LEVEL OF STEM CURRICULUM IMPLEMENTATION ON INITIATIVES AND ADAPTIVE MEASURES ON PROGRAM MECHANISM FOR CRISIS RESILIENCY

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Level of STEM Curriculum Implementation on Initiatives and Adaptive Measures on Program Mechanism for Crisis Resiliency

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Abstract

The STEM education is a science and mathematics-oriented curriculum aimed to develop the 21st-century skills of the learners. An unexpected crisis of COVID-19 challenged the early years of STEM education implementation. However, the Philippine educational system left no stone unturned in looking for ways to continue to serve and facilitate education amidst the pandemic. In this note, the researchers investigated the level of Implementation of the STEM Curriculum. It made use of a modified survey questionnaire taking account of the initiatives and adaptive measures implemented in public Senior High schools offering STEM strands of the Division of Cagayan de Oro City during the pandemic. The result of this study served as the basis for designing an effective STEM program mechanism that promotes crisis resiliency. The result shows that the level of implementation of STEM programs is high ($\bar{X}$=3.48; SD= 0.62). Generally, the implementation of the adaptive and initiative measures promoted a positive outlook. Hence, there was a significant relationship between the STEM program implementation level and students' competency level (r-value = 0.567, P-value= 0.0013). Learners perceived the implementation of STEM programs as high and effective. The adaptive and initiative measures have improved their proficiency in Science and Mathematics subjects.

Keywords: STEM Education, adaptive measures, Senior High School

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I. Introduction

STEM (Science, Technology, Engineering, and Mathematics) is a curriculum established for high schools in the Philippines that emphasizes science and mathematics that teaches 21st century skills such as critical thinking, creativity, cooperation, and communication. These skills are identified as essential requirement for learners of today to thrive in work and in life. To develop these skills, the STEM strand gives senior high school students exposure to the intertwining STEM disciplines, an avenue to see how things works in real life. To succeed in life, students have to be able to apply what they have learned to a variety of scenarios. STEM education teaches them to adapt the concepts that they learn to various iterations of a problem or issue (Matthew, 2019).

The STEM education is part of the K to 12 program. The K to 12 program is one of the biggest educational reform in the country, with many areas for collaboration among the different sectors in the country. The Philippine Education System reform is consistent with the Philippine Qualification Framework of 2012 which aims to align the country's education system with its neighboring ASEAN countries.

On the early years of the STEM education implementation, educators face various challenges in establishing the desired program for

specified learners. Teachers focused on employing appropriate mechanism in implementing the STEM courses, the scope of program content, identify specific program resources, and teaching strategies/styles or program instruction. Along with these concerns, as years shift, the number of STEM students increases and facilities become inadequate.

Moreover, integrated STEM education was introduced, which has found to have issues to be addressed in order to say that an integrated STEM education has truly come to Philippine public schools. Discrepancy hinders the realization of STEM methodology as defined by Moore & Smith (2014). Integrated STEM education is an attempt to combine the four disciplines of science, technology, engineering, and mathematics into one class, unit, or lesson based on the connections among these disciplines and real-world problems. Specifically, STEM integration refers to students participating in engineering design as a way to develop appropriate technologies that involve substantial learning through integration and application of mathematics and/or science. The program has curriculum and human resources, and infrastructure limitations. One major issue is the curriculum prepared by the national office of the Department of Education. All tracks under the Senior High School (SHS)

follow a uniform set of Core Subjects and Contextualized Subjects. Each strand has various set of Specialized subjects relying on the career path a student wants after finishing senior high school (Arnilla, 2018). A critical challenge shaken education as COVID-19 pandemic emerged as the education system started looking into the concerns of the implemented program.

The early years of the STEM education implementation was challenged by an unanticipated crisis of COVID-19. Despite the pandemic, the Philippine educational system did not leave any stone unturned in its search for solutions to continue to serve and facilitate education. Educators and learners need to adapt on this existing circumstances and consider distance learning as an option. As STEM education journeys and continues to focus on its goal on the development of the 21st century skills, it has to design its course as the circumstances call.

Lumbia National High School considered and requested an offering of the STEM strand and granted the request for full implementation in the S.Y. 2020-2021. However, in that school year, all schools in the country had been fully-closed due to the COVID -19 crisis, forcing learners to enroll in distance learning modalities. The associated consequences of school

closures include learning loss, mental distress, heightened risk of drop-out, child labor, and child marriage (UNICEF Philippines, 2021).

Moreover, Lumbia National High School continued to pursue its newly opened Senior High School Academic Strand, the STEM strand (Science, Technology, Engineering, Mathematics), amidst the surge and widespread COVID-19. The city division office initiated the arrangement of SHS subjects and trained the teachers who shifted their teaching-learning pedagogies based on implemented learning modality and focused on essential learning competencies aligned with the new normal. Moreover, schools were encouraged to use other initiatives and adaptive measures to help facilitate learning amidst the crisis.

Technology interventions played a significant role in distance learning that made learning meaningful despite the virus outbreak and several lockdowns. Despite the strategies implemented by the Department of Education for the newly adopted learning modalities, it has faced many challenges to students, teachers, and parents. Foo (2021), in his comparative study regarding distance learning and the conventional face-to-face approach during the COVID-19 pandemic, noted that students in DL (Distant Learning) group had significantly lower scores in all five areas of proficiency (participation, communication, preparation,

critical thinking, and group skills) and discovered that the face-to-face students performed somewhat better.

It has been a great challenge for both teachers and students to adopt the new learning modality by the Department of Education considering the matter of preparation of the learning to be introduced and implemented. According to the study of Ysthr et al. (2020), teachers in Modular Distance Learning face a number of obstacles. As observed, most students could not study at their own pace, and struggled to follow the instructions in their modules. As a result, learners were frequently late in the submission of their modules and majority of the activities in the modules were not answered.

Furthermore, in its second phase of STEM implementation, Lumbia NHS conducted an assessment last January 2022 based on the 1st-semester CMSS in Math and Science subjects. Most of the students have a grade average between 80-85. As the teachers conducted the face-to-face parent-teacher conference, most parents said that students had faced challenges in the major subjects during the COVID-19 pandemic, specifically in student engagement, teaching strategies, and learning environment. Thus, the school made strategies for STEM education implementation in adherence to a pedagogical mechanism that sustains

STEM implementation even amidst a pandemic or crisis. Initiatives and adaptive measures for crisis resiliency were considered and established.

The school considered admission requirements essential in the implementation of the program. According to Dhurumraj et al. (2020), the development of the STEM curriculum played a significant role in economic development because it allowed the production of well-qualified proficiency resources from schools. Competence in the demonstration of critical knowledge areas such as science, technology, engineering, and mathematics determines the STEM curriculum's development (Dhurumraj et al., 2020). Thus, considering admission requirements as part of the STEM implementation sustainable measures amidst the pandemic. Sustainable STEM education is still in its early stage of development in higher education. Although the COVID-19 pandemic presented unprecedented challenges to this relatively new field, it also helped increase the focus on elements of the Fourth Industrial Revolution concerning education (Sobrosa et al.,2020).

The study of Alangari (2022), on the review of current articles on STEM education in higher education during COVID-19, showed that Faculty members considered the transition from face-to-face to web-based programs effective even though they faced several challenges.

The investigation revealed that the application of STEM online learning has helped to increase students' creativity and the rate of STEM research by both students and faculty members. This finding has inspired educators to implement initiatives and adaptive measures to reinforce learning on the new normal. Initiatives, in this context, are defined as actions done by the school to protect its constituents from the effects of COVID-19, implement its educational goals amidst the pandemic, as well as to help alleviate any personal challenges or issues its learners and teachers/staff might be facing in relation to the pandemic. Adaptive measures, on the other hand, are defined as the adjustments made by the school in response to the COVID-19 pandemic. These initiatives and adaptive measures may be concrete, such as building facilities, or abstract, such as a change in school policy and observance of protocols. Since the goal of the school is to create a safe and conducive learning environment and establish lifelong learning, knowing the initiatives and adaptive measures in the school is essential to gauge their curriculum implementation and compliance with the new normal. It is also for us to understand the educational system's drive and preparedness to take action in this pandemic, whether in disseminating information or providing the safety and health needs of the learners and teachers/staff.

In this note, the researchers investigated the Level of Implementation of the STEM Curriculum. Specifically, the study determined the level of implementation of the STEM curriculum, taking into account the initiatives and adaptive measures implemented in public Senior High schools of the Division of Cagayan de Oro City during the pandemic. The result of this study served as the basis for designing an effective STEM program mechanism, a step towards crisis resiliency.

II. Review of Literature

This presents all the reviewed literature and studies used as reference in the planning and expectation of this research.

STEM Curriculum

In order to establish an efficient teaching and learning in standard higher education, an investigation in various teaching learning pedagogy is critically needed. Aside from focusing on the cumulative skills established by the learners, education must be assessment-centered. Opportunities for improvement are developed under these conditions especially in unprecedent circumstances such as COVID-19 pandemic.

During COVID-19 crisis, the schools implement various learning modalities in order to continue to establish education even amidst crisis or

pandemic. As an alternative to face -to-face learning, distant learning was considered.

Face-to-face instruction involves immediate transfer of instruction, while the Online learning curriculum is specially designed for online instruction, which then requires trained online teachers (Black et al., 2021). The COVID-19 pandemic, which is yet to cease, compels that regular school activities be limited to distant operations, a factor that psychologically influenced our learners. According to Li et al. (2021), the surge of the COVID-19 pandemic has promoted an increase in mental health incidents, including, depression, and anxiety among students. Academic experts are attempting to establish models of learning approaches that are most effective owing to the current learning settings.

According to Sarnita et al. (2021), STEM-based learning can potentially improve learners' creative thinking skills. The model encourages learners to develop, embrace and adopt technology to improve their cognitive skills and scientific attitudes. However, factors like a pandemic would really affect the development of the 21st century skills among our learners. In order to continue education amidst pandemic, several distant learning modalities were considered such as online learning, modular learning, bichronous (synchronous and asynchronous) learning, and

Modular-Digital Learning. Teachers adopted innovative measures to maintain learning opportunities for students who stayed at home. Some of these measures, like online lectures or webinars, were in place before the COVID-19 outbreak and some measures were hastily put into place during the COVID-19 pandemic.

According to a study conducted by Ambayon (2020), modular instruction is more effective in the teaching-learning method than traditional teaching methods since students learn at their own pace in this modular approach. It is an unlimited self-learning process in which students are stimulated and their interest is piqued by quick reinforcement, such as a comment on a practice exercise. As a result, this type of learning modality promotes a student-centered learning strategy. However, instructors, students, and parents faced numerous obstacles as a result of the deployment of modular learning.

Another study of Nardo (2017), discussed on the advantage of printed modular approach, and suggested that the use of printed modules encourages independency in learning. Students are involved in their self-directed learning of the concepts given in the module which help them gain a sense of accountability in carrying out the tasks outlined

in the module. However, it could be seen that several challenges were being encountered by the teachers in the Modular distance learning.

Teaching Style and Strategies

Based on the study of Acala (2021), teachers face a variety of obstacles while using a modular remote learning mode. These issues were discovered as a result of how teachers organized and prepared courses, presented, gathered, monitored, and assessed students' outputs, as well as how they offered feedback to students. Teachers cope with the challenges that they facing in the modular distance learning modality by managing their time, innovating teaching strategies, adapting to the changes brought on by the new normal trend in education, being flexible, providing alternative plans, remaining optimistic and patient, and equipping themselves with the necessary skills.

Wenner et al. (2011) discovered that while the modular approach was successful in a remedial math course, the success of greater levels of student participation and completion is dependent on the type of school, courses, quantitative topics presented, assessment, and teacher teaching approaches.

Furthermore, Gonzales (2015) claims that modular learning is one of the teaching methods where the students are given a choice of topics.

Students must work independently and at their own pace to master everything in the module. He also stated that the process is not the same as the traditional one, in which learners simply listen to understand topics based on the teachers' presentation. He also indicated that the modular approach would be a suitable alternative to overcome the issues that students have in typical classroom situations because it is more flexible. Modular approach is student-centered, self-paced, and does not much involve on taking notes.

Bichronous online learning is the blending of both asynchronous and synchronous online learning, where learners can participate in anytime, anywhere learning during the asynchronous parts of the course and participate in real-time activities for the synchronous sessions (Martin, 2021). This will provide the learners to learn at own pace as well as immediate feedback and interaction between the learner and the teacher.

Moreover, the Bichronous Online learning was being suggested as a learning modality. It is blending asynchronous & synchronous. It is the best approach since synchronous communication features are integrated with asynchronous features, making the online course more engaging and directs towards an increase in learning outcomes, positive attitude, and

retention (Martin, 2021). Bichronous online learning can maximize the benefits of both synchronous and asynchronous environments and mitigate the disadvantages of asynchronous online learning alone, such as communication (Hogseth, 2020). Teaching 21st Century Skills in a Bichronous Learning Environment. Students' reflections on how the shift to bichronous learning has affected their acquisition of 21st century skills. After an introduction to 21st century skills, these informed skills were classified into the three categories of the 21st century skills domains; the area of learning and innovation skills, the area of professional and life skills and the area of digital literacy. (Alblooshi, 2020).

Learning Environment

On the study of transitioning to the "new normal" of learning in unpredictable times: pedagogical practices and learning performance in fully online flipped classrooms, describes how successfully the online class learning crisis was overcome by converting two traditional flipped classes into fully online flipped classes using a cloud-based video conferencing application (Hew, 2020).

According to research, online learning materials should include activities for the different learning styles, so that learners can select appropriate activities based on their preferred style (Alzaghoul, 2012). The

shift of new scheme of learning from face to face to online learning requires a lot of adjustment for both learners and teachers. New learning strategy and techniques appropriate learner's capability and learning style will become a challenged.

Interaction has always been valued in distance learning, even in its more traditional independent study format. The challenge for educators in an online learning context is to create a student-centered, content-centered, community-centered, and assessment-focused learning environment at the same period. There is no best medium for online learning, nor is there a specific formula that indicates what type of interaction is most conducive to learning in all areas and to all learners. Rather, teachers must learn to develop their skills to meet the needs of the curriculum and of new and existing students. Teachers can do this by developing a repertoire of online learning activities that can be adapted to different contexts and needs of students (Anderson, 2008).

Furthermore, the investigation of Alangari (2022) showed that the use of STEM online learning has helped to improve students' creativity and the rate of STEM research by students and faculty members. However, STEM (Science, Technology, Engineering, and Mathematics) education is a hands-on endeavor. Thus, in times of a crisis like in COVID-19 pandemic,

everything has changed its path and pace, and learning alternatives turned upside down as the educational system search for appropriate ways and means to sustain quality learning amidst crisis. STEM classrooms nowadays appear extremely different, whether educators are teaching remotely, in-person, or in a hybrid approach. Due to safety concerns, space constraints, and changes in students' schedules, STEM classes must take on a new more flexible approach. "STEM Education" (2021) shows a few ways educators are confronting pandemic-induced curriculum and instructions. First is by adopting a new lab approach. This might mean working in shifts, so that equipment can be sanitized in between uses. Second, "bringing the lab home", STEM teachers may need to implement guidelines when allowing learners to conduct simple and guided lab activities at home if their schools have embraced hybrid or remote learning. This will be more difficult in some subjects, such as high school chemistry or anatomy. Lastly, "taking it outside", an outdoor exploration in a student's local and familiar area helps personalizing of education, not to mention the natural importance of physical activity and fresh air at a time when learners are more isolated at home than before. Special attention should be made to the learning environment's ambiance in order to create a favorably impactful online course or synchronous and

asynchronous course and support to students in attaining their learning objectives.

The case study of Abouhashem et al. (2021) suggested that it is possible to create a STEM-based virtual course that will be given throughout the summer vacation, allowing students to make the most of their free time, but yet learning is guaranteed through digital and conventional teaching tools, hands-on experiments, and assignments in implementing effective course content.

Based on the set of related literature presented, this study investigated the level of implementation of the stem curriculum taking account on initiatives and adaptive measures which served as basis in designing an effective STEM program mechanism, a step towards crisis Resiliency. This study focused on the STEM program implementation involving initiatives and adaptive measures implemented by the schools during pandemic, focusing on the three areas of the STEM Program. These areas are the STEM Curriculum, the STEM Teaching Strategies/Styles, and the STEM Learning Environment. These three areas were considered in this study since these are the most controlled factors in the implementation of the STEM program during pandemic. Initiatives and adaptive measures

established by the schools in its STEM program implementation during the pandemic were identified in this study.

Curriculum content refers to the subject matter and organization of a course's learning materials. According to Liang et al. (2020), the most significant issue in online learning is a lack of independent learning skills. Therefore, teachers should construct interdisciplinary activities that motivate students' attention, especially in online learning. Additionally, materials should consider mental health of the learners since COVID-19 have significantly increased most people's anxiety and stress levels. The same holds true to learners.

Moreover, teachers have encountered difficulties while adopting the remote learning mode during the epidemic, including challenges in lesson planning, assessment of student work, and feedback provision. Since the school district has established a student-centered and inquiry-based SLM, the success of the modular approach is contingent upon the subjects, assessment, and instructional methodologies utilized. Learning materials should offer activities for the various learning types, allowing students to choose tasks based on their learning style. Students get an excellent opportunity to learn at their own pace with the teacher's help.

Finally, during the outbreak, virtual classrooms and platforms were created. The academic accomplishments of individuals have significantly influenced by their interests, concentration, and motivation (Denden et al., 2021). It is widely acknowledged that technology in education facilitates learning and significantly boosts motivation. However, supporting learners in obtaining crucial core skills presents various obstacles. Decreased student motivation to learn new concepts is one of the most prominent examples of such problems, and the absence of technology-based teaching enhancements is another. Since STEM education is a hands-on endeavor, the direction and tempo of everything have changed in times of crisis. Learning alternatives have been flipped as the educational system searches for appropriate techniques and resources to continue high-quality learning throughout situations. Therefore, STEM classes have embraced a more flexible approach. Due to the variability of the home environment, additional care should be given to this area when planning synchronous or asynchronous classes that have a good impact.

III. Research Questions

This study determined the level of implementation of the STEM program employing initiatives and adaptive measures on Curriculum,

teaching styles, strategies and Learning Environment implemented by the schools for STEM learners during pandemic. The STEM program implementation level depends on the knowledge and skills included in the courses, as well as the methods and means used in teaching.

Specifically, it sought to answer the following questions:

1. What is the level of implementation of the STEM program in terms of;

1.1 STEM Curriculum;

1.2 STEM Teaching Styles and Strategies; and

1.3 STEM Learning Environment?

2. What are the initiatives and adaptive measures employed and established by the school in its STEM program implementation during pandemic in the following areas:

2.1 STEM Curriculum;

2.2 STEM Teaching Styles and Strategies; and

2.3 STEM Learning Environment?

3. What is the level of performance of the learners in STEM science and mathematics subjects;

3.1 prior to the implementation of the study; and

3.2 after the implementation of the study?

4. Is there a significant relationship on the competency performance of the learners in STEM Science and Math subjects when initiatives and adaptive measures are implemented in the three areas of the STEM program during pandemic:

4.1 STEM Curriculum;

4.2 STEM Teaching Styles and Strategies; and

4.3 STEM Learning Environment?

IV. Scope and Limitation

This study focuses on level of implementation of the STEM program accounting on initiatives and adaptive measures implemented in the three (3) areas of the STEM program during pandemic. Only three (3) areas of the STEM program are considered in this study. These areas are the STEM Curriculum, STEM teaching styles and strategies, and STEM learning environment. The result of this study hopes to serve as basis in designing effective STEM program implementation towards crisis resiliency. This study involves SHS STEM pioneering learners, school year 2021-2022. The study focuses on the significance of initiatives and adaptive measures in terms of the school implementation of STEM curriculum, STEM teaching styles and strategies, and STEM learning

environment influencing learners' competency performance during pandemic.

V. Research Methodology

This study employed survey research design. Survey research is a technique for collecting data through the use of questions. Sometimes interviews are conducted with individuals at their homes, schools, or places of employment. Other times, individuals are mailed questions to respond and return. Increasingly, telephone surveys are undertaken (SSRIC, 2015).

This section contains the methods used in conducting the study. The following are included in the section: sampling, data collection, ethical issues and plan for data analysis.

a. Sampling

The respondents of the study are the STEM learners of Senior High Schools from the four districts of the Division of Cagayan de Oro City of SY 2021-2022. The researcher chose to examine the Grade 12 learners from the four schools offering STEM program. There are 160 respondents in total to look into the level of implementation of STEM program. The study employed systematic random sampling. Systematic

sampling is a probability sampling method in which a random sample, with a fixed periodic interval, is selected from a larger population. The fixed periodic interval, called the sampling interval, is calculated by dividing the population size by the desired sample size (Hayes, 2022).

In obtaining a sample from a population, a value between 80%-90% is usually used. It indicates the existing relationship between non-exposed and exposed groups in the sample (Mesa et al., 2014). This study randomly selected 80% of the population size of the SY 2021-2022 STEM learners of each school-respondent.

b. Data Collection

Procedures should be undertaken in obtaining the data of the study. An adopted questionnaire from the study of Faulkner et al. (2010) was utilized in this study. The adapted questionnaire was modified into a 4-point Likert scale and distributed to each item to understand the views, perspectives, and specific responses from the respondents. The adapted questionnaire was validated by a panel of experts to elicit the responses from the selected respondents. The experts were asked to assess the

individual item, if it was applicable and appropriate in relation to the construct, and whether the items would sufficiently measure all aspects of the construct. Thus, comments, suggestions, and recommendations of the experts were acknowledged. In order to assess the feasibility of the study, the questionnaire was tested with the Reliability and Validity Test. This was to identify the flaws or problems of the instrument used so that any flaw can be refined and corrected. A test for reliability was conducted through pilot testing on another group of 40 Grade 12 STEM learners of one of the select schools in the same division who were not considered respondents of the study. After the conduct of pilot testing, Cronbach Alpha was computed, and the questionnaire was considered reliable with a result of 0.80.

Moreover, triangulation method was implemented in the collection of data. It involved survey, interview, and focus group discussion.

The researcher established the collection of data of this study by taking the following steps:

First, the CMSS performance of the STEM learners in Science and Math subjects were determined prior to the

implementation of the initiatives and adaptive measures of the school during pandemic.

Secondly, the study considered the accounts of the implementation of initiatives and adaptive measures employed by the school during pandemic which determined through an interview and FGD with the representatives of the STEM learners, school administrator, and school STEM program coordinator.

Thirdly, an adopted survey questionnaire by Faulkner et al., 2010 was given to the STEM learner respondents after implementing the school initiatives and adaptive measures.

Finally, the CMSS performance of the learner respondents in science and math subjects were determined after the implementation of the initiatives and adaptive measures during pandemic.

Data were collected, tallied, analyzed and interpreted. Data will be presented in tabulated form. Results and discussions were established, and conclusions and recommendations will be drawn.

c. Ethical Issues

Researchers sought approval from the school principal with the approved letter from the schools' division superintendent to conduct the study. As permission is granted, the researchers conducted the study. To make it systematic, the researcher sought the consent of the parents through giving the letter to the respondents stating the purpose of the study, an informed consent was obtained, and implementation of survey questionnaires was made.

d. Data Analysis

The collected data were analyzed and interpreted using statistical tools. In the data analysis, descriptive and inferential statistics were employed to ensure systematic and objective data presentation, analysis, and interpretation, such as simple percentages, weighted mean, standard deviation, and Pearson Product –Moment Correlation.

In problem 1, the weighted mean and standard deviation were used to interpret the data on the STEM program implementation level. In problem 2, data were obtained through the focused group discussion among the learners, teachers, and

school heads. In problem 3, the student's performance level in Science and Mathematics was obtained from the (CMSS) Curriculum Management Support System, which was reported to the division office quarterly. The data was statistically analyzed using Weighted Arithmetic Mean. In problem 4, Pearson Product-Moment Correlation was utilized to determine the significant relationship between the level of performance of learners in Science and Mathematics subjects when initiatives and adaptive measures are implemented. The data were presented in tabular forms with corresponding analyses.

VI. Discussion of Results and Recommendations

This section presented the data gathered on this study based on the results on the survey through a survey questionnaire and interview.

A. Level of implementation of the STEM program

The level of implementation of the STEM program employing initiatives and adaptive measures in terms of STEM Curriculum, Teaching styles and strategies, and Learning Environment of the public Senior High Schools of the Division of Cagayan de Oro City for SY 2021-2022 is investigated based on the STEM learners from the four public schools in the proceeding data.

Table 1A. Level of implementation of the STEM program in terms of Curriculum

#	INDICATORS	Mean	SD	Qualitative Description	Interpretation
1.	The program description accurately presents the types of duties a SHS graduate is expected to perform in college and in the work environment.	3.63	0.51	Strongly Agree	High
2.	The program entrance/admission requirements ensure that students have the basic knowledge, skills and/or abilities required to be successful in the program.	3.57	0.52	Strongly Agree	High
3.	The sequencing of subjects offered (i.e., order of subjects presented) within the program considers the course pre-requisites and/or co-requisites.	3.45	0.57	Strongly Agree	High
4.	Learning resources (e.g., print media, audio-visual materials) are appropriately designed and adequately provided for the implementation of the program.	3.40	0.56	Strongly Agree	High
5.	Teachers are trained on the nature in teaching science, technology engineering and mathematics, and are equipped with knowledge, skills, and attitudes they are to promote in the learning process.	3.83	0.41	Strongly Agree	High
6.	The course contents are simplified, made familiar to learners, and are aligned with the current situations which motivate and stimulate learners' interest.	3.58	0.53	Strongly Agree	High
7.	Learning competencies/objectives are understandable and are clearly presented before the lesson proper.	3.53	0.55	Strongly Agree	High
8.	Utilized/designed instructional materials that promote and display appropriate work habits in industry, and ensure that program content/learning activities are consistent with the industry's practices.	3.41	0.57	Strongly Agree	High
9.	There is an adequate balance of theoretical and practical assessments conducted for each course.	3.40	0.56	Strongly Agree	High
10.	The school class program/schedule is designed according to the amount of time (no. of Hrs.) necessary to each subject.	3.49	0.69	Strongly Agree	High
Overall		**3.50**	**0.56**	**Strongly Agree**	**High**

Legend: 3.27 – 4.00 – High, 2.52 – 3.26 – Moderate, 1.76 – 2.51 – Fair, 1.00 – 1.75 – Low

The result shows that there is a high level of implementation on the STEM program in terms of their curriculum. The overall mean of 3.50 and SD

0.56 specifies that the curriculum accurately presented the expected duties to perform in the STEM strand. Learners were made sure that they have possessed the basic skills and abilities required in the program. The school also have followed the given measures on the subject arrangement considering the pre-requisites and co-requisites. Moreover, learning resources such as print medias, audio-visual materials are appropriately designed and adequately provided for the program implementation. More importantly teachers are equipped with knowledge and skills, and attitudes in the nature of teaching science, technology, engineering and mathematics.

Furthermore, the result specifies that course content have been simplified on what is only essential, given the challenge in learning delivery. Instructional materials were designed to promote and display appropriate work habits in industry, and ensure that program content are consistent with the industry's practices even in time of pandemic. Result also shows that there is a high level of implementation when it comes to the balance of theoretical and practical assessment through the initiatives and adaptive measures employed in the school.

Thus, the result implies that the STEM curriculum level of implementation have integrated the adaptive measures the Department

of Education Initiated. The schools also have implemented their own initiative which make the implementation of the STEM curriculum more effective. According to the study of Li et al. (2021), if the curriculum concentrates on increasing student motivation and motivating their interest when it comes to teaching topic, and then we created a variety of varied, highly conceptual, interdisciplinary, and integrated contents and activities to support the growth of students' thinking. Many designs have positive impacts on directing the design of online courses, particularly in terms of providing useful information for students who are studying at home during the pandemic.

Table 1B portrays the statistical calculation of the level of implementation of the STEM program in terms of Teaching Styles and Strategies in Science and Math subjects.

Table 1B. Level of implementation of the STEM program in terms of Teaching Styles and Strategies

#	INDICATORS	Mean	SD	Qualitative Description	Interpretation
1.	Activities are connected to real world & careers.	3.64	0.58	Strongly Agree	High
2.	The teacher offers help to a student when a concept or problem is difficult.	3.73	0.46	Strongly Agree	High
3.	The teacher monitors individual progress on a daily basis.	3.38	0.60	Strongly Agree	High
4.	The teacher has an adequate content knowledge both in the subject matter and in assessing the performance of students	3.65	0.53	Strongly Agree	High

5.	The teacher prepares enough and appropriate instructional materials intended for the students	3.50	0.58	Strongly Agree	High
6.	Use appropriate learning management system (LMS) such as google classroom, google, Microsoft teams, Facebook page, messenger, etc.	3.52	0.60	Strongly Agree	High
7.	Provide 1 device per student for student use at home or in school (e.g.., laptops, tablets)	2.74	1.09	Agree	Moderate
8.	Provide substantial learning materials (e.g., modules, Learning Activity Sheets, Textbooks)	3.60	0.62	Strongly Agree	High
9.	Provide digital learning materials/instruction (e.g., emailed, posted on Facebook or google classroom) for learners and parents/guardians	3.43	0.79	Strongly Agree	High
10.	Use relevant, meaningful and timely assessment strategies/tools appropriate to the chosen learning delivery modality (e.g., standard and modified rubrics, online quizzes, etc.)	3.53	0.60	Strongly Agree	High
Overall		**3.47**	**0.65**	**Strongly Agree**	**High**

Legend: 3.27 – 4.00 – High, 2.52 – 3.26 – Moderate, 1.76 – 2.51 – Fair, 1.00 – 1.75 – Low

As shown in the table, the respondents assess the teaching style and strategies with an overall mean of 3.47 and SD of 0.65. This means that the level of implementation is in high level. The learning activities are connected to the real world and careers which make the learners relate easily to the situation. According to Reuell (2019), studying knowledge that is relevant to their everyday lives, learners were more engaged and interested in the topic. This stimulates interest in a subject by highlighting recent work and influential figures in the area, explaining how the coursework is useful to other subjects, and relating content to current

events outside of the classroom. Moreover, teacher monitors students' progress and offered help to students whenever they need help.

Table 1C shows the level of implementation of the STEM program in terms of Learning Environment.

Table 1C. Level of implementation of the STEM program in terms of STEM Learning Environment

#	INDICATORS	Mean	SD	Qualitative Description	Interpretation
1.	Teachers address learners' accordingly, using their proper name.	3.74	0.51	Strongly Agree	High
2.	The learners are asked to discuss how their experiences relate to the lesson.	3.53	0.65	Strongly Agree	High
3.	The learners are given class assignments that are meaningful.	3.54	0.60	Strongly Agree	High
4.	The teacher often asks for feedback that relates to the lesson.	3.49	0.58	Strongly Agree	High
5.	Learners are encouraged to ask questions.	3.65	0.54	Strongly Agree	High
6.	Teachers are available at scheduled time to respond to students' questions/queries.	3.50	0.58	Strongly Agree	High
7.	The teacher monitors students' progress and establishing linkages with parents and household partners through different modes of communication (i.e. SMS, FB messenger, phone calls, etc.).	3.34	0.67	Strongly Agree	High
8.	The teachers are employing approaches in providing guidance and assistance to both parents and learners in the preparation of student portfolio as proof in assessing learner's performance.	3.43	0.69	Strongly Agree	High
9.	Teachers gave special classes to learners who have difficulties in understanding the concepts.	3.26	0.62	Agree	Moderate
10.	Teachers gave students a place/venue where they can discuss course concepts, answer each other's questions, and collaborate on assignments.	3.08	0.91	Agree	Moderate
	Overall	**3.46**	**0.64**	**Strongly Agree**	**High**

Legend: 3.27 – 4.00 – High, 2.52 – 3.26 – Moderate, 1.76 – 2.51 – Fair, 1.00 – 1.75 – Low

As shown in table 1C the respondents assessed the overall learning environment as high level with the overall mean of 3.46 and SD of 0.64. The Students agreed that their learning environment provided them

with facilitation of learning requirements for skill development, systematic and organized learning, and observance of the guidelines and protocols.

However, the learners only scored the participation and collaboration into a moderate level. The students have only moderate level in engaging and collaborating their leaning with other learners.

The result implies that the student's attitude in learning depends on the type of learning environment they have whether in online or offline. According to the study of Arik (2021), that students have positive opinions about group work and cooperation in online environment.

Table 1D illustrates the summary of the overall result of the level of implementation of the STEM program. The result shows that the implementation of STEM program has the overall mean of 3.48 and overall SD of 0.62. This signifies that generally the implementation of the adoptive measures and initiative measure is in high level.

Table1D. Overall Mean Distribution of the Level of implementation of the STEM program

#	INDICATORS	Mean	SD	Qualitative Description	Interpretation
1.	Curriculum	**3.50**	**0.56**	Strongly Agree	High
2.	Teaching Styles and Strategies	**3.47**	**0.65**	Strongly Agree	High
3.	Learning Environment	**3.46**	**0.64**	Strongly Agree	High
Overall		**3.48**	**0.62**	**Strongly Agree**	**High**

Legend: 3.27 – 4.00 – High, 2.52 – 3.26 – Moderate, 1.76 – 2.51 – Fair, 1.00 – 1.75 – Low

2. What are the specific adaptive and initiatives measures employed and established by the school in its STEM program implementation during pandemic?

Table 2A illustrates the summary of the adoptive and initiative measures implemented, obtained from the focused group discussion with teachers, students, and school heads of the four selected schools. Adoptive measures were part of the DepEd continuity plan while initiatives were the strategies implemented by the teacher initiatively aligning to the DepEd program.

Table 2A. Adoptive and Initiative Measures Implemented in the Selected Schools Offering STEM Strand.

Areas	Adoptive Measures	Initiatives
Curriculum	• Streamlining Learning Competencies to MELC	• Modified class schedule
Teaching Styles and Strategies	• Modular Distance Learning • Online Distance Learning • TV/Radio-Based Instruction • Blended Learning • Homeschooling • Assessment (Portfolio/E-portfolio)	• Game-based approach • Modified Class schedule • Recording Video for remedial • Development of activity sheets for remediation • Blended learning approach • Contextualization

		video for the students
Learning Environment	• Netiquette • Child Privacy	• Bring Home the LAB • Kumustahan! (consultation time) • Breakout session for students to collaborate. • Face to face consultation with the parents.

Table 2A shows the adoptive and initiative measures implemented in the select schools. Data were based on the FGD among the STEM teachers, learners, and school administrators. Table 2A shows the adoptive measures and initiatives implemented in the select schools. Data were obtained based on the FGD among the STEM teachers, learners, and school administrators. The adoptive measures were based on the learning continuity plan from the DepEd that were implemented to the public schools. The select schools have implemented the adoptive measures and have attained the high level of implementation according to the student's survey result.

However, there were also strengths in the implementation of the measures. It helped the learners learn independently by using the Self-directed design modules. The competencies that were streamlined were attainable. Among also of the strengths is contextualized learning. One of the select schools initiated a strategy, "Bring Home the Lab"; students who

could not join the online classes should perform their lab work at home. They should have at least small spaces for their home lab. The materials that were required were only available in their houses. Furthermore, this strategy is also applicable to those students who attended the online classes. Finally, constant communication to the parents have also improved since most of the time the parents were the one passed the student's requirements at the school. Every end of the unit or quarter, the teacher initiates online "Kumustahan" with the students to hear feedbacks from the lessons or tasks that were challenging to do.

However, there were challenges encountered upon the implementation. Most of the difficulties were miscommunications between the students and teachers. Teachers also said that some students contacted them even if it is not already working hours. Then students have a high reliance on the internet. They do their assignment or answer their modules by searching on the internet without understanding them. Some learners were late in returning their modules because there were a lot of activities to answer. As a result, the schools modified the class program. Core and applied subjects were given first and scheduled weekly. Then followed the significant issues in which online classes were done weekly.

Despite the weakness experienced, there were opportunities for learning along the way of the implementation. Manipulation of technologies (video lessons, teaching apps, etc.) was heightened. Instructional materials were utilized, and schools were initiated to address the challenges faced, which the DepEd program cannot address during the pandemic.

3. What is the level of competency performance of STEM learners in science and mathematics subjects before and after?

Table 3A shows the level of competency of the STEM learners in Science and Mathematics subjects in the First Semester based on the CMSS.

Table 3A. Summary Distribution of the Respondents Academic Performance in Math and Science for First and Second Semester

Mathematics					
Grade Average	**Description**	**Before**		**After**	
		Frequency	**Percentage**	**Frequency**	**Percentage**
75-79	Fairly Satisfactory	5	3.12%	0	0%
80-84	Satisfactory	31	19.38%	30	18.75%
85-89	Very Satisfactory	67	41.88%	70	43.75%
90-100	Outstanding	57	35.63%	60	37.5%
Overall Mean		**88.57**		**88.6**	

Science					
Grade Average	**Description**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
75-79	Fairly Satisfactory	11	6.8%	0	0%
80-84	Satisfactory	32	20%	31	19.38%
85-89	Very Satisfactory	59	36.88%	63	39.38%
90-100	Outstanding	58	36.25%	66	41.25%
Overall Mean		**87.08**		**88.48**	

Table 3A shows the distribution of the proficiency level of the students based on the CMSS. The adaptive and initiative measures were strengthened during the second semester of the school year. Then the 2nd Semester CMSS was obtained by the researcher to compare the data. The result gleaned an average rating between 85-89 in their Math subjects before the implementation with an overall mean of 88.57 and result after the implementation with an overall mean of 88.6. As compared from the first semester, there was an increase of the level of competency after the implementation of the study. Moreover, as reflected on the table 3A, that the Science subjects from first semester gleaned an overall mean of 87.08, prior to the implementation and second semester with an overall mean of 88.48 after the implementation. In comparison, there was an increase in the level of competency after the implementation. The level of performance of the learners both in first and second semester can be best

described as very satisfactory according to the description of the DepEd grading system.

This means that most of the STEM learners level of competency both in Math and Science subjects have a level of competency between 85-89 or at the very satisfactory level. This implies that the implementation of adaptive and initiative measures has improved the learners' performance both in Math and Science subjects. This result supports the report on the Curriculum Management Support System (CMSS) of the four selected schools offering STEM strand from four districts.

4. Is there a significant relationship on the performance of the STEM learners in Science and Math subjects when initiatives and adaptive measures are implemented in the three areas of the STEM program during pandemic?

Table 4A depicts the result of statistical calculation on the relationship between the students' competency level in Science and Math subjects and the adoptive and initiative measures implemented.

Table 4A. Correlation Coefficients and Significance of Relationship between Proficiency Level from Adaptive and Initiative Measures

Areas	r-value	P-value	Decision	Interpretation
Curriculum	0.584	0.001	reject Ho	Significant
Teaching Styles and	0.521	0.002	reject Ho	Significant

Strategies				
Learning Environment	0.597	0.001	reject Ho	Significant

*P-value <a, reject null hypothesis *significant at the 0.05 level
*r-value >a, accept null hypothesis

As shown, all indicators of adoptive measures and initiative measures have P-value less than 0.05 which is not the significant level at 0.05; thus, there is a significant relationship between the performance of the STEM learners in Science and Math subjects when initiatives and adaptive measures are implemented in the three areas of the STEM program during pandemic. This implies that adoptive measures and initiative measures implemented had a significant relationship on the performance level of the learners.

This result validates the study of Talaue (2021) that students evaluated the Science curriculum implementation as largely positive. However, students' engagement was challenged because some content activities were perceived as superficial and implementable. Others recognized that some tasks were hard to accomplish because most students lacked access to technologies.

VII. Dissemination and Advocacy Plans

The table below presents the advocacy plans after the completion of the study. Results were considered in designing a program for crisis resiliency in the STEM program throughout the schools.

Activity	Persons Involve	Time Frame	Expected Output
I. Results dissemination on the following:			
1. Dissemination during LAC and INSET	Researchers, School Head, teachers	January -May 2023	Dissemination through presentations in the said events
2. Presentation of research paper to the district level	Researchers, School Head, teachers		
3. Design a Crisis Resiliency Program in terms of Curriculum, Teaching Styles, and Learning Environment.	Researchers, School Head, teachers		
II. Participation presentation in the ff.			
1. Division Planning	Researchers, SDS, ASDS, SGOD and CID	January -May 2023	Policy making for division wide programs, projects and activities
2. Regional Planning	Researchers, SDS, ASDS, SGOD and CID		
III. Participation and presentation in the different stakeholders			
1. SGCA/PTA	Researcher and SGCA/PTA officers	January -May 2023	Policy inputs and supports from stakeholders.
2. LGU	Researcher, Brgy Councils, City Government and Local Dept.		
3. NGOc	Researchers, NGOs		
4. Industries	Researchers, President/CEO		

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