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Research Article:

Teaching College Physics to the K to 12 Program Graduates: Teachers' Experiences and Perspectives

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ABSTRACT

This qualitative research explored the experiences of university professors and instructors in teaching College Physics to the K to 12 Program graduates. The data were obtained from Physics professors and instructors from various state universities in Eastern Visayas through semi-structured interviews. Using Colaizzi's method of data analysis, five themes regarding the issues and challenges were generated. These themes are: STEM versus non-STEM graduates; students' lack of knowledge and poor conceptual understanding; challenges in teaching problem solving; challenges in conducting laboratory activities; and negative perception towards physics. In each of the issues and challenges, corrective measures were employed by the participants. Recommendations addressed to various stakeholders were also sought from them. Results reveal that there is a lack of readiness for the K to 12 Program graduates to take on the College Physics course and there are serious learning gaps between Physics education in higher education and K to 12 Basic Education curricula. The results of this study can guide the concerned individuals in the educational sector in making ways to establish continuity and progression in learning Physics.

Keywords: Colaizzi method, K to 12 Program, Physics education, spiral progression approach, STEM

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INTRODUCTION

Physics, being a fundamental science, is one of the courses offered in any science-related programs in colleges and universities. By learning this course, students can acquire and develop cutting-edge skills useful in other disciplines. Some of these skills include logical and analytical thinking, problem-solving, mathematical model construction, valid approximations and precise definition making (Corpuz, 2017).

Also, with the roll-out implementation of the K to 12 Basic Education Curriculum in the Philippines, physics became a requisite subject in senior high school, especially in the Science, Technology, Engineering and Mathematics (STEM) strand. This basic education reform caused a re-evaluation and implementation of a new tertiary education curriculum that fits the Senior High school graduates' knowledge and skills. The continuity of the learning process should be maintained by establishing links between levels of education through the coordination of the stakeholders involved (Botuzova, 2020).

Despite the curriculum development, students still have several shortcomings in learning physics (Chrzanowski et al., 2013). Students who just entered tertiary education have encountered difficulties in learning College Physics, and this stemmed from having a weak connection between high school and college physics (Liu et al., 2011). In spite of the preparations made by the high school physics teachers, many College Physics professors are still dissatisfied as students are still having difficulty in their introductory courses at the college level (Sadler & Tai, 2000). According to Manalo et al. (2015), several high school teachers fail to recognise the skills, knowledge, attitudes and techniques necessary to understand and apply physics concepts in various situations. Liu et al. (2011) pointed out the need for teachers to pay attention to the interface with high school physics, to have a general idea of the teaching content, and the teaching methods of high school physics.

Only a few studies have been conducted regarding the weaknesses of the physics education curriculum of the K to 12 Program, especially at the secondary level. To address this issue, the researcher tried to look into the experiences of various professors and instructors in teaching College Physics to the K to 12 Program graduates, specifically, the issues and challenges they encountered. Knowing their experiences opens a window in evaluating the performance of the graduates in learning College Physics which provides crucial information on the kind of preparation they had from the newly implemented basic education curriculum. The findings of this study can significantly help in improving the K to 12 Basic Education Curriculum as well as the new curricula of various degree programs.

LITERATURE REVIEW

The implementation of the K to 12 Program in the Philippines allowed revisions and innovations in the science curriculum. In terms of instruction, science education is concentrated now on a more innovative investigation that gives precedence to improving the students' critical thinking and scientific skills. The new curriculum stresses the utilisation of learner-centered approaches, including inquiry-based science learning. Such approaches enhance students' cognitive, affective and psychomotor domains.

The spiral progression approach has also been utilised as a part of the emendations of the science curriculum, according to enclosure no.1 in the DepEd Order No. 31, series of 2012. In this approach, the concepts are being developed in an increasing complexity starting from the primary levels (Department of Education, 2012). According to Dunton and Co (2019), this approach allows the students to grasp the concepts by studying them repeatedly but with increasing levels of sophistication. In the new science curriculum, the four major areas, such as Earth and Space Science, Biology, Chemistry and Physics, are incorporated into every grade level. Each area is taught in one quarter. In addition, the curriculum expands the four-year secondary education to a six-year Junior and Senior High school. One of the curriculum's unique features is the students' option to choose a Senior High school strand. The strands incorporate subjects that prepare the students for their careers in college and industry. Thus, the student's choice of Senior High school strand is of great importance.

One of the strands offered in Senior High school is STEM. This strand develops students' ability to evaluate simple to complex societal problems and formulate corresponding solutions through the application of the intertwining disciplines such as Biology, Physics, Chemistry and Earth Science. Physics, in particular, is divided into two courses – General Physics 1 and 2 – typically taken during their second year. The two courses provide students with an overview of the branches of physics which helps them understand complex concepts normally encountered in College Physics.

Since the basic education was comprehensively reformed, degree programs in higher education also underwent re-evaluation including the refinement of the courses they offer. For instance, based on annex 3 in the CMO No. 92, series of 2017, Physics for Engineers, as one of the technical and introductory courses offered in civil engineering program, now begins with Work, Energy, and Power (Commission on Higher Education [CHED], 2017a; 2017b; 2017c). Also, according to annex B in the CMO No. 75, series of 2017, the secondary science education students commence their physics coursework with Fluid Mechanics (CHED, 2017a; 2017b; 2017c). In addition, based on the memorandum orders released by CHED, most science degree programs, such as Physics, Applied Physics, Chemistry, Computer Science, Engineering, and the like, require students to take Calculus-based College Physics.

The vertical alignment of the science curricula in high school and college is a key factor in the academic achievement of the students (Alipio, 2020). For students to successfully transition from high school to college, they should be well-resourced with their past educational and personal experiences in meeting the demands and expectations in college (Manalo, et al., 2015). With this, high school teachers make much of preparing their students for success in college (Barnett et al., 2012; Sadler & Tai, 2000). However, the current skills and knowledge gained by high school students are being doubted by some College Physics professors despite the high-quality physics curriculum (Sadler & Tai, 2000; Manalo et al., 2015). A number of undergraduate students have poor academic performance in physics and one reason behind this is their poor background in high school. In the study of Bray and Williams (2020), it was found out that students who took college physics still lacked basic content knowledge. This, in turn, posed a challenge to them in delivering physics based on the course syllabi they prepared. In China, the physics professors resorted to cramming education, letting the students absorb exceedingly large information in a short span of time (Liu et al., 2011). On the other hand, physics professors and instructors in the Philippines try their best to help their students by exerting a lot of effort in preparing their lectures and employ peer tutoring and consultations as remediations (Corpuz, 2017). In Polish schools, teachers try to modify their methods in teaching physics to students with the optimal use of multimedia (Chrzanowski et al., 2013).

It has to be noted that the Philippines and other Asia Pacific countries have already implemented the K to 12 Program in their educational system. However, only limited number of studies assessing the physics education curriculum of the said program have been done. Also, published literatures in the Philippines and other Asia Pacific countries focusing on the experiences of Physics professors and instructors in teaching College Physics to K to 12 Program graduates are insufficient. Thus, this paper serves as an opportunity for these countries to conduct researches delving more on the issues and challenges in physics education of the K to 12 Program and formulate ways to address them.

OBJECTIVES

This study set out to explore the experiences of university professors and instructors in teaching College Physics to the K to 12 Program graduates.

Specifically, this study sought to answer the following questions:

1. What are the issues and challenges encountered by university professors and instructors in teaching College Physics to the K to 12 Program graduates?
2. What measures did the university professors and instructors take to address the issues and challenges they encountered in teaching College Physics to the K to 12 Program graduates?
3. What recommendations can be made by the university professors and instructors to address the issues and challenges in teaching College Physics to the K to 12 Program graduates?

METHODOLOGY

Research Design

This qualitative study employed a phenomenological research design. The core of phenomenology is to explore and closely understand the lived experiences of a group of people by interpreting data gathered through a comprehensive phenomenological analysis (Meyers, 2019). Employing this design aided the researcher in exploring the experiences of college professors and instructors in teaching College Physics to the K to 12 Program graduates.

Sampling

Purposive sampling was employed in the study. The researcher interviewed fifteen (15) physics professors or instructors from various state universities and colleges (SUCs) in the Eastern Visayas region. The selected SUCs are recognised by the CHED and offer College Physics or other physics courses to any science-related undergraduate programs. All participants had at least one year of teaching experience in College Physics or other physics courses in college.

Interview

An in-depth interview guide was utilised in the data gathering procedure. The guide consists of three major sections. The first section included the respondents' general demographic information. The second section primarily focused on the participants' experiences in terms of the issues and challenges they faced in teaching physics as well as the corrective measures they applied to address such issues and challenges. The last section focused on the recommendations to address the issues and challenges in teaching College Physics to the K to 12 Program graduates. The interview guide was validated by experts in research and physics education. It was also pilot-tested prior to the data gathering proper. In the pilot test, ten (10) physics professors and instructors from the same research locale were interviewed. As suggested by participants and validators, corrections regarding the construction of the questions as well as their order were integrated into the final interview guide.

Data collection was done through one-on-one interviews designed to explore the experiences of each teacher participant. Specifically, semi-structured interviews were administered. This method gave the researcher a chance to probe the answers of the participants allowing new ideas to emerge during the interview. Due to the COVID-19 outbreak, interviews were scheduled and conducted either online or by phone call. For online interview sessions, videoconferencing applications were utilised.

Letters were sent to the universities to seek permission to conduct the study. Upon agreement, participants were contacted to seek their informed consent. The informed consent form outlines the purpose of the study, data gathering procedure, confidentiality, study participation, withdrawal, and the researcher's contact information. The participants were informed that involvement in this study was voluntary and that if at any time, they could withdraw. Personal identification numbers were used in place of each participant's name. Participants were informed before and during the interview that questions can be skipped if they did not want to respond to them. Also, with their permission, interviews were video/audio recorded for later transcription and analysis.

DATA ANALYSIS

Colaizzi's method was employed as the primary method of data analysis. This method includes a clear and systematic procedure for analysing the data, which will give a detailed description condensed into a statement that captures only the essential aspects of the structure of the phenomenon (Sosha, 2012). Data were analysed by observing the seven steps of Colaizzi's method which are presented below:

1. Familiarisation: At first, the transcribed interviews were individually read, and reread to gain a general understanding of the data.
2. Extracting Significant Statements: Significant statements describing the phenomenon were extracted from the transcripts. Such statements were recorded on a separate sheet noting the personal identification number of the participants, pages, and line numbers.
3. Formulating Meanings: Each significant statement was attributed with a certain meaning. The formulated meaning should capture the essence of significant statements.
4. Aggregating Formulated Meanings into Theme Clusters and Themes: Similar meanings were grouped to form theme clusters. Related theme clusters were aggregated to establish themes. Five themes emerged from such analysis. To ensure consistency, the process has been reviewed by the researcher and his adviser several times.
5. Developing an Exhaustive Description: The five themes were integrated to form a description of the phenomenon thoroughly presented in the Results and Discussion section.
6. Generating a Description of the Fundamental Structure of the Phenomenon: A thematic chart of the fundamental structure has been created to show the condensed version of the exhaustive description of the phenomenon and is presented in Table 1.
7. Validation of the Findings: Lastly, to ensure validity, right after the result was reviewed by the adviser, the researcher emailed it to the participants and asked them whether it captures their experiences. All participants confirmed that the exhaustive description accurately depicts their experiences.

Table 1. Thematic chart of the fundamental structure of the phenomenon

Themes	Theme clusters	
	Issues and challenges	Corresponding measures
1: STEM versus non-STEM graduates	• The edge of STEM graduates from non-STEM graduates • Difficulties faced by non-STEM graduates • Maturity and decision-making skills of the students	• Peer tutoring • Rediscussion of the basics • Detailed lecture discussions
2: Students' lack of knowledge and poor conceptual understanding	• Lack of knowledge • Poor conceptual understanding • Misconceptions	• Lesson adjustment • Rediscussion of the basics • Conducting review sessions • Detailed lecture discussions with more examples and simulations

(Continue on next page)

Table 1 (continued)

Themes	Theme clusters	
	Issues and challenges	Corresponding measures
3: Challenges in teaching problem solving	• Weak mathematical foundation • Difficulty in deriving formulas • Calculus-based physics • Difficulty in analysing problems	• Providing more examples • Conducting personal consultations • Guided practice
4: Challenges in conducting laboratory activities	• Lack of laboratory facilities and equipment • Familiarisation of the laboratory apparatuses and equipment	• Employing unconventional methods • Reliance to technology
5: Negative perception towards physics	• Problem-solving nature of physics	• Employing various interactive classroom methods • Words of encouragement
Recommendations	*For High School Teachers* • Strengthen the foundation • Professional growth *Curriculum Developers and Policymakers* • Revisiting the K to 12 basic education curriculum • Implementation of bridge program • Constant communication between DepEd and CHED	

RESULTS

From the data gathered, five themes regarding the issues and challenges encountered by college professors and instructors in teaching College Physics to the K to 12 Program graduates have emerged. In each of the issues and challenges, several initiatives were employed by the participants.

Theme 1: STEM versus Non-STEM Graduates

One significant theme emerged during all interviews was the difference between the performance of the STEM and non-STEM graduates. The physics professors and instructors observed that most of the students who took STEM during their Senior High school outperformed those who took non-STEM strands. As stated by participant T11, "It is very obvious that those who graduated from STEM are better, and only a few of those who graduated from other strands excelled, like two or three" (p. 7). This observation is consistent with the findings of Molina (2019) in his study regarding the performance of STEM and non-STEM graduates in engineering courses. It was concluded that engineering students from the STEM strand outperformed the engineering students from the non-STEM strands in Calculus 1. This is a challenge to the professors and instructors as they still have to attend to students who lack knowledge of the basics to proceed to the next topic. Participant T06 shared, "It really took a lot of time for me to pace with my students because others are really having a hard time, especially the non-STEM graduates" (p. 8). This change in the track of students can be attributed to some factors. Some participants mentioned that their students still lack maturity. This observation corroborated the findings of Orbeta et al. (2018). They found out that the K to 12 students lack maturity, and some were not yet assertive. It is, then, important for the teachers to develop the maturity and decision-making skills of the students to prevent the misalignment of the Senior High school strand, and college program, or even worse, a misfit in the workplace (Ouano et al., 2019).

As a remedial action to this issue, one strategy implemented by the participants is peer tutoring. Ali et al. (2015) defined peer tutoring as an activity where students study or learn in groups or pairs in order to assist one another. It typically leads to a more excellent grasp of academic subjects. The researchers added that peer tutoring is beneficial to teachers since it is impossible to cater to the needs of the students individually. The statement of participant T10 corroborated the significance of peer tutoring as stated by the aforementioned study:

> For those non-STEM graduates who still don't know the lesson, I advise them to tap their classmates who learned it already... They can do study groups, or ask to teach them. Not that they will just ask for answers. Personally, I gave them such advice if they want to cope because time is so limited in teaching. (p. 3)

With this strategy, students can learn effectively given that there is no hesitation and they are comfortable with each other. Ullah et al. (2018) stated that peer tutoring boosts the confidence of introverted students and improves their cognitive abilities. Participant T09 shared, "It's better when it's only them working together. This is because if there is a teacher with them, they feel awkward and are shy to ask." (p. 11)

Theme 2: Students' Lack of Knowledge and Poor Conceptual Understanding

During the interviews, many participants expressed their feelings of dissatisfaction in terms of the knowledge level of the graduates. The knowledge gained by the graduates in physics was not enough to grasp the complex topics in College Physics, as participant T15 claimed, "...like there are also... some lacking information about those concepts which really need to be addressed" (p. 2). Some participants shared that the Physics lessons they know are just superficial. Participant T08 said, "I mean, a lot is discussed, but they are shallow only" (p. 10). Participant T07 also said, "But they are just until the conceptual level. They can't apply it yet to deeper ideas. They are mostly introduction" (p. 6). In addition, the participants reported that most of their students have a poor conceptual understanding of physics. According to Kola (2017), when students have a poor conceptual understanding of physics, many problems arise; one such challenge is students' misconceptions. Undeniably, several participants shared their encounters with student misconceptions in physics. For example, participant T12 mentioned, "...even during the orientation, I ask them regarding their ideas of the topics. I have short questions that are answerable by high school students, and yet, you would observe that there are a lot of misconceptions" (p. 9). Most of the participants reported that students usually have misconceptions on topics such as kinematic quantities and the difference between mass and weight.

Some participants inferred with regard to the origin of these misconceptions. Participant T05 said, "There are many misconceptions from students because of high school, the way the high school teacher teaches the students, that misconception extends to college" (p. 4). This can be deduced that those misconceptions can be rooted in prior learnings. These observations made by the participants were similar to the findings of Smith et al. (1993, as cited in Goris & Dyrenfurth, 2010). They have stated that students' misconceptions come from their past learning experiences inside the classroom. The study of Mishra (2020) revealed that student misconceptions emerge from the teachers' inadequate knowledge, poor understanding, and failure to link the previous knowledge to a new one. These results imply very low quality of the teachers handling high school physics.

The lack of knowledge and poor conceptual understanding of the students impeded the flow of lesson outlines of the professors and instructors. Much time was devoted to rediscussing the basic concepts in physics and mathematics. Most of them adjusted their syllabi to help students build first the foundational concepts necessary to learn the complex topics in physics. Participant T13 said, "You have to break down everything into details, like you start from the top, and teach them slowly" (p. 3). They also conducted their lecture discussions in a detailed manner with more examples and simulations. Participant T01 said, "...it's not part of the syllabus, but I include it because otherwise it would be hard to proceed (p. 7). This initiative agreed with the claim of Rosenshine (2012) that conducting review sessions is one of the most common and effective teaching strategies that is being implemented to supplement the students' lack of knowledge and understanding. Conducting reviews ensures a firm understanding of the knowledge that would be needed in learning complex topics.

Theme 3: Challenges in Teaching Problem Solving

It is eminently noticeable that the participants have a significant challenge in terms of teaching problem-solving. One of their main concerns is the weak mathematical foundation of the students. It has to be noted that Mathematics is a way of expressing the physical laws quantitatively and is essential in analysing physical problems. However, the participants have observed that their students lack the fundamentals of Mathematics, especially in the field of algebra, trigonometry, and solid mensuration. This may imply that the students were not able to fully grasp the topics well during their previous years. It has to be noted that these topics are already integrated into the mathematics curriculum of the K to 12 Program. Analysing problems is also one of the difficulties observed by the participants from their students. Most of them mentioned that students have a hard time understanding the problems. This finding supported what Sartika and Humairah (2018) found in their study. Seventy-eight percent of the students experienced difficulty in the question-understanding phase. Moreover, the participants noticed the difficulty of the students in manipulating formulas. Participant T15 said, "Yes, the one with only one variable and the others are already given, but what if one of the variables on the other side is the one missing? They struggle in deriving the formula" (p. 4). This observation was in agreement with the results of the study of Samuel et al. (2016). They discovered that students failed to manipulate algebraic expressions. Lack of this skill affected their ability to solve problems involving algebraic equations appropriately.

Some participants mentioned that the College Physics they are teaching is Calculus-based. This also posed a challenge to them because most of their students either did not have any Calculus courses or did not gain enough knowledge regarding such. Participant T04 stated, "My concern is their background especially if physics is calculus-based. It is really... I find it difficult to teach" (p. 2). In the K to 12 Basic Education Curriculum, only the students under the STEM strand are able to take Calculus courses – the Pre-Calculus and Basic Calculus. This entails difficulty for non-STEM graduates in learning Calculus-based College Physics.

The professors and instructors tried a number of typical strategies to deal with the difficulties in problem-solving instruction. One of which is providing more worked examples. The method of providing the students with several worked examples after introducing the principles or theorems is known as example-based learning (Renkl, 2013). Studies show that employing example-based learning allows students to construct complete problem-solving representation, thereby fostering meaningful student learning (Sern et al., 2015). Personal consultations were also carried out by the participants. Consultations are beneficial because it is an avenue for the teachers to provide specific feedback to students and provide remedial sessions on the lessons they are struggling with (Hampton & Reiser, 2004). Guided practice was also employed by some of the participants. This approach allows the students to elicit learning by collaborating with the teachers. The study of Hushman and Marley (2015) revealed that guided practice provides a positive outcome on students' overall academic performance.

Theme 4: Challenges in Conducting Laboratory Activities

According to Borja and Marasigan (2018; as cited in Abas & Marasigan, 2020), "the laboratory is the heart of science in which individuals could put theory into practice" (p. 13). Hands-on laboratory activities provide learners an opportunity to reinforce concepts and theories and, consequently, develop their scientific literacy. However, most of the participants reported that there is a lack of laboratory facilities and equipment in their respective universities. Participant T07 shared, "It is in the laboratory that I had a difficult time because in the campus, honestly, their laboratory equipment and apparatuses are lacking" (p. 2). Another issue perceived by the participants is the students' lack of familiarity with the laboratory apparatuses and their functions. Participant T02 mentioned, "There are students who don't know the name of some apparatuses. There are some who have seen the apparatuses already, like when they had physics before, but they don't know how to use them" (p. 9). This posed a challenge to the participants because a lot of their time was expended on introducing the laboratory apparatuses and equipment and demonstrating their functions which could have been used in performing advanced laboratory activities.

In resolving the challenge of lack of laboratory apparatuses and equipment, most participants leaned on employing unconventional methods of conducting laboratory activities. Participant T08 shared, "Since we don't have hi-tech apparatuses, I would just make my own apparatus – teacher-made apparatus" (p. 7). Some of them told their students to be resourceful by using materials that can be found in their respective homes. Others relied on technology by letting their students watch videos on the internet or utilise online simulations. What the participants did to address this problem was parallel to the methods employed by some educators in addressing the issues and challenges in conducting laboratory activities in the study by Abas and Marasigan (2020).

Theme 5: Negative Perception Towards Physics

Success in physics is influenced by students' manifestation of a favorable perception towards it. However, until now, students have this common preconceived notion that physics is difficult. Most of the participants mentioned that the negative perception of the students toward the subject is associated with it having a lot of problem-solving. Participant T13 said, "Whenever they hear the word 'physics', they think right away that it is difficult the fact that it involves problem-solving" (p. 2). This confirmed the assertion of Ogunleye (2009) that the subject's negative perception stems from its problem-solving nature. Physical quantities and mathematical niceties are at the heart of all fields of physics, and students have no choice but to deal with them. It can be inferred that if the students are apprehensive about Mathematics, there will be a negative effect on learning Physics.

According to Ornek et al. (2008), students' success in learning physics can be equated to their interest and motivation. Teachers are then encouraged to employ strategies that can boost the students' interest and motivation (Cahyono et al., 2016). During interviews, some participants mentioned the use of various interactive classroom methods such as demonstrations and simulations. The study of Churukian (2002) revealed that the students find the use of the said methods to be a positive experience. Participants also shared words of encouragement to their students to instill hope and confidence despite the perceived difficulty, as acquiesced by Rogers (2019). Participant T05 shared, "If they are willing to take a risk on that subject, then they will learn. It will be easy. So, the best thing to do is love physics" (p. 5). Some of them focused on the importance of physics and its relevance to our daily lives. Ornek et al. (2008) emphasised that providing real-life applications can increase the student's interest and motivation in learning physics.

Recommendations to Address the Issues and Challenges

During the interviews, the participants shared some insights and recommendations to address the issues and challenges in teaching College Physics to the K to 12 Program graduates. These are subdivided into two: recommendations for the high school teachers and the curriculum developers and policymakers.

For High School Teachers

Participants showed a consensus that the students did not have enough mathematical skills to solve physics problems and lacked knowledge and conceptual understanding of the fundamentals of physics. Thus, for high school teachers, it was mainly recommended that they have to build a strong foundation in physics and mathematics. Some participants suggested giving more emphasis on Classical Mechanics. This area of physics discusses fundamental concepts such as motion, force, and energy, which are needed in understanding other branches of physics. In the refinement of some science degree programs, it was presumed that students who graduated from Senior high school are well-versed already of the fundamental concepts in Classical Mechanics; thus, the contents of the College Physics course they prepared were advanced. However, based on the result, students were not yet prepared to take on the course.

The participants emphasised that the foundations should be strengthened in lower years because when they go to college where the level of difficulty is getting higher, they have the tools to learn complex topics. However, this will not be possible if the high school teachers are not well-equipped with strategies to enforce effective learning in physics. Therefore, teachers should be exposed to training and seminars to increase their effectiveness in helping students acquire the critical abilities that they struggle to acquire. Such opportunities allow teachers to imbue knowledge and infuse them with newly learned skills and strategies to create learning experiences suitable to students' needs.

Curriculum Developers and Policymakers

Several participants suggested that the K to 12 Basic Education Curriculum should be revisited. They claimed that the curriculum could not build students a strong foundation of the necessary skills and knowledge to learn complex topics in college. Regarding the continuity and progression of the learning process from secondary to tertiary education, one solution the participants recommended was the implementation of a Bridge Program. Tinto (1993; as cited in Singh et al., 2014) emphasised that such a program can be beneficial to students in coping with the difficulties in terms of changing their routines, roles, and beliefs as they move from high school to college. However, most of the participants reported that there were no bridge programs offered in their respective universities. Another option given by the participants is by improving the curricula of all programs in a way that students from other strands will be given the opportunity for a holistic education despite the insufficiency of their knowledge and skills. DepEd and CHED need to have better collaboration especially in crafting or reviewing the current basic and tertiary curricula. Constant communication between these governing bodies is needed to address the issue of misalignment of Senior High school strands and college programs.

DISCUSSION

One of the aims of the science curriculum of the K to 12 Basic Education Program is to enhance learners' critical thinking, conceptual understanding, problem solving, and other scientific skills. However, based on the results of the study, the researcher found out that in the teaching of College Physics, there have been several issues and challenges experienced by the professors and instructors in teaching the graduates of the said program. The first challenge was the difficulty in teaching non-STEM graduates. Several participants mentioned that they have more students from non-STEM strands compared to STEM. With the lack of skills of these non-STEM graduates, the pace of their discussions was slow. This can be attributed to the CHED Memorandum Order No. 105 regarding the policy that the K to 12 Program graduates can enroll in any higher education programs regardless of the strand they have taken during their Senior High school (CHED, 2017a; 2017b; 2017c). Although the memorandum order grants the graduates to have wider choices, it gives a great disadvantage to non-STEM graduates who take Physics-related programs because they have not taken the fundamental subjects necessary for them to take on the college physics curriculum. This mismatch between the Senior High school strand and college program is alarming as this shows that the goal of the K to 12 Program is not achieved. Non-STEM graduates are trained well with knowledge and skills appropriate for specific programs, but taking a STEM-related program hinders them from maximising such knowledge and skills. This also posed a challenge to the physics professors and instructors for they still have to attend to students who lack knowledge of the basics to proceed to the next topic. Though some of the participants employed peer tutoring, most of them still resorted to reteaching the basics and giving detailed discussions especially in doing calculations. To lessen their burden, some of them suggested to have a Bridge Program for the non-STEM graduates. However, implementing a bridge program is not easy because there are factors to consider, such as the availability of the instructors and the cost to run the program (Barnett et al., 2012).

Another issue faced by the participants was the students' weak foundation in mathematics and basic physics. This constitutes the major obstacles of all the difficulties the participants experienced. They gave much accentuation on the students' lack of knowledge in basic physics and poor conceptual understanding and problem-solving skills. This is parallel to the findings of Mekonnen (2014) and Bray and Williams (2020) regarding the association of students' academic performance in college physics and their background from high school physics. Professors and instructors have expressed how the college students are unprepared to cope up with the demands of the course. With this, it can be implied that K to 12 Program graduates lack the readiness to take on tertiary STEM-related programs. This is in agreement with the findings of Mamba et al. (2020). It was found out that the said graduates did not perform well in the Science and Mathematics areas of the college readiness test administered to them. It is then recommended by the participants to revisit the K to 12 Program, specifically the implementation of the Spiral Progression approach.

Despite the strong points of Spiral Progression approach, its implementation needs to be examined closely because many Science teachers are having difficulty adopting it (Andaya, 2019). Some participants shared that the teachers in the basic education are teaching physics even if they are not specialising in it. Since the four major areas, such as Earth and Space Science, Biology, Chemistry, and Physics, are already integrated into every grade level, teachers, particularly the specialists, are forced to handle areas out of their scope of knowledge. Generalists are also in a tough situation since they are unable to teach complicated topics given that they only have a rudimentary understanding of the four areas. This is one of serious issues and problems on the teacher job placement practices in educational governing bodies in the Philippines (Tolentino, 2016). Solutions have to be made to ensure that educators are hired and only placed in classes for which they are reasonably fit and highly qualified.

Resurreccion and Adanza (2015) added that in the spiral curriculum, a lot of lessons are covered but only briefly. They also mentioned that the said curriculum fails to promote enough review once each unit is done. Since only one quarter is given for a specific area, topics will not be seen again until the following academic year. With this, there is no mastery of concepts. Establishing a firm foundation in physics and mathematics at the beginning of learning needs emphasis on the basic content (Liu et al., 2011). Teachers have to make sure that students are able to understand the concepts and break through the key points. The emphasis on the foundation can effectively improve students' interest and enthusiasm for learning the advanced lessons. This can also make the students change their negative perception of physics and gain a positive outlook toward it.

In the science curriculum and among science instructors, conducting laboratory activities have long been a defining feature, especially in higher education (Hofstein, 2004). Students are more engaged in learning and have a broader understanding of the physical laws of the world as a result of these activities. With this, they tend to appreciate Science and that the subject becomes meaningful to them. However, this study showed that many professors and instructors struggle in conducting laboratory activities given that they lack facilities and equipment and that students lack the knowledge in utilising apparatuses. But, in spite of such challenges faced by the participants, they were still able to let their students experience physics by being resourceful and doing a lot of alternatives. According to Mathew and Earnest (2004), changing or modifying the laboratory activities can render challenging work for teachers, but if planned well, they can still help in increasing the skills of the students.

CONCLUSIONS AND RECOMMENDATIONS

The Philippines has just undergone a reform in its basic and tertiary education in the hopes of producing globally competent graduates. Physics education has also been accentuated in the K to 12 Program by embedding physics in the enhanced Science curriculum, especially in the STEM strand. However, many physics education experts still have raised concerns regarding the physics learning experiences provided in secondary schools; hence, this study.

Based on the experiences and perspectives of physics professors and instructors, it can be deduced that there is a lack of readiness for the K to 12 Program graduates to take on the College Physics course as observed from their lack of knowledge of the basic concepts, poor conceptual understanding, difficulty in solving problems, difficulty in conducting laboratory activities, and negative perception towards physics. These challenges can be attributed to (a) the CHED Memorandum Order, which allows non-STEM graduates to take on physics-related programs in college, (b) the problematic implementation of the Spiral Progression Approach in the Science curriculum, wherein the high school teachers are forced to handle Physics subjects even if they are not academically prepared for such, and (c) the lack of laboratory facilities and equipment. The results of this study also show that there is a need to improve the vertical alignment of the K to 12 Basic Education curriculum and the tertiary curriculum. The issues and challenges experienced by the participants indicate that there exist serious learning gaps in physics education. It is recommended that the corrective measures as well as the suggestions the participants provided, which are very substantive, have to be considered by the concerned individuals to reinforce the continuity and progression in learning physics.

To further validate the claim of this study, it is recommended for future researchers to conduct a similar study involving a greater number of participants. Moreover, they may narrow the focus to a certain issue or challenge to have a wider understanding of such and the solutions that can be done. Lastly, a study focusing on the origin of these issues and challenges and how they can be addressed effectively may be done.

REFERENCES

Abas, H., & Marasigan, A. (2020). Readiness of science laboratory facilities of the public junior high school in Lanao Del Sur, Philippines. *IOER International Multidisciplinary Research Journal*, *2*(2), 12–20. https://doi.org/10.54476/iimrj361

Ali, N., Anwer, M., & Abbas, J. (2015). Impact of peer tutoring on learning of students. *Journal for Studies in Management and Planning*, *1*(2), 61–66. https://www.researchgate.net/publication/319292234_Impact_of_Peer_Tutoring_on_Learning_of_Students

Alipio, M. (2020). Academic adjustment and performance among filipino freshmen college students in the health sciences: Does senior high school strand matter? *Education and Management*. https://doi.org/10.35542/osf.io/xq4pk

Andaya, J. (2019). The K to 12 Basic Education Program: Emerging issues of concern. *Key Issues in Curriculum, Assessment, and ICT in Basic Education*, 3–10. University of the Philippines Center for Integrative and Development Studies.

Barnett, E., Bork, R., Mayer, A., Pretlow, J., Wathington, H., Weiss, M., Weismann, E., Teres, J., & Zeidenberg, M. (2012). Bridging the gap: An impact study of eight developmental summer bridge programs in Texas. *National Center for Postsecondary Research*, 1–4.

Botuzova, Y. (2020). Factors of providing the continuity of teaching mathematics during transition from high school to university. *Universal Journal of Educational Research, 8*(3), 857–865. https://doi.org/10.13189/ujer.2020.080316

Bray, A., & Williams, J. (2020). Why is physics hard? Unpacking students' perceptions of physics. *Journal of Physics: Conference Series,* 1512, 012002. https://doi.org/10.1088/1742-6596/1512/1/012002

Cahyono, A., Haryanto, S., & Sudarsono. (2016). *Increasing motivation and science learning achievement through the implementation of outdoor cooperative learning model in class VIII SMP 2 Banguntapan Academic Year*. *Journal of Education and Practice, 7*(26), 21–26. https://core.ac.uk/download/pdf/234639254.pdf

Chrzanowski, J., Bieg, B., & Kravtsov, Y. (2013). Challenges in teaching and learning physics for first year students. *Scientific Journals*, *33*(105), 11–15. http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.baztech-d6c7b8de-a695-456d-a566-d19c63fa0400/c/Chrzanowski_Bieg_Kravtsov.pdf

Churukian, A. (2002). *Interactive engagement in an introductory university physics course: Learning gains and perceptions*. https://www.researchgate.net/publication/252589573_Interactive_engagement_in_an_introductory_university_physics_course_Learning_gains_and_perceptions

Commission on Higher Education. (2017). *CHED memorandum order No. 75 series of 2017. Policies, standards, and guidelines for the Bachelor of Science in Civil Engineering (BSCE) Program effective academic year (AY) 2018-2019.* https://chedro1.com/wp-content/uploads/2019/07/CMO-92-s.-2017-BS-Civil-Engineering.pdf

Commission on Higher Education. (2017). *CHED memorandum order No. 92 series of 2017. Policies, Standards, and Guidelines for Bachelor of Secondary Education (BSEd).* https://chedro1.com/wp-content/uploads/2019/07/CMO-No.-75-s.-2017.pdf

Commission on Higher Education. (2017). *CHED Memorandum Order No. 105 series of 2017. Policy on the Admission of SHS Graduates to the Higher Education Institutions Effective Academic Year 2018-2019.* https://ched.gov.ph/wp-content/uploads/2018/01/CMO-No.-105-s.-2017-Policy-on-the-Admission-of-Senior-High-School-Graduates-to-the-Higher-Education-Institutions-Effective-Academic-Year-2018-2019.pdf

Corpuz, A. (2017). Difficulties encountered, learning strategies and academic performance in physics of psychology students. *Journal of Social Sciences*, *6*(2), 365–374. https://doi.org/10.25255/jss.2017.6.2.365.374

Department of Education, Republic of Philippines. (2012). *DepEd Order No. 31, s.2012. Policy Guidelines on the Effective School Year 2012-2013.* https://www. deped.gov.ph/wp-content/uploads/2012/04/DO_s2012_31.pdf

Dunton, J. B., & Co, W. S. (2019). Spiral progression approach in teaching science and the performance of learners in District I, Capiz. *Journal of Physics: Conference Series*, *1254*, 012045. https://doi.org/10.1088/1742-6596/1254/1/012045

Goris, T., & Dyrenfurth, M. (2010). Students' misconceptions in science, technology, and engineering. https://www.researchgate.net/publication/228459823_Students%27_Misconceptions_in_Science_Technology_and_Engineering

Hampton, S., & Resier, R. (2004). Effects of a theory-based feedback and consultation and learning in college classrooms. *Research in Higher Education*, *45*(5), 497–527. https://doi.org/10.1023/B:RIHE.0000032326.00426.d5

Hofstein, A. (2004). The role of laboratory in science teaching and learning. *Chemistry Education: Research and Practice*, *5*(3), 247–264. https://doi.org/10.1007/978-94-6300-749-8_26

Hushman, C., & Marley, S. (2015). Guided instruction improves elementary student learning and self-efficacy in Science. *The Journal of Educational Research*, *108*(5), 1–11. https://doi.org/10.1080/00220671.2014.899958

Kola, A. J. (2017). Investigating the conceptual understanding of physics through an interactive lecture-engagement. *Cumhuriyet International Journal of Education*, *6*(1), 82–96. http://cije.cumhuriyet.edu.tr/en/pub/issue/29856/321440

Liu, X., Li, Q., & Gao, J. (2011). A study on linking high-school physics and perfect teaching reformation of college physics. *Higher Education Studies*, *1*(1), 121–124. https://doi.org/doi:10.5539/hes.v1n1p121

Mamba, M., Tamayao, A., & Vecaldo, R. (2020). College readiness of Filipino K to 12 graduates: Insights from a criterion-referenced test. *International Journal of Education and Practice, 8*(4), 625–637. https://doi.org/10.18488/journal.61.2020.84.625.637

Manalo, L. G. Baniqued, A. B., & Dulog, C. A. (2015). *Readiness level of engineering freshman students in college physics*. Munich: GRIN Verlag. https://www.grin.com/document/338514

Mathew, S., & Earnest, J. (2004). Laboratory-based innovative approaches for competence development. *Global Journal of Engineering Education, 8*(2), 167–174. http://www.wiete.com.au/journals/GJEE/Publish/vol8no2/Mathew.pdf

Mekonnen, S. (2014). Problems challenging the academic performance of physics students in higher governmental institutions in the case of Arbaminch, Wolayita Sodo, Hawassa and Dilla Universities. *Natural Science, 6,* 362–375. https://doi.org/10.4236/ns.2014.65037

Meyers, A. (2019). *A phenomenological study of the lived experiences of counseling students in a co-facilitated experiential group* [Dissertation], University of Arkansas. https://scholarworks.uark.edu/cgi/viewcontent.cgi?article=4830&context=etd

Mishra, L. (2020). Conception and misconception in teaching arithmetic at primary level. *Journal of Critical Reviews*, *7*(6), 1047–1050. http://www.jcreview.com/fulltext/197-1588576804.pdf

Molina, M. G. (2019). Comparison of the Calculus 1 performance of engineering students from STEM and non-STEM SHS strands. *PUPIL: International Journal of Teaching, Education and Learning*, *3*(2), 102–123. https://doi.org/10.20319/pijtel.2019.32.103123

Ogunleye, A. (2009). Teachers' and students' perceptions of students' problem-solving difficulties in physics: Implications for remediation. *Journal of College Teaching & Learning*, *6*(7), 85–90. https://doi.org/10.19030/tlc.v6i7.1129

Orbeta, A., Lagarto, M., Ortiz, K., Ortiz, D. A., & Potestad, M. (2018). *Senior high school and the labor market: Perspectives of grade 12 students and human resource officers.* Discussion Paper Series No.2018-49, Philippine Institute for Development Studies. https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps1849_rev.pdf

Ornek, F., Robinson, W., & Haugan, M. (2008). What makes physics difficult? *International Journal of Environmental & Science Education*, *3*(1), 30–34. https://files.eric.ed.gov/fulltext/EJ894842.pdf

Ouano, J. J., T, J. F., Japitan, W., & Moneva, J. (2019). Factors influencing on grade 12 students chosen courses in Jagobiao National High School - Senior High School Department. *International Journal of Scientific and Research Publications, 9*(1), 421–431. https://doi.org/10.29322/IJSRP.9.01.2019.p8555

Renkl, A. (2013). Toward an instructionally oriented theory of example-based learning. *Cognitive Science*, *38*(1), 1–37. https://doi.org/10.1111/cogs.12086

Resurreccion, J., & Adanza, J. (2015). Spiral progression approach in teaching science in selected private and public schools in Cavite. *DLSU Research Congress 2015*, *3*, 1–12. https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2015/LLI/017LLI_Resurrecion_GF.pdf

Rogers, B. (2019). The language of encouragement in the classroom. Retrieved from https://dmbcwebstolive01.blob.core.windows.net/media/Default/ChildrenYoungPeopleFamilies/29a%20Language%20of%20Encouragement%202019.pdf

Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. *American Educator*, *Spring*, 12–39. https://www.aft.org/sites/default/files/Rosenshine.pdf

Sadler, P., & Tai, R. (2000). Success in introductory college physics: The role of high school preparation. *Science Education*, *85*(2), 11–136. https://doi.org/10.1002/1098-237X(200103)85:2%3C111::AID-SCE20%3E3.0.CO;2-O

Samuel, K., Mulenga, H. M., & Angel, M. (2016). An investigation into challenges faced by secondary school teachers and pupils in algebraic linear equations: A case of Mufulira District, Zambia. *Journal of Education and Practice*, *7*(26), 99–106. https://files.eric.ed.gov/fulltext/EJ1115865.pdf

Sartika, D., & Humairah, N. A. (2018). Analysing students' problem solving difficulties on Modern Physics. *Journal of Physics: Conference Series, 1028*, 012295. https://doi.org/10.1088/1742-6596/1028/1/012205

Sern, L., Salleh, K., Mohamad, M., & Yunos, J. (2015). Comparison of example-based learning and problem-based learning in engineering domain. *Universal Journal of Educational Research*, *3*(1), 39–45. https://doi.org/10.13189/ujer.2015.030106

Singh, B., Kumar, R., & G, S. (2014). Bridge program: An effective tool for transition of students from pre-university to university. *Asian Journal of Multidisciplinary Studies*, *2*(12), 68–74. https://www.researchgate.net/publication/282869514_Bridge_Program-An_Effective_Tool_for_Transition_of_Students_from_Pre-University_to_University

Sosha, G. A. (2012). Employment of Colaizzi's strategy in descriptive phenomenology: A reflection of a researcher. *European Scientific Journal*, *8*(27), 31–43. https://core.ac.uk/download/pdf/236417203.pdf

Tolentino, R. (2016). Travails of public school teachers: Job placement issues in focus. *International Journal of Learning and Teaching*, *2*(1), 28–38. https://doi.org/10.18178/ijlt.2.1.28-38

Ullah, I., Tabassum, R., & Kaleem, M. (2018). Effects of peer tutoring on the academic achievement of students in the subject of biology at secondary level. *Education Sciences*, *8*(3), 112. https://doi.org/10.3390/educsci8030112