necessary 21st-century teaching competencies and learning skills or merely artificial knowledge brought about by the integration of technologies in education.

According to the Programme for International Student Assessment (PISA, 2022), the Philippines ranked 77th out of 81 countries globally in the said student assessment. This test explores how well students can solve complex problems, think critically, and communicate effectively, indicating that Filipino learners continue to lack the necessary 21st-century skills in the area of science, including general biology and physics.

The problem in the Philippines has been evident for years. The PISA result begs the question: why do Filipino students continue to lag behind other countries in global education assessments? The Department of Education (DepEd) and the Senate of the Philippines believed that, aside from a lack of resources, students' learning skills in the 21st- century still need improvement. They focused on mere memorization, which is a low-order thinking skill, while PISA questions require critical thinking, which is one of the essential 21st-century skills. Learners should be taught to solve real-life problems, which is a form of higher-order thinking skill.

To solve the problems of the modern world, 21st-century students need higher-order thinking skills called 21st-century learning skills. Critical thinking is one such unique higher-order thinking skill. Students should be able to apply the knowledge and skills they have acquired during learning in real-life situations (Hafni, 2018). According to Sunarti et al., (2023), thinking skills are crucial for students to master to compete in the era of technological development and the demands of the 21st-century. Critical thinking skills are not seen in the

department but in the ability of each individual to solve problems in the 21st century.

Additionally, Miterianifa etal., (2020) emphasized that the 21st century demands critical thinking skills as one of its essential skills. Critical thinking skills are crucial in preparing students to tackle social, scientific, and practical problems effectively in the future. The 21st-century learning skills are a set of capabilities and competencies that students must acquire to succeed in their work and life in today's modern world (Sumen and Calisici, 2017).

In today's modern world, 21st-century teaching competencies also play an important role in students' learning. Teachers should guide and support their students' production readiness, curiosity, problem-solving skills, and critical thinking as the facilitators of learning (Kıyasoğlu, 2019). All individuals need to develop these 21st-century skills, which is only possible with a learning and teaching environment based on 21st-century knowledge and skills.

Fernando and Asavisanu (2022) supported the idea that teachers have a critical role to play in instilling these essential 21st-century skills in their students, and teaching competencies are vital for that. The 21st-century teaching competencies are more than just knowledge and skills and involve the teacher's abilities to magnify meaning, elevate experience, amplify agency, curate curriculum, bust barriers, teach technology, and revamp their roles to mobilize the acquired knowledge and resources effectively (Kary, 2022). To possess 21st-century teaching competencies, teachers should demonstrate leadership, establish a respectful environment for a diverse population of students, know the content they teach, facilitate learning for their students, and reflect on their practice (Nessipbayena, 2022). These competencies are essential for teachers to become effective and efficient educators in the 21st-century.

Furthermore, according to a study conducted by the World Bank (2016), the knowledge of teachers and the teaching method used for a subject were significant determinants of students' learning outcomes in the Philippines. Among all the subjects, Science got the lowest rating from the students. It means that the students have a hard time understanding science content knowledge, specifically General Physics and Biology, as stated by Zimmerman and Maker (2020).

With regard to science content knowledge particularly General Biology, the Philippines is one of the nation's facing issues with high school biology academic performance. Biological education in the Philippines, especially at the basic education level, is lagging behind the rest of the world. Students' performance falls below expectations based on standardized national assessments (Organisation for Economic Co-operation and Development (2020). The Philippines also ranks 42nd in science out of 45 countries that took the Trends in Mathematics and Science Survey (TIMSS). The most significant challenges in learning biology are a lack of teachers, students' lack of motivation, low self-confidence in learning biology, a large number of students in each class, a lack of connection to other lessons, an inadequate number of laboratory equipment and facilities, and inadequate time allocation for biology education despite an intensive curriculum (Kaptan & Timurlenk, 2014).

A study conducted by Miranda (2019) at a HEI-supervised and DepEd school in the Philippines revealed that the literacy level of science content knowledge specifically in general physics and application of students is at a low mastery level, with only three students achieving mastery. This indicates that students lack sufficient knowledge in the field of physics.

To foster 21st-century learners, it is crucial to prioritize teachers' 21st-century teaching competencies, provide opportunities for teachers and students to enhance their skills, and rethink how teachers are assessed and trained. Teachers can use the 21st-century skills framework as a tool for self-assessment to evaluate and monitor students' performance, particularly in Science subjects. Furthermore, schools can offer intensive training and workshops to improve 21st-century teachers' competencies. It is also essential to expose teachers and students to training and activities that promote the integration of 21st-century skills both inside and outside the classroom.

An Enhancement Program can help tackle the need to acknowledge 21st-century skills and competencies. This program aims to sustain

and enhance both the 21st-century teaching competencies of teachers and the 21st-century learning skills and science content knowledge of students. This enhancement program will be conducted year-round, with sessions held every Friday, each lasting for one hour. This regular schedule ensures consistency and allows participants to fully engage with the program over an extended period. The one-hour duration of each activity strikes a balance between providing substantial content and accommodating participants' schedules. It also ensures that participants are equipped with the tools and knowledge necessary to succeed in today's rapidly changing educational landscape.

The problems mentioned earlier provide substantial support for the idea that our educational system in the 21st-century has a gap that needs to be filled with 21st-century skills and competencies. The researcher therefore conducted this study to determine the level of teaching competencies, learning skills, and science content knowledge of students that could have a positive impact on both teachers and learners when it comes to developing 21st-century skills and competencies. Additionally, the study's findings serve as the basis for an enhancement program that can help the educational system improve the 21st-century skills and competencies of students and teachers.

Statement of the Problem and the Hypothesis

The study aimed to find out the level of 21st-century teaching competencies, learning skills, and science content knowledge of STEM students among DepEd schools in the Province of Capiz for the school year 2023-2024.

Specifically, this study attempted to answer the following questions:

1. What is the level of 21st-century competencies of teachers as a whole and in terms of magnifying meaning, elevating experience, amplifying agency, curating curriculum, busting barriers, teaching technology, and revamping role?
2. What is the level of 21st-century learning skills of students as a whole and in terms of critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills?
3. What is the level of science content knowledge of STEM 12 students as a whole and in terms of General Biology I and General Physics I?
4. Is there a significant difference in the science content knowledge among the levels of 21st-century teaching competencies?
5. Is there a significant difference in the science content knowledge among the levels of 21st Century Learning Skills?
6. Are there significant relationships among 21st-century teaching competencies, 21st-century learning skills, and science content knowledge?
7. What possible program can be drawn from the results of the study?

Based on the stated problems of this study, the following hypotheses are tested:

1. There is no significant difference in the science content knowledge among the levels of 21st-century teaching competencies.
2. There is no significant difference in the science content knowledge among the levels of 21st-century learning skills.
3. There are no significant relationships among 21st-century teaching competencies, 21st-century learning skills, and science content knowledge.

Method of Research

This study utilized the mixed method design of research specifically, the concurrent parallel method approach where qualitative and quantitative data were collected and analyzed simultaneously. It combined both types of data to offer a comprehensive view of the research problem, leveraging the strengths of both methods (Creswell and Plano, 2017). This approach was used as triangulation for validity where findings from both data types cross-verify each other, enhancing the validity of the results.

The type of quantitative research used in this study was the survey-correlational research. The survey method obtains data to determine the specific characteristics of a group at a particular time (David 2004 as cited in

Sabid 2014). The purpose of correlational research is to establish a relationship (or lack of it)or to use a relationship in making predictions.

The qualitative research utilized in this study was the Focus Group Discussion (FGD). A Focus Group Discussion (FGD) is an informal yet structured in-depth discussion involving a small group of participants, typically ranging from 6 to 12 individuals. Under the guidance of a skilled moderator or facilitator, participants engage in a conversation about topics that are of particular relevance to the research issue at hand (Creswell, 2012). The primary purpose of an FGD was to provide qualitative insights that complement and enrich quantitative findings, offering a more nuanced understanding of the study's results.

By encouraging interaction and the exchange of diverse viewpoints, FGDs help explore participants' attitudes, perceptions, and experiences, providing a deeper layer of interpretation that may not be captured through surveys or other quantitative methods. In this study, an FGD was conducted to validate and enhance the quantitative data, offering participants the opportunity to elaborate on their responses and clarify any underlying factors influencing their opinions. This qualitative approach not only corroborates the findings but also enables the researcher to uncover details and insights that strengthen the overall understanding of the research problem.

To analyze the FGD data, the discussion was transcribed and systematically examined using thematic analysis. The process involved identifying recurring themes and patterns from the participants' responses. These themes were then categorized into relevant topics aligned with the research objectives. Key insights, notable quotes, and differences in perspectives were emphasized to provide a comprehensive interpretation of the findings. The qualitative data were compared with the quantitative results to verify and deepen the understanding of the research issue, ensuring that the study's conclusions were well-rounded and comprehensive.

The independent variables in the study were the 21st-century teaching competencies and learning skills and the dependent variable was the science content knowledge of STEM 12 students.

The statistical tools that were utilized in the study were the frequency count, percentage, mean, and standard deviation. The inferential statistics used were the Analysis of Variance and Pearson r. The alpha level of significance was set at 0.05.

Analysis of Variance (ANOVA) and Pearson's correlation coefficient (Pearson r) were selected to examine the relationship between 21st-century teaching competencies, learning skills, and science content knowledge of STEM 12 students. ANOVA was a parametric test used to compare the means of science content knowledge across different groups defined by varying levels of teaching competencies or learning skills, assuming the data were normally distributed and had homogeneous variances. Pearson r was also a parametric test that measured the strength and direction of the linear relationship between continuous variables, such as learning skills and science content knowledge. Both tests were parametric because they assumed that the data met certain distributional conditions, including normality and interval-level measurement. To ensure the validity of these tests, assumptions were verified: for ANOVA, assumptions of normality, homogeneity of variances, and independence of observations were checked, while for Pearson r, the data were assessed for linearity, normality, and appropriate scale of measurement. These tests were selected as they were suitable for examining group differences and relationships between continuous variables in the study.

Locale and Respondents of the Study

This research was conducted among the STEM 12 students in the Province of Capiz for School Year 2023-2024.

The participants of this study were three hundred six (306) STEM 12 students in the Province of Capiz. Out of three hundred six (306), thirty-three (33) came from the Division of Roxas and two hundred seventy-three (273) came from the Division of Capiz.

The distribution of the sample size for the STEM student respondents is shown in Table 1 below.

Table 1. Sample Size of STEM 12 students in the Province of Capiz

School	Population	Sample
ROXAS CITY DIVISION		
Cong. Ramon A. Arnaldo HS	55	12
Roxas City School of Phil Craftsmen	39	8
Tanque NHS	60	13
TOTAL	154	33
CAPIZ DIVISION		
Capiz NHS	237	50
Casanayan NHS	20	4
Col. Patrocinio Artuz NHS	39	8
Commissioner Luis R. Asis NHS	46	10
Cuartero NHS	35	7
Dao NHS	33	7
Dumalag NHS	43	9
Estefania Montemayor NHS	42	9
Feliciano Yusay Consing NHS	90	19
Florentina Degala MNHS	21	4
Ivisan NHS	60	13
Jagnaya NHS	26	5
Jamindan NHS	74	16
Jose Diva Avelino Jr NHS	39	8
Maayon NHS	37	8
Maindang	23	5
Mambusao East NHS	30	6
Marciano Patricio NHS	31	7
Panitan NHS	76	16
Pontevedra NHS	45	9
Sapian NHS	74	16
Tapaz NHS	41	9
Tuburan NHS	22	5
Vicente Andaya Sr. NHS	108	23
TOTAL	1, 292	273
Overall Total	1446	306

The required number of participants for this study was determined through stratified random sampling using the Raosoft sample size calculator.

The study utilized a stratified random sampling to determine the number of participants from the different public schools in the Province of Capiz. It is a method that involves the division of the population into smaller groups known as strata. The strata are formed based on member's shared attributes or characteristics. A random sample from each stratum is taken in a number proportional to the stratum's size when compared to the population. These subsets of the strata are then pooled to form a random sample.

In this study, only the STEM 12 students who already took the Physics and Biology subjects were the respondents.

Profile of Respondents

Of the 306 total STEM 12 respondents in the Province of Capiz, 193 (63.1%) of them were male and 113 (36.9%)were female. In terms of age, 4 (1.3%) were 16 years old, 110 (35.5%) were 17 years old, 174 (56.9%) were 18 years old, and 18 (5.9%) were 19 years old. In terms of family income, 71 (23.2%)earned below 5,

000 pesos a month, 138 (45.1%) earned 5, 000 to 15, 000 pesos a month, and 97 (31.7%) earned above 15, 000 pesos a month. In the case of respondent's father's educational attainment, 25 (8.2%) were elementary level, 8 (2.6%) were elementary graduates, 56 (18.3%) were high school level, 41 (13.4%) were high school graduates, 95 (31.0%) were college level, 45 (14.7%) were college graduate, 10 (3.3%) were with master's units, 2 (.7%) were master's degree holder, 3 (1.0%) were with units in doctorate degree, and 1 (.3%) were doctorate degree holder. While in their mother's educational attainment, 14 (4.6%) were elementary level, 4 (1.3%) were elementary graduate, 48 (15.7%) were high school level, 47 (15.4%) were high school graduate, 90 (35.6%) were college level, 52 (17.0%) were college graduate, 15 (4.9%) were with master's units, 6 (2.0%) were master's degree holder, 6 (2.0%) were with units in doctorate degree, and 5 (1.6%) were doctorate degree holder.

Table 2. Profile of the Respondents

Profile	f	%
Sex		
Male	193	63.1
Female	133	36.9
Age		
16 years old	4	1.3
17 years old	110	35.5
18 years old	174	56.9
19 years old	18	5.9
Family income		
Below 5k	71	23.2
5k-15k	138	45.1
Above 15k	97	31.7
Father's Education		
Elementary	25	8.2
Elementary Graduate	8	2.6
High School	56	18.3
High School Graduate	41	13.4
College	95	31.0
College Graduate	45	14.7
Master's	10	3.3
Master's Degree Holder	2	.7
Doctorate	3	1.0
Doctorate Degree Holder	1	.3
Mother's Education		
Elementary	14	4.6
Elementary Graduate	4	1.3
High School	48	15.7
High School Graduate	47	15.4
College	109	35.6
College Graduate	52	17.0
Master's	15	4.9
Master's Degree Holder	6	2.0
Doctorate	6	2.0
Doctorate Degree Holder	5	1.6
Total	306	100.0

Data-Gathering Instruments

The questionnaires used in this study were divided into four (4) components. Part I, was to determine the demographic profile of the respondents. Part II was the 21st Century Teaching Competencies Questionnaire (Magnify Meaning, Elevate Experience, Amplify Agency, Curate Curriculum, Bust Barriers, Teach Technology, Revamp Role); Part III, was the 21st Century Learning Skills Questionnaire (Critical Thinking, Creativity, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity, Social Skills); and Part IV was Science Content Knowledge Test.

Demographic Profile Questionnaire. This was used to determine the personal information of the respondents in terms of sex, age, strand, family income, and parents' educational attainment.

21st Century Teaching Competencies Questionnaire. This was a 70-item researcher-made questionnaire that was used to assess the level of teaching competencies. It underwent face and content validation by the dissertation adviser and was pilot-tested by 30 STEM 12 students for reliability purposes. All suggestions and recommendations were incorporated into the assessment tools. The result of the pilot testing underwent a reliability test using the Statistical Package for Social Science (SPSS) software. The reliability test for the 21st Century Teaching Competencies Questionnaire resulted in a Cronbach's alpha of .956.

Each item in the questionnaire was responded using the following guide:

Score	Responses
5	Strongly Agree
4	Agree
3	Moderately Agree
2	Disagree
1	Strongly Disagree

For the descriptive interpretation of the mean score, the table below was arbitrarily used:

Scale	Description
4.21 - 5.00	Very High
3.41 - 4.20	High
2.61 - 3.40	Moderate
1.81 - 2.60	Low
1.00 - 1.80	Very Low

The 21st Century Learning Skills Questionnaire. This was a 120-item researcher-made questionnaire used to evaluate the learning skills of students. It underwent face and content validation by the dissertation adviser and was pilot-tested by 30 STEM 12 students for reliability purposes. All suggestions and recommendations were incorporated into the assessment tools. The result of the pilot testing underwent a reliability test using the Statistical Package for Social Science (SPSS) software. The reliability test for the 21st Century Teaching Competencies Questionnaire resulted in a Cronbach alpha of 0.989 making the instrument highly reliable.

Each item in the questionnaire was responded using the following guide:

Score	Responses
5	Strongly Agree
4	Agree
3	Moderately Agree
2	Disagree
1	Strongly Disagree

For the descriptive interpretation of the mean score, the table below was arbitrarily used:

Scale	Description
4.21 - 5.00	Very High
3.41 - 4.20	High
2.61 - 3.40	Moderate
1.81 - 2.60	Low
1.00 - 1.80	Very Low

Science Content Knowledge. This was an 80-item multiple-choice test adopted from Competency Based Assessment – DepEd (School Division of Capiz, 2021) was used to assess STEM 12 students' content knowledge, specifically in General Biology I and General Physics I.

Prior to the use of the instrument, it underwent pilot testing for the 30 STEM 12 students. The results of the test underwent item analysis. The analysis was the basis on which items should retained, revised, and discarded. Based on the results of the item analysis, all items were retained.

The score in the instrument was interpreted using the guide below:

Score	Description
33-40	Very High
25-32	High
17-24	Moderate
9-16	Low
1-8	Very low

Focus Group Discussion Guide. The qualitative data needed in the study were gathered using the focus group discussion (FGD). Teachers and students from the different secondary schools in the Province of Capiz were invited to the focus group discussion. A focus group is a planned, facilitated discussion among a small group of stakeholders designed to obtain perceptions in a defined area of interest in a permissive, non-threatening environment (Slocum, 2005 cited in Crespo, 2018).

The researcher constructed a focus group discussion guide for the participants consisting of 10 questions for teachers and 9 questions for students. It was submitted to the dissertation adviser for suggestions and recommendations. The questions aimed to gather the discussants' views, concepts, perceptions, beliefs, and practices about 21st-century teaching competencies, learning skills, and science content knowledge.

Data Gathering Procedures

Before the actual conduct of the study, the researcher asked permission from the school division Superintendents of the Division of Capiz and Roxas City through a letter. After the letter was approved, the researcher distributed the questionnaires to the target respondents through face to face and via Google form. Respondents were given enough time to reflect on their responses to the three instruments. After all the questionnaires were answered, these were retrieved, tallied, tabulated, and analyzed using the appropriate statistical tools.

Prior to the collection of the qualitative data and to ensure ethical research, the participants were informed that: (1) they are participating in a research, (2) there are benefits when this study is done; (3) the nature of research participation is voluntary; (4) procedures used to ensure to protect confidentiality.

A Focus Group Discussion (FGD) was conducted using the FGD guide. There was a moderator or facilitator who served as a guide through the essential topics regarding the research study. The participants were determined from the target populations to obtain their ideas and opinions which are relevant to the research problem.

The proceedings of the FGD activities were recorded through an audio and video recorder as well as photos for documentation. All recorded responses during the focus group discussion were transcribed to derive meaning, interpretation, and information from them.

The focus groups also elicited information in a way that allowed researchers to find out why an issue is salient (Lian and Tan, 2001, cited in Crespo, 2018).

Results and Discussions

Descriptive Data Analysis

Level of 21st-Century Teaching Competencies

Table 3 reflects the level of 21st-century teaching competencies of teachers as a whole and in terms of magnifying meaning, elevating experience, amplifying agency, curating curriculum, busting barriers, teaching technology, and revamping role in the province of Capiz. It was revealed that in general, the 21st-century teaching competencies of STEM 12 students are "Very high" (M = 4.38, SD = 0.46).

Table 3. Mean and Standard Deviation of 21st Century Teaching Competencies

Variable	Mean	Description	SD
21st Century Teaching Competencies	4.38	Very high	.46
Magnifying Meaning	4.45	Very high	.52
Elevating Experience	4.35	Very high	.53
Amplifying Agency	4.35	Very high	.53
Curating Curriculum	4.39	Very high	.54
Busting Barriers	4.40	Very high	.51

Variable	Mean	Description	SD
Teaching Technology	4.30	Very high	.53
Revamping your Role	4.39	Very high	.52

Scale	Description
4.21 - 5.00	Very high
3.41 - 4.20	High
2.61 – 3.40	Moderate
1.81 – 2.60	Low
1.00-1.80	Very low

The "Very high" level of 21st-century teaching competencies implies that teachers possess the 21st-century teaching competencies that are necessary for the students to developed their 21st-century skills. This implies that teachers possess the 21st-century teaching competencies that set a strong foundation for effective learning and growth of students. With these teachers leading the way, students are more likely to engage in meaningful learning experiences that foster the 21st-century learning skills essential for success in the modern world.

The teachers have "Very High" (M = 4.45, SD = 0.52) magnifying meaning competency. This implies that teachers can help students understand why their learning is important. These teachers facilitate learning by providing tasks that allow students to actively participate, in exploration and experimentation. They demonstrate expertise in their subject matter and encourage students to explore and investigate content independently to satisfy their curiosity.

The teachers have "Very high" (M = 4.35, SD = 0.53) elevating experience competency. This implies that teachers are consistent in providing hands-on activities and facilitating experiences that could further develop the understanding of students about concepts in science. These teachers promote inclusive teaching by offering diverse options for interaction and engagement inside the classroom. They emphasize flexibility in motor skills, providing alternatives for physical responses and interactions of students.

The teachers have "Very high" (M = 4.35, SD = 0.53) amplifying agency competency. This implies that teachers provide students the opportunity to assess their selves and reflect on their strengths and weaknesses in learning, especially in science subjects. These teachers foster students' voices and choices with the goal of increasing students' sense of autonomy and ownership over their learning. They include providing tools like prompts, reminders, and checklists to target specific self-regulatory goals such as reducing aggressive outbursts and increasing on-task behavior.

The teachers have "Very high" (M = 4.39, SD = 0.54) curating curriculum competency. This implies that teachers continuously make instruction better based on the needs of students. These teachers integrate effective literacy instruction throughout the curriculum and across content areas to enhance the learning of students.

The teachers have "Very High" (M = 4.40, SD = 0.51) busting barriers competencies. This implies that teachers create a conducive learning environment for students to feel secure and supported. These teachers create a classroom climate characterized by acceptance and support, varying social demands, and levels of protection to accommodate the diverse needs of students.

The teachers have "Very high" (M = 4.30, SD = 0.53) teaching technology competency. This implies that teachers in the 21st century are equipped to integrate technology inside the classroom. These teachers used different technology to engage students in interactive lessons and prepare them for today's modern world.

The teachers have "Very high" (M = 4.39, SD = 0.52) revamping role competency. This implies that teachers are knowledgeable in assessing the importance of technology in learning especially in science subjects while adapting their role to the significant changes brought by the digital world. These teachers are not

simply delivering knowledge but rather facilitating and guiding students in their journey of learning science by integrating technology inside the classroom.

This result is in line with the ideas, perceptions, and experiences of the discussants in the focus group discussion. The teachers agreed that they possess 21st-century teaching competencies. The discussion highlights the diverse approaches and perspectives of teachers and students regarding 21st-century teaching competencies, particularly in the context of science education. Teachers emphasize the importance of magnifying meaning by connecting lessons to real-world relevance, fostering student agency through interactive and personalized learning, and leveraging inclusive practices and technology to enhance digital literacy and innovation. While some teachers acknowledge the ongoing development needed to address challenges in teaching science, such as literacy and numeracy difficulties, they remain adaptable and focused on instilling scientific concepts effectively. Also, students appreciate their teachers' efforts to make learning engaging through fun experiments, creative activities, and technology integration, fostering a welcoming and supportive classroom environment. Despite varying teaching methods, both traditional and modern, educators prioritize critical thinking, problem-solving, and collaborative learning to meet the educational needs of today's students.

Teacher Discussant 1: as a 21st-century educator, my teaching competency revolves around magnifying meaning. By connecting the lesson to real-world relevance. Lessons regarding real-life experiences are simplified and connected so it will be easier for the students. So, because elevating these experiences through interactive and personalized learning, amplifies agency by fostering students' autonomy and empowerment. So, we are empowering our students through these experiences and of course, it encompasses diverse perspectives and skills, busting barriers through inclusive practices, so this is very important as a teacher in nurturing the 21st century teaching skills. We should practice inclusive practices because we know our students have individual differences and we have different types of students. And of course, I also utilized teaching through technology to enhance digital literacy and innovation. And of course, revamping my role, because we are in the 21st century, as a facilitator of knowledge, theoretical thinking, and lifelong learning.

Teacher Discussant 8: I would say that as a science teacher, I can describe my 21st-century teaching competencies as continuously developing. I am adaptive to the changes that I may encounter, especially to the challenges that science education requires us. Eventually, teachers, specifically Science teachers are very adaptive to these changes. Especially in terms of the difficulty of our learners, especially in literacy and numeracy where we can say that we are affected by this. In Senior High School, it is somewhat challenging for a teacher, especially in science to address the needs of the learners with these difficulties, so that's the problem I experienced as a science teacher. The challenge of instilling the Science concept to our learners in the most successful way is one of those challenges. So, I am still developing. I can say that I am still developing and continuously adapting to 21st-century teaching competency.

Teacher Discussant 6: 21st-century competencies as a whole are relevant, flexible, and aligned to the fast-changing modern times. As to magnifying meaning, it could be advantageous to our STEM students to maximize the learning experience in preparation for them to absorb and apply science information. And for teachers, of course, it means we need to give an extra effort in terms of preparation especially when we are teaching Senior High School students therefore, I believe that persons in the agency involved should have better planning in making our curriculum or science curriculum best for science learners. I also believe that identifying and addressing learning barriers, would significantly affect the learning of our students by maximizing the positive use of technology because we cannot deny that in these modern times, technology now is our tool in giving experiential Science learning to our students. And also, so that the role of teacher and learning, or our role as teacher should be student or learner-centered. In that way, we can focus more on being a facilitator of learning and allowing students to their learning by

giving them wholesome Science learning. That's my answer.

Student Discussant 2: I would say that our science teachers possess 21st-century teaching competencies because they don't just take to the old ways. They all make fun and creative by doing cool experiments and activities. They also sometimes take charge of learning which is for me awesome. They also use technology to help us learn better and to make sure that everyone gets the help they need. Plus, our science teacher is super nice, guides us, and makes sure that everyone feels welcome in class.

Student Discussant 3: In regard to the question, I would say yes, because based on my observation, my science teacher immersed us in experiments, presentations, research reports, and work immersion.

Student Discussant 5: Based on my observation, although among of my science teachers use the traditional method, which is the chalkboard, also, they also leverage 21st-century competencies such as they leverage technology and emphasize critical thinking, problem-solving, and collaborative learning. And these competencies are likely well-equipped to meet the educational needs of today's students.

Results indicating that teachers possess "very high" 21st-century teaching competencies are aligned with the perspectives and experiences shared by the discussants in the focus group discussion. The discussants agreed on the high level of 21st-century teaching competencies among science educators, emphasizing their role as pioneers in education, research, and innovation. There is a consensus on the need for continuous professional development to further enhance teaching competencies, especially in areas like technology integration, student engagement, curriculum design, and inclusivity. Science teachers are described as skilled, well-versed, and adaptive, continually upgrading themselves both professionally and technologically for lifelong learning. Their adaptability to new programs and innovations ensures they meet evolving educational standards and effectively educate diverse student populations. Students recognize the effectiveness of science teachers in utilizing technology and modern teaching methods, fostering interactive learning environments, and imparting essential 21st-century skills like robotics and app development, thereby evolving from traditional to contemporary learning settings to meet the needs of each student.

Teacher Discussant 1: Science teachers are known as the prime movers of education, especially in research and innovation. We are expected to adapt to the 21st-century teaching competencies that's why I really agree that Science teachers have a very high level of 21st-century teaching competencies. Additionally, it is also needed for the ongoing professional development of science teachers to further enhance the 21st-century teaching competencies. So, we need to have our ongoing professional development and self-assessment which can further enhance teacher's competence to ensure continuous growth and adaptation, of course to the evolving educational needs. Even though it came out to be a very high level but then, we science teachers need more. We need to adapt more to the evolving educational needs. We need to be versatile in every aspect. We need to have or to focus more on technology integration, student engagement, curriculum design, and of course, inclusivity when we are dealing with the 21st century teaching competencies.

Teacher Discussant 2: Science teachers are skilled, well-versed, and adaptive. So, they are skilled because they upgrade themselves professionally and technologically not just for the acquisition of knowledge, but for lifelong learning. Science teachers are well-versed because of their years of continuing development and teaching experience. They acquire knowledge and experience which they apply in every aspect of their lives. May it be personal or professional. Lastly, I believe that Science teachers are adaptive or flexible because whatever new programs or innovations, the department is implementing, Science teachers adjust and adapt to it and conform to standards.

Teacher Discussant 5: Science teachers surely have a very high level of science competence due to the fact that we deal with diverse students. So, we adapt to enable the free flow of quality Science education.

Student Discussant 7. Science teachers have a very high level of 21st-century teaching competencies since they have a flexible approach to

teaching and learning as learners that enable them to effectively educate and teach us in the field of science also, most science teachers in our school utilize technology. For example, the use of PowerPoint presentations projected on TV or projector in teaching lessons enabled us to teach in a more interactive way.

Student Discussant 4: Yes, I agree, because based on my personal observation, teachers really have the skills in 21st-century teaching because as far as I observed, teachers were able to utilize the use of technology and other modern things or modern methods in teaching because teachers were able to train us students or teach us students 21st-century skills such as robotics and app development.

Student Discussant 5: Yes, I agree with that, since we are now in the 21st century period, our teachers evolved from traditional to 21st-century learning settings to advance and comply with the needs of each student.

The study conducted by Fernando and Asavisanu (2022) found strong support for the overall mean score of 3.780, which indicates that secondary school teachers have excellent 21st-century instructional competencies. Additionally, Zamora (2022) highlighted the significant changes in the role of teachers from traditional spoon-feeders to facilitators of learning in recent decades. In this regard, teacher education institutions have a crucial role to play in preparing teachers for the field. Consequently, the study aimed to determine the level of 21st-century teaching skills and teaching standards competence among the teachers of Mindoro State College of Agriculture and Technology (MinSCAT). The findings showed that the teachers' skills and competence were of high to very high extent. Based on the various studies presented, it can be concluded that teachers possess a high level of 21st-century teaching competencies.

Level of 21st Century Learning Skills

Table 4 shows the level of 21st-century learning skills of students as a whole and in terms of critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills in the province of Capiz. It was revealed that as a whole the 21st-century learning skills of STEM 12 students is “Very high” (M = 4.29, SD = 0.41).

Table 4. Mean and Standard Deviation of 21st Century Learning Skills

Variable	Mean	Description	SD
21st Century Learning Skills	4.29	Very high	.41
Critical thinking	4.09	High	.53
Collaboration	4.48	Very high	.43
Communication	4.24	Very high	.51
Creativity	4.32	Very high	.48
Information literacy	4.35	Very high	.49
Media literacy	4.28	Very high	.51
Technology literacy	4.27	Very high	.54
Flexibility	4.26	Very high	.51
Leadership	4.28	Very high	.55
Initiative	4.31	Very high	.52
Productivity	4.30	Very high	.53
Social skills	4.36	Very high	.53

Scale	Description
4.21 - 5.00	Very high
3.41 - 4.20	High
2.61 – 3.40	Moderate
1.81 – 2.60	Low
1.00-1.80	Very low

The "Very high" level of 21st-century learning implies that STEM 12 students possess the necessary learning skills to navigate and succeed in a rapidly changing world. These students are equipped not only with knowledge of science, technology, engineering, and mathematics (STEM) but also with critical thinking, problem-solving, collaboration, communication, and digital literacy skills. With these competencies, they are better prepared to adapt to new technologies, embrace innovation, tackle complex challenges, and contribute meaningfully to the advancements of society in the 21st century.

The students have "High" (M = 4.09, SD = 0.53) critical thinking competency. This implies that STEM 12 students demonstrated a level of critical thinking ability, but there is still room for improvement in this skill. These students can understand ideas and questions that lead to critical thinking, though their critical thinking skills may not be at the highest extent.

The students have "Very high" (M = 4.48, SD = 0.43) collaboration competency. This implies that STEM 12 students are highly skilled at communicating, cooperating, and contributing to group efforts. These students ensure that the ideas of all members are equally valued by actively participating in team decision-making.

The students have "Very high" (M = 4.24, SD = 0.51) communication competency. This implies that STEM 12 students are highly proficient in expressing themselves clearly, listening attentively, and conveying their ideas effectively. These students can answer questions comprehensively and present information in a clear, concise, and logical manner.

The students have "Very high" (M = 4.32, SD = 0.48) creativity competency. This implies that STEM 12 students exhibit a high degree of curiosity, open-mindedness, and willingness to experiment and take risks in their learning process. These students are well-equipped to think creatively, adapt to new situations, and contribute innovative ideas in both academic and real-world contexts.

The students have "Very high" (M = 4.35, SD = 0.49) information literacy competency. This implies that STEM 12 students demonstrate strong skills in critically assessing the credibility, relevance, and accuracy of various sources of information. These students are able to understand and discern facts from fake news, especially information that they will encounter on different media platforms.

The students have "Very high" (M = 4.28, SD = 0.51) media literacy competency. This implies that STEM 12 students can discern and evaluate various aspects of media, including publishing methods, outlets, and sources. These students can critically evaluate different media sources and demonstrate proficiency in operating media devices. They are also aware of the effects that media has on them.

The students have "Very high" (M = 4.27, SD = 0.54) technology literacy competency. This implies that STEM 12 students have the capacity to use and navigate various technological tools and resources for learning purposes. These students are equipped with the skills to adapt to technological advancements and effectively integrate them into their educational endeavors.

The students have "Very high" (M = 4.26, SD = 0.51) flexibility competency. This implies that STEM 12 students are able to adapt to changing circumstances inside and outside the classroom. These students incorporate feedback effectively, handling both praise and criticism positively to enhance their performance. They maintain a flexible mindset when approaching assigned tasks, enabling them to adapt efficiently to changing circumstances and deliver outcomes that meet expectations.

The students have "Very high" (M = 4.28, SD = 0.55) leadership competency. This implies that STEM 12 students are involved in more than just directing others, it also encompasses setting clear goals, guiding a team through the necessary steps, and achieving those goals through collaboration and teamwork. These students lead by example and demonstrate selflessness that inspires others to strive for excellence, fostering a culture of mutual respect and trust.

The students have "Very high" (M = 4.31, SD = 0.52) initiative competency. This implies that STEM 12 students are proactive and show self-driven behavior to take independent action and pursue learning opportunities without waiting for explicit instructions from the teacher. These students take the initiative in assigned tasks,

taking a proactive stance by identifying potential improvements, suggesting innovative approaches, and willingly undertaking additional responsibilities to ensure the success of their academic endeavors.

The students have "Very high" (M = 4.30, SD = 0.53) productivity competency. This implies that STEM 12 students can complete work in an appropriate amount of time. These students actively participate, demonstrate reliability and punctuality, and collaborate with teams to achieve common goals. They can prioritize tasks and set clear deadlines, leading to efficient completion of assigned tasks.

The students have "Very high" (M = 4.36, SD = 0.53) social skills competency. This implies that STEM 12 students can interact effectively and harmoniously with their peers, teachers, and other individuals in their environment. These students participate in learning activities that promote peace and understanding of cultural diversity. They are also equipped with conflict resolution skills to manage disagreements constructively and adapt to changes in the learning environment.

The result of the study, indicating that STEM 12 students possess 21st-century learning skills, finds resonance in the ideas and experiences shared by the discussants during the focus group discussion. The discussants collectively affirm the presence and development of 21st-century learning skills among students, highlighting the impact of effective teaching strategies. Teachers emphasize the importance of ethical considerations and attitude alongside intelligence, noting positive behavioral changes in students, particularly through media and information literacy education. STEM students, in particular, exhibit adaptability, critical thinking, creativity, and collaboration, as demonstrated during challenging circumstances such as class suspensions due to high heat indexes. Students express high levels of confidence in their mastery of 21st-century skills, attributing their success to the effective teaching methods employed by their educators. They describe their skills as exemplary, indicating their ability to apply critical thinking, creativity, collaboration, and other competencies to various aspects of their lives, reflecting the positive influence of their school environment and teachers.

Teacher Discussant 6. I believe that all these skills are evident to my students. Before, the sections I handled were problematic, they were always at the principal's office. But, since I taught Media and Information Literacy, I really stress the ethical considerations for that. And above all, it is not only intelligence that is the measure of the person, but the attitude itself.

Teacher Discussant 3; I can describe my students specifically my STEM students, they are really far from being perfect and they possess all of these skills. But then, I can say that most of the skills, in general term, they have it like today in the public school, they have this flexibility, they have this critical thinking skills, the creativity, and the collaborations, especially nowadays that our class is suspended due to the high heat index. They can show how they cope, adjust, and adapt to the situation. Because of the literacy they possessed, they could come up with some solutions.

Student Discussant 3. I would describe 21st-century learning skills as a whole as "High", because currently students are exposed to technology and teachers manage to teach them effectively by doing experiments, work immersion, and in terms of critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy.

Student Discussant 9: I would describe my 21st-century learning skills as exemplary because in terms of all these examples like critical thinking, creativity, collaboration, and so on, these were taught to us in school and I can say that I have highly achieved this kind of competencies because of how teachers in our school instilled this kind of skills into us, and I believed that this enhances the way I think and learn and work and live in this world. So I would say that it's exemplary and it's a good example for everyone to follow.

The findings suggesting that students exhibit "very high" 21st-century learning skills are consistent with the perspectives and experiences exchanged by the discussants during the focus group discussion. he discussants collectively assert the high proficiency of STEM

students in possessing 21st-century learning skills, noting their exceptional capabilities in research, technology usage, time management, and leadership. Teachers highlight the outstanding academic achievements of STEM students, with many consistently earning honors and excelling in research papers. They attribute this success to students' versatility, adaptability, information literacy, and strong social and leadership skills. Students themselves express confidence in their proficiency, emphasizing their access to diverse resources, including technology and supportive learning environments, which contribute to the development of essential 21st-century skills. They acknowledge the significant role of teachers in imparting these skills, shaping not only their academic success but also their ability to navigate everyday life with competence.

Teacher Discussant 5: Yes, Ma'am. So, I do agree with your statement that the STEM 12 students nowadays have a very high level of 21st century learning skills, or I can say that they might even exceed our skills actually. So, I just wanted to share to you my experience in teaching these STEM students. So last year, 60 are my advisees and all of them are honorees, with highest honors. And in this school year, I have 58 advisories and all are honorees again. So, imagine having this kind of students, I found out that they are more good in making research paper as compared to the master teachers. Now I have a student of 60 last year overall and this year 58 all which are honorees. So, imagining having this kind of students. They are more good in using technology and making research paper, in complying the necessary requirements or nine subjects in one day to five days a week. So, they are really versatile when it comes to learning. Okay, so they are truly flexible, they are information literate and possess very high social and leadership skills. Overall, with this kind of skills they possess, they truly have a very high level of 21st century learning skills.

Teacher Discussant 8: I really agree to the previous discussions in terms of the advancement and the competent level of the stem students. So, just because they are equipped with the necessary skills from their teachers as well as of course from the curriculum. So, they have developed lots of potential of being advanced when compared to some regular students

Student Discussant 7: Students like me have a "very high" rating in 21st century learning skills, and I believe in this statement because students like me have an access to the diverse array of resources such as technology, digital tools and learning materials and media, as well as a supportive and stimulating learning environment because it is more likely that as students or students like me will acquire and develop 21st century learning skills."

Student Discussant 6: I believe it's true that students like us in today's world have a very high rating for 21st century learning skills. Our teachers have a major impact on these skills, I believe, because they are the ones who teach and educate us, and by educating us, we are also able to be influenced with the skills needed not only in our schools, but also in our everyday life.

The result is supported by the study of Karakaş (2015) which found that 8th-grade students possess 21st century learning skills at a high level.

Gülen (2014) also affirmed that the students have adequate 21st century learning skills. According to the interviews conducted, the students identified their 21st century skills, and it was observed that most of them have skills in imagination and curiosity, cooperation and leadership, and at least one skill in accessing and analyzing information.

The result also relates to the study of Sumen and Calisici (2017) states that female students have significantly higher 21st-century skills than male students. Female students had higher scores than male students in the cognitive and affective subscales, while no significant difference was found in the sociocultural subscale.

Level of Science Content Knowledge

Table 5 shows the level of science content knowledge of STEM 12 students as a whole and in terms of General Biology I and General Physics I. It was revealed that the science content knowledge as responded by STEM students is "High" (M = 24.64, SD = 5.14).

Table 5. Mean and Standard Deviation of Science Content Knowledge

Variable	Mean	Description	SD
Science Content Knowledge	24.64	High	5.14
General Biology I	25.57	High	5.29
General Physics I	23.72	Moderate	5.65

Scale	Description
33 - 40	Very high
24 - 32	High
17 – 24	Moderate
9 – 16	Low
0 - 8	Very low

The "High" level of science content knowledge implies that STEM 12 students possessed a high level of science content knowledge as a whole, encompassing both General Biology I and General Physics I. These students demonstrate a consistent and high understanding of scientific concepts and principles. Their proficiency in science content knowledge indicates a thorough grasp of key topics and demonstrates competence in applying scientific principles across disciplines.

In terms of General Biology I, the result is "High" (M = 25.57, SD = 5.29). This implies that STEM 12 students exhibit a strong understanding and proficiency in General Biology I concepts. These students are likely well-equipped to excel in further studies within the field of biology and related disciplines. They demonstrate confidence in applying their understanding of General Biology I concepts to tackle more complex topics and challenges within the subject.

In terms of General Physics I, the result is "Moderate" (M = 23.72, SD = 5.65). This implies that STEM 12 students exhibit average understanding and proficiency in General Physics I concepts. These students may benefit from additional support and resources to strengthen their understanding and proficiency in General Physics I concepts. With concerted effort and targeted instruction, they have the potential to improve their grasp of foundational physics principles and excel in this subject.

The finding aligns with the viewpoints, beliefs, and experiences expressed by the participants in the focus group discussion. The discussants collectively explore the varying levels of content knowledge among STEM students in General Biology I and General Physics I. While STEM students generally exhibit competence in science subjects, differences emerge in their interest and proficiency levels between Biology and Physics. Teachers note that students often show higher interest and learning capability in General Biology I, attributed to its foundational concepts and relevance to their daily experiences. Conversely, in General Physics I introduce new and abstract principles, requiring a deeper understanding of mathematical concepts, leading to slightly lower proficiency levels compared to Biology. Female students tend to favor Biology, while male students gravitate towards Physics, reflecting individual preferences and aptitudes. Teachers express concerns about students' performances in Physics, noting fewer students excelling in the subject compared to Biology. However, students describe their knowledge in General Biology I as comprehensive and high, attributing their understanding to interactive teaching methods and engaging activities implemented by their teachers.

Teacher Discussant 8: So, for me in terms of content knowledge in science, so STEM students as we have already described, they are competent. But, in terms of General Biology I and General Physics I in our experience as a science teacher in senior high school, the students may show higher interest and learning capability in terms of content knowledge in general Biology I than Physics 1.

Teacher Discussant 6: I'm teaching General Physics I, but with students with higher mathematical capability, they would prefer Physics more on computational rather than memorization. So, it's a win-win situation and I cannot

say it's directly proportional or inversely proportional because I observe most male students would prefer Physics and female students would prefer General Biology subject.

Teacher Discussant 1: Based on my observation in terms of the students' level of content knowledge specifically in General Biology I and General Physics I, it depends on the topic. Usually in General Biology, students typically encounter foundational concepts such as cellular biology, genetics, which is more familiar to them and accessible compared to the abstract principles in physics. They mostly encounter this kind of concepts and the brief of topics covered in Biology, may also contribute to a higher level of content knowledge as students have more opportunities to engage with the diverse array of biological phenomena. They are exposed of the events in their surroundings that's why the content knowledge of students in general biology are more evident. On the other hand, General Physics I often introduces students to new and potentially challenging concepts related to mechanics, forces and other topics. These topics may require students to develop deeper understanding of mathematical principles and abstract reasoning which could contribute to the slightly lower rating or moderately high compared to Biology.

Teacher Discussant 7. In terms of the level of content knowledge in General Biology 1, I think most of my students are exceling in this subject compared to General Physics I. Based on my co-teachers, teaching general physics 1, only few students are exceling. As a teacher, she is worry of the performances or results of the academics of their students in general physics, in contrast to my subject general biology 1 and 2. I also agree to the other discussant that those students who are mathematically inclined are most probable exceling in physics, however, in general biology 1 whenever mathematically inclined or not, their level of science content knowledge is high, because the general biology is about the environment, life so they are knowledgeable about that, because they saw it, they experience it every day.

Student Discussant 9: I describe my knowledge in general biology 1 as comprehensive and high compared to general physics 1. The basic knowledge has been introduced to us by our science teachers, which paved the way into understanding deeply and mastering efficiently the topics. They've made interactive activities such as experiments.

The result is aligned with the study of Masood (2014) that a lack of motivation is a significant challenge that contributes to a decline in students' performance in physics. According to the American Association of Physics Teachers (2014), there has been a decline in students' enrollment and performance in physics for an extended period, mainly due to the subject's abstract nature. The subject's difficulty and demand for additional effort are the primary reasons for the poor performance and low enrollment in physics as perceived by most students.

The results also support to the study of Tekwani (2020), that the students find physics difficult because they have to contend with different representations such as experiments, formulas and calculations, graphs, and conceptual explanations at the same time.

The results also relate to the study of Erinosho (2014) which found that students require assistance in comprehending specific topics in the physics curriculum. These topics are typically characterized as lacking concrete examples and requiring a lot of mathematical manipulations or visualization, which leads to decreased performance in the subject. Physics is a subject that heavily relies on mathematical representations to explain the interaction of various elements in the environment, and these representations are expressed as formulas, requiring students to have numerical manipulation abilities. Thus, the ability to work with numbers is a crucial factor that enhances students' learning outcomes in physics.

The findings also align with Chiu et. al's (2022) research, which suggests that a social hierarchy separates STEM fields into harder and easier subjects, alongside gender-based hierarchies of conventional traits. According to the study, students in STEM tend to view biology as the easiest subject, ranking it at the bottom of the STEM hierarchy.

It was also supported by the study of Spall et al., (2023) which showed that students enrolled in the physics program tended to perceive biology as less conceptual, easier, and less

mathematical than their own field of study. Similarly, biology students also perceived physics as more mathematical and conceptual as compared to biology, but they found biology to be more interesting.

Inferential Data Analysis

Difference in the Science Content Knowledge Among the Levels of 21st-century Teaching Competencies

The result of the Analysis of Variance of science content knowledge among the levels of the 21st century teaching competencies is reflected in Table 6.

Data show that there is "no significant difference" in the science content knowledge among the levels of 21st-century teaching competencies of STEM 12 teachers in the province of Capiz F = 1.772, with p = .172 at 5% alpha level.

Table 6. Analysis of Variance of Science Content Knowledge Among the Levels of 21st Century Teaching Competencies

Source of Variance	SS	df	MS	F	Sig.
Between Groups	93.2	2	46.6	1.772ns	0.172
Within Groups	7967	303	26.3		
Total	8060	305			

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

The no significant difference in science content knowledge among the levels of 21st-century teaching competencies implies that regardless of the level of teaching competencies of teachers, the science content knowledge of the students is still the same due to the different factors that may influence their content knowledge.

This result is in line with the ideas and experiences of the discussants in the focus group discussion. The discussants delve into factors influencing STEM students' levels of science content knowledge in General Biology I and General Physics I. They emphasize the impact of student background, and assessment methods on student performance and curriculum design are the factors that can significantly affect students' understanding and proficiency in each subject. Teachers recognize the challenges of teaching physics, particularly its complexity and the need for mathematical understanding, compared to the more relatable concepts in biology. They also raise concerns about the overwhelming number of competencies in the physics curriculum and the lack of adequate instructional materials. These insights highlight the need for curriculum revisions, teacher support, and resource availability to enhance students' learning experiences and content mastery in both subjects.

Teacher Discussant 1. Based on my experience, the students, especially our STEM students, have a high level of science content knowledge in general biology 1 and moderately high in general Physics 1. This is really true, especially in the context in our school. Based on my experience, STEM students are more exposed to actual phenomena especially on those topics that are happening specifically in general biology, compared to the complex situations that they encounter sometimes in general physics. However, it is also essential to consider various factors that may influence this results wherein high level in Biology and moderately in General Physics. Especially the teaching methodology, why do we need to consider this factor? Because if the teacher from the biology subject will teach physics, the teaching methodology could affect the performance of our students. And number 2, the student background, if the students are really good in mathematical problems or he/she is inclined in mathematics, there is a possibility that his/her knowledge in physics or both physics and biology is high. That's why in science content knowledge, we are considering different factors. That's what I said earlier about the teaching methodology. The teacher is not inclined in physics because he/she is a biology teacher but still, he/she is teaching physics. So the

performance of students is also affected. And of course, another factor is the assessment method that we give, because in general biology, usually the assessment method is easy that we can give to our students. But in physics, we all know that usually in physics that complex, they need to solve problems and whatsoever. So the assessment method could also affect the content knowledge or one of the factors that we should consider with the result that the rating is slightly high in biology compared to physics that is moderately high.

Teacher Discussant 2: I think another factor in my own opinion is the curriculum that the department crafted for general physics. I have noticed that there are too many competencies for just a week, I think it's too massive, and the competencies are bombarded for the students. So I think the department could reflect and revisit and review the curriculum in general physics as compared to the other subjects that are offered in STEM.

Teacher Discussant 5: I strongly believe that it is true. Because I am teaching physics, and at the same time, I am teaching biology. So I observed to my STEM students that in biology class, most of my students really have a high level of science content knowledge, which is somehow different from the content knowledge of students when it comes to general physics. I do agree with the other discussant that when it comes to biology, they can connect it to the real-world scenario in the environment, however, when it comes to physics, you need calculations because it covers a broad topic. It is very complex and intricate that ends up for students to experience a hard time in understanding physics concepts. And we can include the teacher factor, because somehow we can say that I am not expert in teaching physics because physical science is my major, and we do have touch biology, we touch physics, but when it comes to teaching physics, it is really complex. The discussions are like engineering. Actually, students' questions me "how did you get from that point to this point?". And then, I want to add the other factor that there are not enough materials for physics and for biology. And if there is, actually there is a book provided by DepED, however it lacks explanations in deeper concepts and it provides students a minimal amount of knowledge.

The result is supported by the study of Zuelke (2018), which shows that there is no significant difference between teachers' competencies and students' performance in biology among the respondents. This same outcome has been observed in several other studies, including Ibe et al. (2016), which found no significant difference between the average academic achievement scores of students taught by motivated biology teachers. These findings suggest that the impact of teachers' motivations on students' academic performance in biology is still uncertain.

Studies have emphasized that teachers without a solid foundation in physics education often struggle with subject-specific pedagogy and content knowledge, which can hinder their ability to teach effectively. Effective physics teaching requires not only general teaching skills but also specialized knowledge in physics concepts and pedagogy to address student misconceptions and foster deep understanding (Fischer et al., 2014; Ergönenc et al., 2016).

Therefore, the null hypothesis which states that there is no significant difference in the science content knowledge among the levels of 21st century teaching competencies is accepted.

Difference in the Science Content Knowledge Among the Levels of 21st-century Learning Skills

The result of the Analysis of Variance of science content knowledge among the levels of the 21st century learning skills is reflected in Table 7.

Data show that there is a "significant difference" in the science content knowledge among the levels of 21st century learning skills of STEM 12 students in the Province of Capiz F = 3.339, with p = .037 at 5% alpha level.

Table 7. Analysis of Variance of Science Content Knowledge Among the Levels of 21st Century Learning Skills

Source of Variance	SS	df	MS	F	Sig.
Between Groups	173.8	2	86.9	3.339*	0.037
Within Groups	7886	303	26		
Total	8060	305			

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

The significant difference in science content knowledge among the levels of 21st-century learning skills implies that students with higher levels of 21st-century learning skills tend to have a better understanding of science content. These students are likely to demonstrate a stronger grasp of science content due to their higher levels of 21st-century learning skills.

The result is supported by the ideas and insights shared by the discussants in the focus group discussion. The student discussants concur that their level of science content knowledge is indeed influenced by their 21st-century learning skills. They emphasize the importance of skills like critical thinking, problem-solving, and technology proficiency in comprehending complex subjects such as biology and physics. They credit teachers with 21st-century teaching competencies for enhancing their learning experiences through modern methods and resources, making the subjects more engaging and accessible. These skills empower students to evaluate, analyze, and apply scientific information effectively, equipping them to navigate the challenges of modern education and become well-rounded individuals.

Student Discussant 5: Yes, I agree that the level of science content knowledge can be influenced by the 21st century learning skills as the skills enhance my ability to evaluate, analyze, and apply scientific information.

Student Discussant 2: Yes, I believed that my science content knowledge is influenced by my 21st century learning skills. So, in today's education, critical thinking, the problem solving, and the technology are crucial for understanding complex subjects like biology and physics. So, the teachers with 21st century teaching competencies enhanced my learning experience, my performance by utilizing modern methods and resources making the subjects more engaging and accessible, making us a well-equipped individual.

The result of the study agreed with the statement that educators have been emphasizing the need to integrate 21st-century skills with core subjects such as science, mathematics, technology, and engineering. This has led to a growing focus on STEM education to enhance 21st-century skills, as noted by Jang (2016), and Li et al. (2019). To promote effective learning, STEM education needs to provide more innovative support for the acquisition of 21st century learning skills. Li et al. (2019) have also suggested that STEM education can facilitate the development of new thinking skills among students that are closely linked to 21st century skills.

Therefore, the null hypothesis which states that there is no significant difference in the science content knowledge among the levels of 21st century learning skills is rejected.

Relationships Among 21st Century Teaching Competencies, Learning Skills, and Science Content Knowledge

The relationships among 21st century teaching competencies, 21st century learning skills, and science content knowledge are shown in Table 8.

Results showed that there is "a significant relationship" between 21st Century Learning Skills and Teaching Competencies, r = 0.656, with p = .000. There is "a significant relationship" between 21st Century Learning Skills and Science Content Knowledge, r = 0.133, with p = .020. There is "no significant relationship" between 21st-century teaching competencies, learning skills, and science content knowledge, r = .022, with p = .697.

Table 8. Pearson r Among 21st Century Learning Skills and Teaching Competencies and Science Content Knowledge

Variables	r	Sig
21st Century Learning Skills and Teaching Competencies	.656*	.000
21st Century Learning Skills and Science Content Knowledge	.133*	.020
21st Century Teaching Competencies and Science Content Knowledge	.022ns	.697

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

The "significant relationship" between 21st-century learning skills and teaching competencies suggests a strong correlation between the abilities of STEM 12 students and teachers to engage with and leverage modern educational practices. This implies a strong correlation between the abilities of STEM 12 students and teachers to engage with and utilize modern educational practices. The STEM 12 teachers demonstrate high-level 21st-century teaching competencies that cultivate 21st century learning skills in their students.

This outcome corroborates the finding indicating a significant relationship between 21st-century learning skills and 21st-century teaching competencies as observed in the focus group discussion. The discussants agreed that 21st-century teaching competencies significantly impact students' acquisition of 21st-century learning skills. They stress the pivotal role of teachers in fostering critical thinking, nurturing curiosity, and developing students' skills. They emphasize the importance of teachers being well-equipped to effectively impart these skills to students. They also emphasize the challenges that teachers face when preparing lessons that suit students' learning skills, highlighting the necessity for teachers to possess the capacity and ability to adapt their teaching methods accordingly.

Teacher Discussant 7: For me, Ma'am it's a yes, the 21st-century teaching competencies affect our students 21st-century learning skills since we teachers are said to be instrumental in imparting knowledge, fostering critical thinking skills and nurturing intellectual curiosity to our students. If that students have the skills and we, teachers, are not equipped to develop those skills within the students, it will be useless. So, it is important that we, teachers, are well-equipped to develop the skills of the students that they possess.

Teacher Discussant 8. I really agree. So, I agree with this that the teaching competencies affect the students 21st-century learning skills. So, we all know that there are other times that it's hard for us. So, teachers cannot give what they do not have. This is one of the challenges that real science teachers can experience in the teaching field because we must prepare those lessons that suit our students. But eventually if we do not have that capacity or the ability to prepare those lessons for them, it does not suit their learning skills. So, the teaching competencies of teachers really affect the learning skills of students

The result is in line with the study of Rashid and Asghar (2016) in which the incorporation of technology in educational settings will influence how individuals comprehend knowledge, research and inquiry abilities, self-driven learning, and their ability to use technology from a young age. Additionally, it is thought to improve their essential and professional skills. Therefore, it is considered that there is a relationship between secondary school students' educational technology competencies and 21st century learning skills.

Additionally, to stay relevant in our rapidly changing world, students need to possess 21st-century learning skills. These skills can only be taught by teachers who are also equipped with 21st-century teaching competencies. Therefore, both students and teachers must be in a 21st-century school. As students prepare to enter the workforce, they need to develop skills that are relevant to employment, entrepreneurship, job training programs, and/or military service (Davis, 2016).

Robinson (2014) and Dignath et al. (2018) also stressed out that teachers can help integrate 21st-century skills in students by adopting student-centered learning. This means they should make their instructions relevant by using student-centered methods that stimulate student interest in the subjects being taught.

The significant relationship between 21st-century learning skills and science content knowledge implies that STEM 12 students who possess higher levels of 21st century learning skills are more likely to have very high science content knowledge, specifically in General Biology I and General Physics I. These students possess a high level of 21st century learning skills and can do better in understanding science concepts.

The result of the study is aligned with the ideas and experiences expressed by the discussants during the focus group discussion, who asserted that 21st-century learning skills have a profound influence on their acquisition of science content knowledge. The discussants agreed that their level of science content knowledge is positively influenced by their 21st-century learning skills. They recognize that skills such as critical thinking, problem-solving, and technology proficiency are essential for comprehending complex subjects like biology and physics in today's education landscape. They credit teachers with 21st-century teaching competencies for enhancing their learning experiences by employing modern methods and resources, thus making the subjects more engaging and accessible. Ultimately, they acknowledge that these skills contribute to their development as well-equipped individuals ready to tackle the challenges of modern education and beyond.

Student Discussant 5: Yes, I agree that the level of science content knowledge can be influenced by the 21st century learning skills as the skills enhance my ability to evaluate, analyze, and apply scientific information.

Student Discussant 2: Yes, I believed that my science content knowledge is influenced by my 21st century learning skills. So, in today's education, critical thinking, the problem solving, and the technology are crucial for understanding complex subjects like biology and physics. So, the teachers with 21st century teaching competencies enhanced my learning experience, my performance by utilizing modern methods and resources making the subjects more engaging and accessible, making us a well-equipped individual.

The result of the study agreed the statement that educators have emphasized the need to integrate 21st century learning skills with the fundamental content of various subjects such as science, mathematics, technology, and engineering. In recent years, there has been a growing focus among educators to enhance 21st-century skills through STEM education (Jang, 2016; Li et al., 2019). STEM education should provide more innovative support to improve learning effectiveness and foster the acquisition of 21st century learning skills. According to Li et al. (2019), students can develop new thinking skills through STEM education that are closely associated with 21st-century skills.

Therefore, the null hypothesis which states that there is no significant relationship in the science content knowledge among the levels of 21st century learning skills is rejected.

There is no significant relationship between 21st-century teaching competencies and science content knowledge implying that there is no correlation between 21st-century teaching competencies and science content knowledge. This indicates that there are other factors beyond teachers' competencies that influence the science content knowledge of students such as student's interests, motivation, student backgrounds, and curriculum design.

This result is consistent with the finding indicating no significant relationship between 21st-century teaching competencies and science content knowledge in the focus group discussion. The discussants emphasized the presence of other influential factors that impact students' understanding and mastery of scientific concepts. They discuss the factors influencing STEM students' varying levels of science content knowledge in General Biology I and General Physics I. They note that while students excel in Biology due to its relatability to real-world phenomena, they encounter challenges in Physics, influenced by teaching methodology, student background, and assessment methods. Additionally, concerns are raised

about the curriculum's overwhelming number of competencies in General Physics, suggesting a need for review. These show the importance of considering multiple factors, including student backgrounds, and curriculum design, in shaping students' proficiency levels in science subjects within the STEM curriculum.

Teacher Discussant 1. Based on my experience that the students especially our STEM students have high level of science content knowledge in general biology 1 and moderately high in general Physics 1. This is really true, especially in the context in our school, based on my experience, STEM students are more exposed in actual phenomena especially on those topics that are happening specifically in general biology, compared to the complex situations that they encountered sometimes in general physics. However, it is also essential to consider various factors that may influence these results wherein high level in Biology and moderately in General Physics. Especially, the teaching methodology, why do we need to consider this factor? Because if the teacher from biology subject will teach physics, the teaching methodology could affect the performance of our students. And number 2, the student background, if the students are really good in mathematical problems or he/she is inclined in mathematics, there is a possibility that his/her knowledge in physics or both physics and biology is high. That's why in science content knowledge, we are considering different factors. And of course, another factor is the assessment method that we give, because in general biology, usually the assessment method is easy that we can give to our students. But in physics, we all know that usually in physics that complex, they need to solve problems and what so ever. So, the assessment method could affect also the content knowledge or one of the factor that we should consider with the result that the rating is slightly high in biology compared to physics that is moderately high.

Teacher Discussant 2: I think another factor in my own opinion is the curriculum that the department crafted for the general physics. I have noticed that there are too many competencies for just a week, I think it's too massive, and the competencies are bombarded for the students. So, I think the department could reflect and revisit and review the curriculum in general physics as compared to the other subjects that offered in STEM.

The result of the study also supports the findings of Kim, Raza, and Seidman (2019), the development of 21st-century skills in learners is significantly influenced by the education delivery system. Factors such as pedagogy, curriculum, school rules and climate, assessments, and benchmarking skill acquisition play a key role in the way these skills are developed and monitored. However, the classroom is the primary location where these factors converge to facilitate knowledge acquisition and skill development. Learners can observe their teachers model these skills and practice them in the classroom.

Therefore, the null hypothesis which states that there is no significant relationship among 21st century teaching competencies and science content knowledge is accepted.

Additionally, an enhancement program tailored to the results of the study would be well-suited for improving STEM 12 education. By developing a program that addresses these interconnected aspects, educators can create a more holistic approach to teaching and learning in STEM 12 subjects, specifically General Biology I and General Physics I.

The enhancement program is entitled "21st Century Teaching Competencies, Learning Skills, and Science Content Knowledge Enhancement Program." This program aims to sustain and enhance both the 21st century teaching competencies of teachers and the 21st century learning skills and science content knowledge of students.

Table 9. Outline of 21st Century Teaching Competencies, Learning Skills, and Science Content Knowledge Enhancement Program

Objectives	Title	Activity	Persons Involved	Time frame
To ensure that teachers maintain and strengthen their 21st-century teaching competencies through targeted professional development and collaborative learning opportunities	21st Century Teaching Excellence Series: Advancing Professional Growth Through Collaborative Learning	• workshops covering technology, teaching styles, inquiry-based learning, and assessment methods. • Collaborative sessions for lesson planning and peer observation, helping teachers share ideas and improve together.	Teachers	Every Friday 1 hour
To sharpen students' critical thinking abilities, fostering their capacity to analyze, evaluate, and solve problems effectively in diverse situations.	Brain Boost: Critical Thinking Adventures in Science	• hands-on activities designed to stimulate critical thinking skills of students. Activities include puzzles, brain teasers, logic games, and group discussions on scientific concepts. • Each session would focus on different aspects of critical thinking, such as analysis, evaluation, problem-solving, and decision-making, with the goal of gradually building students' capacity to think critically across diverse situations.	Teachers and students	Every Friday 1 hour
To deepen students' understanding of physics concepts and principles through engaging lessons and hands-on experiments, fostering confidence and proficiency in the subject.	Mastering Physics: A Journey Through Concepts and Principles	• workshop could cover a physics concept through engaging demonstrations, group discussions, and problem-solving activities. Hands-on experiments and simulations would complement theoretical discussions, allowing students to observe the concepts in action and deepen their understanding.	Teachers and students	Every Friday 1 hour

Table 9 shows the outline of 21st century teaching competencies, learning skills, and science content knowledge enhancement program which is carefully crafted to address the diverse needs of both teachers and students. It focuses on empowering educators

through targeted professional development and collaborative learning opportunities to enhance their 21st-century teaching competencies. Through ongoing training and support, teachers are equipped with the latest pedagogical approaches and instructional techniques to effectively engage and inspire students in today's dynamic learning environments. Concurrently, the program prioritizes the cultivation of critical thinking skills among students, providing them with ample opportunities to analyze, evaluate, and solve problems across various contexts. Lastly, through engaging lessons and hands-on experiments in physics, students deepen their understanding of fundamental concepts while fostering confidence and proficiency in the subject. This comprehensive approach ensures that teachers and students are equipped with the tools and knowledge necessary to thrive in an ever-evolving educational landscape.

This enhancement program will be conducted year-round, with sessions held every Friday, each lasting for one hour. This regular schedule ensures consistency and allows participants to fully engage with the program over an extended period. The one-hour duration of each activity strikes a balance between providing substantial content and accommodating participants' schedules. Additionally, conducting the program every week allows for continuous learning and reinforcement of concepts, promoting sustained growth and development for both teachers and students throughout the academic year.

The workshops will cover a range of technology tools and teaching styles, including spreadsheets for grade calculations, PowerPoint presentations with animations and graphics for daily lectures, and applications of various science websites for instruction; Inquiry-based learning, such as hands-on experiments, problem-solving activities, and research projects, encourages students to actively explore concepts, ask questions, and investigate answers independently or collaboratively; and assessment method include creating various types of exams, developing rubrics for evaluating student performance, and designing activities that assess students' learning skills. In addition, collaborative sessions for lesson planning and peer observation will be implemented to foster teamwork among teachers and encourage the sharing of best practices.

Moreover, hands-on activities designed to stimulate the critical thinking skills of students will be implemented. These activities include puzzles, brain teasers, logic games, and group discussions on scientific concepts. Each session would focus on different aspects of critical thinking, such as analysis, evaluation, problem-solving, and decision-making, to gradually build students' capacity to think critically across diverse situations.

Furthermore, a workshop could cover a physics concept through engaging demonstrations, group discussions, and problem-solving activities. Hands-on experiments and simulations would complement theoretical discussions, allowing students to observe the concepts in action and deepen their understanding.

This program ensures that participants are equipped with the tools and knowledge necessary to succeed in today's rapidly changing educational landscape. Through ongoing professional development, collaborative learning opportunities, and hands-on activities, the program fosters a culture of continuous growth and improvement among educators and learners alike. With its tailored approach to addressing diverse needs and promoting active engagement, the enhancement program stands as a beacon of innovation and excellence in education.

In light of that, Pa-Alisbo (2017) recommended that teachers can use 21st-century teaching competencies to evaluate their job performance. To improve their 21st-century teaching competencies and learning skills, schools should organize intensive training and workshops. Curriculum developers should also prioritize teachers' development in technology integration for teaching. Teachers should receive more training on special education and intervention programs for at-risk learners.

Conclusions

On the basis of the preceding findings, the following conclusions were drawn:

1. The STEM 12 teachers exhibit a remarkable mastery of 21st-century teaching competencies, enabling them to effectively guide students in acquiring essential skills for the modern world. They can also facilitate learning and apply 21st-century skills in real-world scenarios. The STEM 12 teachers can promote critical thinking among students, encouraging them to analyze, evaluate, and synthesize information to form well-reasoned judgments. They can create learning environments that stimulate curiosity and problem-solving, empowering students to approach challenges with confidence and creativity. Furthermore, teachers can foster collaborative learning environments where students engage in teamwork, communication, and cooperation. By facilitating group projects, discussions, and peer-to-peer learning activities, they cultivate essential interpersonal skills of students that are necessary for success in the teaching and learning process. Additionally, they can integrate technology into their teaching practices, leveraging digital tools and resources to enhance the learning experiences of students.
2. The STEM 12 students demonstrate an impressive mastery of 21st-century learning skills, empowering them to excel in understanding scientific concepts and seamlessly apply them to real-world contexts. This mastery not only enhances their academic performance but also equips them with the adaptability and resilience needed to navigate the dynamic challenges of a rapidly changing world. The STEM 12 students possess critical thinking skills, enabling them to analyze complex scientific concepts, evaluate evidence, and devise innovative solutions to real-world problems. This ability to think critically equips them with the capacity to tackle challenges with creativity and resourcefulness, but this ability can be further developed to the highest levels of proficiency in possessing critical thinking skills.

   Therefore, they are not only possessing critical thinking but using it to easily understand science concepts and apply them to real-life scenarios. This would help them not only acquire a high understanding of science but also develop the transferable skills necessary to critically evaluate information, solve problems, and make informed decisions in a wide range of contexts. Additionally, STEM 12 students can collaborate and engage in teamwork, communication, and knowledge sharing.

   By collaborating with peers on projects and discussions, students could develop essential interpersonal skills and learn to effectively communicate their ideas and findings to diverse audiences. By mastering these 21st-century learning skills, students are not only prepared to excel academically but also equipped to thrive in a world where innovation, collaboration, and adaptability are essential for success. This could help them to be future leaders and problem solvers capable of addressing the complex challenges of the 21st century.
3. The STEM 12 students demonstrate a high level of science content knowledge, they not only excel academically but also possess a set of additional abilities that are invaluable for navigating real-world situations where scientific understanding is essential. Students with a deep understanding of science concepts are adept problem solvers. They can analyze complex problems, identify patterns, and apply scientific principles to develop effective solutions. Stem 12 students with a high level of science content knowledge in biology possess a range of abilities that extend beyond academic achievement. This could help them to have a deeper understanding of the biological concepts they may encounter in their daily lives. They can analyze biological data, evaluate hypotheses, and propose solutions to biological problems.

   STEM 12 students with a moderate level of science content knowledge in physics may not have reached mastery, but they still develop valuable skills, understandings, and attitudes that contribute to their academic and personal growth. Their exposure to physics concepts lays the groundwork for further exploration and development of scientific literacy, critical thinking, and problem-solving abilities essential for

success in the 21st century. They can learn to approach challenges systematically, apply mathematical reasoning, and devise strategies to solve physics problems, enhancing their overall problem-solving abilities across different domains. This could lead them to interpret and explain everyday occurrences in terms of fundamental physics principles, fostering scientific curiosity and inquiry.

4. Students' science content knowledge remains consistent regardless of variations in teachers' teaching competencies. STEM 12 students could learn to seek out resources, ask questions, and explore topics independently, driving their academic growth. They could demonstrate resourcefulness and adaptability in navigating different teaching styles and classroom environments. They can also learn to adapt to varying instructional methods and leverage diverse learning opportunities to enhance their understanding of science content. Stem 12 students cultivate intrinsic motivation and curiosity for science, driven by their inherent interest in the subject matter rather than external factors such as teaching methodologies. This could lead them to be naturally inclined to explore scientific concepts, conduct experiments, and seek deeper understanding, irrespective of instructional approaches.
5. Students with higher levels of 21st-century learning skills tend to have a better understanding of science content. This could provide them with a more holistic understanding of scientific principles and their real-world applications. They can critically analyze scientific information, collaborate effectively with peers, communicate their ideas clearly, and adapt to new situations with ease. They can also take ownership of their education, initiate collaborative projects, and inspire their peers to engage in scientific exploration and discovery, fostering a culture of curiosity and innovation in the classroom.
6. The STEM 12 teachers equipped with 21st-century teaching competencies can nurture and enhance 21st-century learning skills in students, empowering them to thrive in today's complex and dynamic world. Teachers can create engaging and impactful learning experiences that equip students with the 21st-century learning skills necessary for success in today's modern era. They can apply innovative teaching strategies to foster student engagement and promote deeper learning experiences. Additionally, by integrating technology effectively into their lessons, STEM 12 teachers can provide students with opportunities to develop digital literacy skills and explore new avenues for collaboration and creativity. This could help them cultivate a supportive and inclusive learning environment where students feel empowered to take risks, think critically, and collaborate with their peers.

A significant relationship between 21st-century learning skills and science content knowledge demonstrates a deeper understanding of scientific concepts, as these skills enable them to think critically, collaborate effectively, communicate clearly, and adapt to new challenges in scientific inquiry. This could lead to more proficient problem-solving abilities, as students are better equipped to analyze complex scientific problems from multiple angles and develop innovative solutions.

Students' science content knowledge remains consistent regardless of variations in teachers' teaching competencies. There may be different factors beyond teachers' competencies that influence the science content knowledge of students. Students with a strong foundation in science or a high level of intrinsic motivation can excel in acquiring new knowledge regardless of variations in teaching competencies. The students' intrinsic motivation and curiosity could drive their engagement with scientific topics, leading to a more profound learning experience. This could help them understand the science concepts in their own experience.

7. An "enhancement program" is developed and will be implemented in the context of 21st-century competencies, learning skills,

and science content knowledge. This enhancement program can provide STEM 12 teachers and students an opportunity to develop the necessary 21st-century teaching competencies and learning skills in today's modern world. Through an enhancement program, students can also further understand science content knowledge.

Recommendations

Based on the aforementioned findings and conclusions, the following recommendations are hereby endorsed:

1. Teachers may continue to engage in reflective practice and seek opportunities for growth and development. They may also collaborate with colleagues to share best practices and innovative teaching strategies, fostering a culture of continuous improvement and collaboration within the school community.

   School administrators may implement a system for monitoring and evaluating teacher performance regularly and providing constructive feedback based on classroom observations, student feedback, and academic results. They may also provide ongoing professional development such as workshops, seminars, and courses focusing on advanced teaching methods, subject-specific knowledge, technology integration, and pedagogical innovations that could maintain their 21st century teaching competencies.
2. Students may actively engage in experiential learning experiences and extracurricular activities that allow them to further develop and apply their 21st century skills. Engaging of students in extracurricular activities can promote social connections and networking opportunities, enabling them to interact with individuals from diverse backgrounds and perspectives.

   Teachers may create instruction to meet the diverse learning needs and abilities of high-skilled students. They may provide advanced materials, enrichment activities, and opportunities for independent research or project-based learning to keep them engaged and motivated. They may also promote critical thinking skills by designing lessons and activities that encourage students to analyze, evaluate, and synthesize information critically.
3. Curriculum planners may regularly review and revise curriculum documents to ensure alignment with 21st century learning goals and competencies. They may also prioritize the development of digital literacy skills and the integration of technology tools and resources to enhance teaching and learning experiences.

   Students may stay updated on science by reading news and exploring books. This helps them keep learning and growing in science alongside their classroom activities. They may also practice scientific problem-solving to enhance their learning skills and deepen their understanding of scientific concepts.
4. Teachers may focus on determining other factors that can influence students' science content knowledge so that they can better understand and address the various aspects impacting their students' learning outcomes.

   School administrators may prioritize creating a supportive learning environment that promotes student engagement and motivation so that students can thrive academically and reach their full potential.
5. Educational institutions may incorporate technology tools and resources to enhance science learning and promote 21st-century skills development. They can utilize simulations, virtual labs, and multimedia presentations to engage students and facilitate their exploration of scientific concepts.

   Teachers may implement active learning strategies such as discussions and hands-on activities to encourage student participation and interaction to foster 21st-century learning skills while deepening understanding of science content.

   Students may actively participate in science classes, discussions, and hands-on activities that can further develop their 21st-century skills.
6. Teachers may create teaching approaches to accommodate diverse learning styles and abilities among students. They may also utilize variety of instructional

methods, materials, and assessments to effectively reach and engage all learners. Additionally, they may create opportunities for students to actively participate in their own learning through discussions, group activities, and hands-on experiences.

Students may actively engage in class discussions, ask questions, and seek clarification when needed. They should take responsibility for their own learning by setting goals, managing their time effectively, and seeking out resources to support their learning journey. Additionally, they can actively participate in group activities and collaborative projects to enhance their understanding and strengthen their teamwork skills.

7. The enhancement program is carefully designed to address the multifaceted needs of both teachers and students. This may focus on empowering educators through targeted professional development and collaborative learning opportunities aimed at enhancing their 21st-century teaching competencies. Through ongoing training and support, teachers are equipped with the latest pedagogical approaches and instructional techniques to effectively engage and inspire students in today's dynamic learning environments. Concurrently, this program may prioritize the cultivation of critical thinking skills among students, providing them with ample opportunities to analyze, evaluate, and solve problems across diverse contexts. Through engaging lessons and hands-on experiments in physics, students may deepen their understanding of fundamental concepts while fostering confidence and proficiency in the subject. This comprehensive approach may ensure that both teachers and students are equipped with the tools and knowledge necessary to thrive in an ever-evolving educational landscape.

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