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MOVING FORWARD IN STEM EDUCATION, CHALLENGES AND INNOVATIONS IN SENIOR HIGH SCHOOL IN THE PHILIPPINES: THE CASE OF NORTHERN ILOILO POLYTECHNIC STATE COLLEGE

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ABSTRACT

This qualitative research focused on school experiences of 20 females and 14 males senior high school (SHS) students majoring in science, technology, engineering and mathematics (STEM) in Northern Iloilo Polytechnic State College (NIPSC), the Philippines from Academic Year 2017-2018 and 2018-2019. This study aimed to identify both the positive and negative points on Senior High School (SHS)- Science, Technology, Engineering and Mathematics (STEM) track in terms of curriculum, instructional materials, laboratory equipment, faculty educational qualification, research output and courses to be taken in NIPSC of SHS-STEM students. Purposive sampling was used for the selection of the informants. Interview, focus group discussion, and observation were employed in the study. The students' responses in the interview revealed teachers' qualifications and their passion for enhancing SHS-STEM curriculum. Besides, the availability of facilities was a strong point of NIPSC as a model school in implementing STEM curriculum in the district. However, lack of time management for teachers to hold classes, limited science textbooks and classroom, and unavailability of the laboratory for hands-on activities need proper attention by concern authorities. Around 46% of SHS-STEM graduates take civil engineering at NIPSC because of the well-trained teachers, and the high rating in board examination. Also, the Commission on Higher Education (CHED) allowed non-STEM to enroll in science-related courses, and the Department of Science and Technology (DOST) allowed them to apply for the scholarship program. However, the bridging program is a waste of time, effort, and money for both teachers and students. NIPSC as a model school in SHS-STEM track has to enhance facilities as well as the guidance office to correctly assist students in future endeavors and to take courses similar to their tracks and interests.

Keywords: Science, technology, engineering and mathematics (STEM), Senior high school (SHS), Philippines

INTRODUCTION

In 2011, after series of consultations, discussions, and debates among experts and practitioners, the Philippines government agreed to enhance primary education in the entire archipelago called K-12 basic education program by virtue of Republic Act 10157 (Cabansag, 2014). Twelve years is the standard for a basic education program in the world (Orale & Sarmiento, 2016)

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and the ten-year system being the shortest in the world for primary education is a disadvantage for Filipino workers abroad as well as those wanting to continue their education outside the country; thus, the call for shifting to 12 years is very significant for all Filipinos (Tupas & Matsuura, 2011a).

Furthermore, the alarming poor achievement results in science which were documented for many years are also one of the reasons for enhancing the education curriculum in the Philippines (Magulod, 2017). For instance, in 1996 the National Elementary Achievement Test (NEAT) was 41.5%, an increase of 12.6 % in 2005 but only 14.8% attained mastery of the goals of science curriculum (Bernardo, 2004). Moreover, in School Year (SY) 2011-2012, the result of NEAT for grade 6 was 40.5%. While in the secondary curriculum, the result was 39.5%, and around 1.8% of students reached the mastery learning. In Trend International Mathematics and Science Survey (TIMSS), the Philippines ranked 43rd out of 46 countries in high school (HS) II Science. Out of 25 participating countries, fourth grade was ranked 23rd (Calderon, 2015).

This poor performance in the primary science curriculum in the Philippines, according to Bernardo (2004) is due to the inadequate science curriculum and poor preparation of science teachers. Moreover, the scarcity of instructional materials has also contributed to the low performance of Filipino science learners (Tupas & Matsuura, 2011a). Thus, Montebon (2014) exposed that science curriculum in primary education should undergo significant revisions.

Series of discussions, debates, and meetings with experts, and practitioners, the Philippine government decided to enhance the primary education curriculum by virtue of Republic Act 10157 or also known as K12 Basic Education Program. The new system composed of 1 year in kindergarten at the age of 5, 6 years in elementary school, 4 years in junior high school (JHS) between 6 to 11-year-old and two years in senior high school (SHS) between 16 to 17 years. This was pushed through to develop Filipino learners' holistic 21st-century skills. In SHS, there are three major tracks: general academic, sports and arts, and technical vocational and livelihood education. The additional two years help students mastered and prepared for workforce aside from traditional thinking to make them ready for college life (Cabansag, 2014). Around 1.5 million grade 11 enrolled in 2016 all over the Philippines (Patrinos & Al-Samarrai, 2016).

Science, technology, engineering, and mathematics (STEM) strand is embedded in the general academic track. The traditional method is shifted into a more innovative approach that emphasizes critical thinking and scientific skills (Montebon, 2014). Furthermore, Estonato (2017) explained that STEM is planned to encourage secondary level graduates to enroll in science-related courses in the tertiary level. Furthermore, Orale & Sarmiento (2016) discovered that SHS-STEM track in the Philippines is better than that in Japan and the US. Cabansag (2014) revealed that STEM would be prepared graduates for a better occupation abroad. Also, this will generate competent learners of the 21st-century skills, who are essential for economic and social progress of the country. However, since this is new to the educational system of the country, close monitoring and evaluation must be implemented properly. The teachers must undergo education development to eradicate misconceptions of the K-12 program.

SHS-STEM curriculum is designed to develop learners' skills from simple to complex problems in the country and the world as well in terms of science, technology, engineering and mathematics concepts. It also intends to prepare them to pursue degree in college and become future scientists, technological experts, engineers, mathematicians, programmer, science educators and others (Estonanto, 2017). The curriculum comes from a Latin word "*currere*" which means to run; thus, it is defined as to run by a student for achieving specific goals specifically in education. Nowadays, the curriculum is about total experiences of a child in school activities and experiments. In the perspective of science, it refers to the acquired knowledge on science teaching given on specific time in the classroom. Thus, the science curriculum is all about learning experiences through various activities inside or outside school premises, either formal or informal education. The curriculum is a gist of lessons and topics covered in a specified period in a class (Mallick, 2012). Science curriculum materials include textbooks, teachers guide, and technology-based materials provide by the ministry or department, designed by teachers to help learners improve their performance.

Effective science teachers have a vast array of instructional strategies and methods to produce successful learners. Filipino teachers become flexible; they always have unique strategies, and techniques to make science teaching fun and exciting (Tupas & Matsuura, 2012) to enhance the performance of science learners. Education is constantly changing; thus, professional growth is one way to stay on current knowledge and practices. Professional development of teachers is required to bring strong information in science and enable them to acquired new knowledge (Ejiwale, 2013).

In grade 10, junior high school students will take the National Career Assessment Examination (NCAE). This assessment aims to provide information to students regarding career awareness. There are four domains in the NCAE evaluation. In terms of general scholastic aptitude, the assessment covers Science, Maths, Logical Reasoning, Reading, and Verbal. Student's Career Opportunity and Personality Evaluator (SCOPE) is a computerized assessment developed by System Technology Institute (STI) College. This examination is taken by senior high graduates to help them find the best career that fits their personality.

In 2017, Northern Iloilo Polytechnic State (NIPSC) answered the call of the national government to help DepEd in the operation of SHS. The requirements for allowing secondary schools and higher education institution (HEI) to offer SHS are qualified faculty, facilities, and classroom. As a lone college in the district, facilities are all ready. For two years all HEI in the country will have no freshman enrollees; thus, the administrations were informed to send their faculty for graduate programs, or do extension and research works, or offer SHS curriculum.

Nevertheless, the administration still finds ways to improve the implementation of SHS-STEM track in NIPSC as a model school in Iloilo. The significant problems in the operation of STEM strand are the lack of facilities and instructional materials of the school in the Department of Education (DepEd) (Estonato, 2017). DepED cannot afford and accommodate to offer all tracks and strands in one school. The implementation of the SHS will be dependent on the availability of classrooms, teacher qualification, and facilities. Thus, some colleges and universities, both public and private, are allowed to offer SHS curriculum (Gubalane, 2016). Students enrolled in state universities and college, and the private institutions will also be provided a voucher, a government subsidy to cover the entire school year.

The research is anchored on John Dewey's Theory on Education, Experience, and Education published in 1938. In this theory, students enrolled in school not just to learn concept and ideas but wanted to teach how to apply in daily lives. Learning is not just about mental development but also the growth of a person as a whole. This is a vital tool to develop the system so that the generations fulfill experiences in learning. He added new movement for education teachers, and educator must look into a broader perspective. The development of education today is attributed to the previous experiences gained by various individuals that lead widening inputs. Besides, in the study of Eldeeb (2013), experiences come from two principles, continuity and interaction. He defined continuity as the experiences from present to future, and interaction is the influence of situation and educators to the learners. We need a theory of experiences to enhance our education system. Thus, this theory is relevant because being the lone college in the district with course focused on engineering, biology, midwifery, fishery, agriculture, and education major in science and mathematics, the experiences of these SHS-STEM students will guide the administration for enhancing the curriculum and facilities not only for STEM strands but for science-related courses in the college. These will also give feedbacks to DepEd on how to implement the program correctly.

Furthermore, Behaviorism was also fixed in this study. The behavioral theory, which has been well-established in the 20th-century, is used to study animal behavior but later was also employed for the human (Oelze, 2018). In the early 1900s, he introduced the foundational concepts of behaviorism. Instead of using feelings, or unobservable introspections, he employed observable behavior. In learning and teaching, behavioral is action or manner controlled by a set of condition (Trifiletti et al., 2005). Behaviors with a set of condition tend to occur frequently; however, if it is unpleasant or undesirable, this condition will occur less frequent. In relation, this behavioral theory is about classroom management, which focused on teaching, enhancing, and maintaining social and academic behavior.

Constructivism was another theory employed in this research. This theory of philosophy is about abstract reasoning and ideas towards learner experiences that create knowledge and form of meaning which enhances students' logical and conceptual growth. Accommodation and assimilation are the two key concepts. Accommodation is reframing the world and new experiences into the mental capacity, and assimilation talks about integrating new experiences into the old experiences (Bada & Olusegun, 2015). Teachers play significant roles in the constructivism learning theory. Teachers act as facilitators, not the traditional way of lecturing, focused on the student and their learning. Teachers ask questions to encourage students to formulate their own con-

clusions and teacher as facilitator continues to extract more ideas from the learners. This creates a learning environment following Piaget's theory of constructivism. They challenge the student by making them effective critical thinkers. They act as not being merely a "teacher" but also a mentor, a consultant, and a coach (Matthew, 2003).

This study focused on the school experience of the SHS-STEM students of NIPSC. Everyone's life experiences always have tremendous value. Our experiences also teach us our purpose as human. It gives us a sense of directions as well as the purpose of living the best out of our negative and positives involvements. Nevertheless, the schools focus more on knowledge and information than experiences; thus, learning institutions are commonly branded as enormously mind-oriented. Learners are taught facts and abstract information that has no significant values to career and life (Hodson, 2013).

The Office of the Registrar-NIPSC Main Campus revealed that there were very few students enrolled in STEM programs. Each of this degree has only around 35 or fewer students. Learners preferred to take criminology or tourism because they believe that pursuing those degrees would make it easier for them to find a job. Thus, it is essential to strengthen STEM track in NIPSC to encourage more students to engage in science-related courses.

NIPSC has seven campuses in Municipality of Ajuy, Barotac Viejo, Batad, Concepcion, Estancia (Main Campus), while Lemery, and Sara (Victorino Salcedo Campus) are located in the fifth district of the province of Iloilo offering significant courses such as fishery, agriculture, and technology. The majority of NIPSC programs are STEM-related courses such as Bachelor of Science (BS) in Fishery, Biology, Agriculture, Civil Engineering (CE), Mechanical Engineering (ME), Marine Engineering, Information Technology, Computer Science and Electronic Technology, Education major in Mathematics and Science, and Bachelor in Agriculture Technology. Thus, NIPSC has to offer SHS-STEM to ensure that we could have students enrolled in our science and technology courses.

From the time of the implementation of SHS, many adverse reports are found such as lack of materials, equipments, textbooks, and shortage of classrooms, although the budget has been estimated (Estonanto, 2017). Teachers in SHS must have a master's degree in the field of specialization as a basis to teach in grade 11 and 12. However, very few were qualified; thus, they hired non-board with six units in the master degree to fill-in the gap of unqualified teachers. They were given five years' probationary period renewable every year to continue the implementation of the program.

Also, there were very few studies conducted related to the implementation of SHS. This resulted in a few number of schools that are allowed to open STEM strand. Out of 11 big secondary schools in northern Iloilo, only Ajuy National High School, Barotac Viejo National High School, Estancia National High School, and Eucharistic King Academy and NIPSC offered STEM track during Academic Year 2016-2017. This is very alarming because some students who are interested in enrolling in STEM curriculum will be shifted to other strands. This will also affect the vision of the government to encourage our youth to engage in science and technology fields.

Hence, this study was formulated to identify both the positives and negatives points on SHS-STEM. Both identifed points were used as a basis to enhance the implementation of the STEM track in NIPSC, and become the model school in the district. The results of the study are expected to help the DepEd in the effective implementation of the STEM curriculum in the country.

The purpose of this research was to determine and account the perceptions and live experiences such as curriculum, instructional materials, laboratory equipment, faculty educational qualification, research output and courses to be taken in NIPSC of SHS-STEM students.

METHODS

This study was a case study using purposive sampling. The research started in June 2017 during grade 11 of the informants and ended in July 2019 after they enrolled in college. Furthermore, this study focused on school experiences of SHS-STEM students in NIPSC-Main Campus. NIPSC is the only tertiary institution in the district and only Main Campus allowed by the Board of Trustee of the college to offer SHS program

There were 34 SHS-STEM students enrolled in NIPSC, Estancia, Iloilo in Academic Year (AY) 2017-2018. See Table 1. They were top 1 or excellent students in science and mathematics coming from different neighboring towns. All the responses were analyzed, triangulated, and themed for two years. All informants were given codename. Triangulation was utilized in this study because of multiple responses of the informants from different methods to ensure the accuracy of the findings.

Table 1. Profile of the SHS-STEM Students

Informant	Age as of AY 2017-2018	Gender	Home Address
1	17	M	Batad, Iloilo
2	17	M	Estancia, Iloilo
3	17	M	Carles, Iloilo
4	17	F	Estancia, Iloilo
5	19	F	San Dionisio, Iloilo
6	17	F	Carles, Iloilo
7	17	M	Estancia, Iloilo
8	17	F	Estancia, Iloilo
9	17	M	Estancia, Iloilo
10	17	M	San Dionisio, Iloilo
11	18	M	Pototan, Iloilo
12	17	M	Estancia, Iloilo
13	17	F	Estancia, Iloilo
14	17	F	Batad, Iloilo
15	17	F	Estancia, Iloilo
16	17	F	Estancia, Iloilo
17	17	F	Estancia, Iloilo
18	17	F	Estancia, Iloilo
19	17	F	San Dionisio, Iloilo
20	17	M	Estancia, Iloilo
21	17	M	Carles, Iloilo
22	17	F	Estancia, Iloilo
23	16	M	Estancia, Iloilo
24	17	F	Estancia, Iloilo
25	17 to 18	F	Estancia, Iloilo
26		M	
27	17	F	Estancia, Iloilo
28	17	M	Carles, Iloilo
29	16	F	Carles, Iloilo
30	17	M	Batad, Iloilo
31		F	
32	17	F	Pototan, Iloilo
33	16	F	Batad, Iloilo
34	17	F	Estancia, Iloilo

This study used interview, focus group discussion (FGD) and observation. The guide questions were translated to Hiligaynon for better understanding and responses among the informants. The interview was utilized to seek actual meaning on the key concepts about their experiences as SHS-STEM students in NIPSC. The semi-structured interview was used because the researchers wanted to gain rapport and trust with the informants. The researchers employed guide questionnaires composing 10 open-ended questions. These were validated by science teachers in public schools in northern Iloilo and faculty major in science education coming from different SUCs in Region VI. The interview was conducted 10 minutes after their class in Practical Research I and General Biology I. Last December 2018, the informants were asked if what courses in college they plan to take and validated in last July 2019 after they enrolled in their respected schools.

In terms of FGD, the informants were group together according to their interest and brought in the Audio Visual Room in NIPSC Main Library. They were allowed to discuss their experiences such as science subjects, time allotment, teachers' qualification, science materials and equipment, research outputs, and courses to be taken in college. A tape recorder was used to capture all the responses of the 34 informants. In the interview, 10-15 minutes was allocated, and around 35 to 50 minutes in the FGD. This was tape-recorded and transcribed to capture the responses of the students.

The observation was carried out in this study because the researchers wanted to know each respondent. The respondents were not informed about the schedule of the observation to control the preconception. They were also instructed to act naturally during their science classes. The observation was done during their class hours in their all science subjects. The in-charged teachers were given a letter signed by the principal of SHS, informing them about the study.

RESULTS AND DISCUSSIONS

Tables 2 and 3 summarize the positive and negative responses of SHS–STEM students in the interview, respectively. The positive and negative points were found in subject matter, instructional materials, laboratory equipment, and research outputs.

Table 2. Positive Responses of the SHS-STEM Students

Topics	Number of Responses	Responses
Faculty	27	"Our teachers are excellent and well-equipped with the topics."
	20	"They are always ready to teach the lessons."

Subject matter	20	"The science topics are easy."
	25	"The basic topics are learned during Junior High School."
Instructional materials	30	"I bought the instructional materials from my teacher, and it helped a lot."
	31	"The content is similar to our science textbooks, and it has good activities."
Laboratory equipment	34	"We have biology lab., physic lab — moreover, chemistry lab.
Research output	29	"The research is interesting."

Table 3. Negative Responses of SHS-STEM Students

Topics	Number of Responses	Responses
Subject matter	30	"We have limited time in learning the subject."
	28	"Co-curricular activities, as well as meetings, and conferences and training attended by our teachers affect our learning."
Instructional materials	30	"I want to have a textbook, but we are not allowed to buy. There were only two books in the library."
Laboratory equipment	33	"We cannot use the laboratory because college students were using it for their experiment and activities."
	31	"The equipment and facilities are old."
Research output	34	"The research is interesting, but we little time to collect our data. One semester is not enough."

Faculty in NIPSC has a good reputation among students. Teachers' qualifications and their passion are the strong points of SHS-STEM in NIPSC. All faculties of NIPSC are master's degree holders, and some have already finished a doctoral program in science and mathematics from world-class institutions in the country. They also attended various training, workshops, and conferences to gain more knowledge about teaching methodology. These are one of the requirements for becoming faculty of (HEIs) specifically in state universities and colleges (SUCs) in the Philippines. Some of them are the Department of Science and Technology-Science Education Institute (DOST-SEI) and Commission on Higher Education (CHED) scholars from world-class institutions in the region. Some of them have also trained abroad.

Quality and standard are two terms coined to achieve the main thrust of the Commission on Higher Education (CHED) to produce competent graduates (Lapiz, 2015). Thus, teachers must have necessary educational qualifications (Civil Service Commission, 2016) as the requirement for a faculty position in either state universities and colleges (SUCs) or local universities and colleges (LUCs) under CHED Memorandum Order (CMO) no. 36, series of 1998 (Lapiz, 2015). Teachers must have a graduate degree in the area of specialization or allied fields, and vertical articulation between undergraduate and graduate levels. NIPSC has a robust screening committee to hire competent and capable teachers. Besides, the application of the college for university hood is also one of the reasons for having experienced faculties.

The science subjects are divided into two; core and specialized. The core subjects are earth and life science, general mathematics, statistics and probability, disaster readiness and risk reduction, and physical science. The specialized subjects cover general biology I and II, general physics I and II, and general chemistry II. The subjects are well-crafted with the help of science experts for learners to easily understand them. This is the product of rigid deliberation and research of the experts in the country. The spiral concepts in their junior high school help students grasped advance science efficiently and effectively. Thus, these students already have basic knowledge of STEM subjects. Also, it reflects that all of them have a great interest in learning science.

There are STEM textbooks in the library, and teachers create instructional materials. There were only two textbooks per subjects available in the library. The teacher borrows one copy as a reference, and a student borrows the other copy. Teachers discouraged students from buying their textbooks as per instruction of the administration. Since 2016, no any SHS-STEM textbook is available or distributed in all public schools in the entire archipelago. Francisco (2019) revealed that textbooks were also not yet completed and printed. In line with this, Tupas & Matsuura (2011a) revealed that scarcity of science textbooks has been always a severe problem in the Philippines. In public schools, the absence of textbooks in teaching senior high school affects learning as well as time allotment. National bookstore around the country is already selling science textbooks made by private publishers. which cost around $9.00 to $12.00.

Teachers were blank on the materials for their teaching. Luckily, NIPSC teachers are trained to make instructional materials, and also they can get points for promotion. Aside from textbooks, instructional materials (IM) are essential elements for the effectiveness of the curriculum. College teachers create IM to guarantee the quality of instructions with maximum efficiency and cost-effectiveness (de Cadiz & Aguirre, 2013). Espinosa (2014) noted that employing strategic intervention of material-based instruction is a practical approach in improving students' performance and learning. The survey also revealed that intervention was appreciated and appealed to all types of students.

These IM, which are created and distributed with the charge by NIPSC faculty, have helped the SHS-STEM students to learn more about science. The research outputs of SHS-STEM students at grade 12 were all biology-related topics because the adviser assigned were researchers in biology. Their expertise in biology was already given credits like allowing them to present their papers in the various research forums. Teacher advisers trained and guided grade 12 STEM students on how to conduct research properly. However, theystudents have limited time to collect the data. They learned research in their Practical Research I or qualitative in grade 11 2nd semester and Practical Research II or quantitative in grade 12 1st semester. Grade 12 learners have the freedom to use any research output as a requirement for their graduation. However, the limited time also affects the quality of research output; most notably that all of them focused on an experimental study on biology-related topics. Thus, the DepEd must conduct more studies on the way they distributed the subjects per grade levels. For instance, the Practical Research I will be placed in the 1st semester, and Practical Research II will be in the 2nd semester of grade 11. Then, the students are allowed to do immersion during summer break for 20 days in their industry of choice. This is also to safeguard the interest of students in science.

It was also found out that SHS could choose one or two activities from the following; research, immersion, career advocacy, and culminating activity (Jugar, 2017). However, SHS-STEM in NIPSC only selected the research. On the other hand, immersion is the key feature of SHS that allowed learners to familiarize themselves of the actual work environment and do hands-on activities, which should be implemented in the curriculum in SHS-STEM in NIPSC (Department of Education, 2017). This immersion could help students to increase their interest in science and technology. Also, while they are doing their practicum, students could be guided to formulate possible research topics based on learning during the immersion program. Hence, after the end of the immersion, the student will create a proposal in preparation for research output. During the 1st semester of grade 12, students can now start to conduct their research proposal to have ample time to produce a quality research output.

However, the teacher's business and lack of equipment resulted in the negative points. The time allotment is 80 minutes per subjects and teachers could not hold classes regularly because of extracurricular activities, faculty meeting, conferences, and others. Many of these teachers have additional loads in college and designations. They attended research conferences as one of the requirements for higher education institutions in the Philippines.

There are biology, chemistry, and physics laboratories in the campus, state-of-art engineering facilities, and hatchery equipment for a fishery. However, the students have no classroom and cannot use laboratory often enough. However, Filipino teachers are innovative; they improvise science facilities to ensure quality education among students (Tupas & Matsuura, (2012). This is also one of the common problems in public high schools in the entire archipelago. Some can do hands-on activities, but not all can use science materials (Tupas & Matsuura, 2012).

Unexpectedly, not all students enrolled in SHS-STEM track want science-related courses in college. 75% of students planned to take STEM courses such as engineering, Bachelor of Science in Biology and Nursing, education major in science and mathematics, veterinary medicine and architecture, and 29% of them agreed to take Filipino and tourism. These non-STEM courses will help them find jobs quickly after college-that is what they think about.

Figure 1 shows the proportions of courses taken by SHS-STEM graduates of NIPSC for AY

2018-2019. Civil engineering had the most considerable portion. Civil engineering in NIPSC was doing well in the licensure examination, and this was one of the reasons that encourage the grade 12 STEM to enroll in the course. Both science-related courses and non-STEM courses were about the same. Architecture, as one of the science courses, also had the right proportion. These Non-STEM courses are Tourism, Education major in Filipino and Business Administration. Non-STEM courses are fields in arts, humanities, and social science.

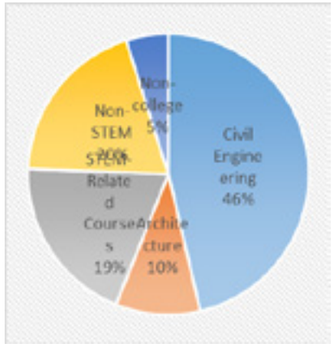

Figure 1. Courses Taken by the SHS-STEM Students in College

While Figure 2 revealed that NIPSC garnered a large proportion of the chart. The responses exposed that many of the STEM students wanted to stay near their families. The second-largest proportion went to University of San Agustine (USA), and Central Philippine University (CPU) while the Western Institute of Technology (WIT) and Iloilo Science and Technology University (ISAT-U) had the same proportion together with Iloilo Doctor's College (IDC) and Capiz State University (CapSU).

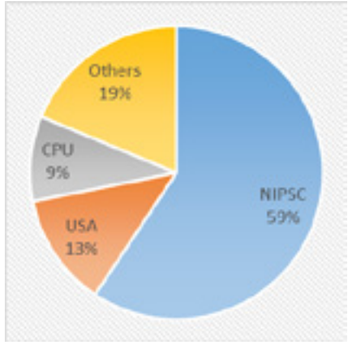

Figure 2. The Universities and College SHS-STEM NIPSC Students Enrolled

The majority of SHS-STEM for an academic year (AY) 2019-2020 enrolled in civil engineering in NIPSC as it has a good standing in terms of quality education and board passers.

There were six priority STEM courses in tertiary education, such as engineering, information technology, agriculture and related fields, science and mathematics, health, and teacher education. This was also confirmed by CHED that listed agriculture, engineering, science, and maths, information technology (IT), teacher education, and health sciences. The government also offered different science and technology scholarship to persuade students to take STEM courses with the help of various agencies. However, CHED issued a memorandum allowing students to take any courses in college regardless of their strands or tracks in senior high school. Further, the Department of Science and Technology (DOST) made a statement allowing non-STEM to be permitted to apply for government science and technology scholarship. Thus, the Philippine government should have fixed policy about the education system in the country.

These students who enrolled differently from their track in SHS will take the bridging program or remedial class for two weeks to be qualified in the desired course. Many concluded that this is just a waste of time, effort and money, and the effectiveness of the program. Furthermore, this will also delay students from finishing the program in college on time because the first semester will be intended to get subjects related to the courses. This is under CHED Memorandum Order No. 10 series of 2017, Category 3-a that specifies tertiary institute around the country to have options in employing bridging programs that ensure the readiness of students to enter college aside from the strand taken during SHS.

The new curriculum has a new program called career pathway that helps students from grade 10 to grade 11 and 12 to have right directions to work after SHS or to continue to college (Ontal, ND). Currently, SHS-NIPSC has no personal guidance personnel to handle the students in their journey to college. The guidance counselor must direct students on proper courses based on their interest. There were three guidance counselors in NIPSC, but they were tasked to guide college students. They cannot run their duties on the SHS-STEM because of a significant number of college students enrolled in the institution.

Galliot & Graham (2015) stated that career guidance must be provided to students together with their families for awareness and guidance on how to make use of resources and opportunities

available in the real world. The family has a significant factor that influences students for their future endeavors. Given examples of mother's profession and income which have a significant impact on the interest of students in choosing college degree (Saysay, 2011). Other than that, siblings position, and elective grades during high school also influence students' choices in life. Hence, cooperation with parents and guardians are also recommended. For this reason, having reliable guidance facilities will support students to be on the right track.

CONCLUSION

Teachers' qualifications and their passion for enhancing SHS-STEM curriculum and the availability of facilities were the strong points of NIPSC as to become a model school in implementing STEM curriculum in the district. However, lack of time management for teachers to hold classes, limited science textbooks and classroom, as well as unavailability of the laboratory for hands-on activities require proper attention by concern authorities to enhance the delivery of SHS-STEM. Since almost all the courses in NIPSC are science-related, and very few secondary schools offering STEM in the district, all the positive points must remain, and negative points must be improved.

Research advisers are all equipped with various training and conferences to help their advisees to generate a quality output. The majority of the students enrolled in science-related courses around the region. Nevertheless, civil engineering had the most considerable portion, and almost all of them joined in NIPSC. Furthermore, the findings of this study are expected to be beneficial not only NIPSC but also DepEd to encourage our youth to be STEM enthusiasts and finally, the government would improve the facility and equipment.

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REFERENCES

Bada, S. O. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. IOSR Journal of Research and Methods in Education, *5*(6), 66-78.

Bada, S. O., & Olusegun, S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. *Journal of Research & Method in Education*, *5*(6), 66-70.

Bernardo, A. B. I. (2004). Constructivism, curriculum and the Challenges in Transforming Science Education in the Philippines. *Learning Edge*, *4*, 1-33.

Cabansag, M. G. S. (2014). Impact Statements on the K-12 Science Program in the Enhanced Basic Education Curriculum in Provincial Schools. *Researchers World*, *5*(2), 29.

Calderon, M. T. F. (2015). A Critique of K-12 Philippine Education System. *Arellano University Graduate School Journal*, *12*(1), 1-1.

Civil Service Commission (2016). MC No. 22, s. 2016. Education Requirement for Faculty Positions in State Universities and Colleges (SUCs) and Local Universities and Colleges (LUCs). Retrieved from http://csguide.org/items/show/888.

Commission on Higher Education (2017). CMO No. 10, s. 2017. Policy on Students affected by the Implementation of the K12 Program and the New General Education Curriculum. Commission on Higher Education, Republic of the Philippines.

De Cadiz, G. B., & Aguirre, D. O., Jr. (2013). Instructional Materials Development Manual. Easter Visayas State University, Tacloban City, Philippines. Retrieved from https://www.researchgate.net/publication/266023994_Instructional_Materials_Development_Manual/download.

Department of Education. (2017). Guidelines for Work Immersion (DO. 30). Republic of the Philippines. Retrieved from http://www.deped.gov.ph/2017/06/05/do-30-s-2017-guidelines-for-work-immersion/.

Ejiwale, J. A. (2013). Barriers to successful implementation of STEM education. *Journal of Education and Learning*, *7*(2), 63-74.

Eldeeb, R. (2013). Review and Critique of the Book" Education and Experience" by John Dewey. *IOSR Journal of Research & Method in Education*, *1*(2), 44-47.

Estonanto, A. J. J. (2017). Acceptability and Difficulty of the STEM Track Implementation in Senior High School. *Asia Pacific Journal of Multidisciplinary Research*, *5*(2), 43-50.

Francisco, A. C. A. (2019). Senior High School in the Philippines: How is it Doing? School Division of Office Science City of Munoz, Department of Education Retrieved from www.depedscm.com/senior-high-school-in-the-philippines-how-is-it-doing/

Galliott, N. Y., & Graham, L. J. (2015). School Based Experiences as Contributors to Career Decision-Making: Findings from a Cross-Sectional Survey of High-School Students. *The Australian Educational Researcher*, *42*(2), 179-199.

Gubalane, D. (2016). How to Choose K to 12 Senior High School Track and Strand. Daniel Gubalane – Teacher to Blogger. Retrieved from https://www.danielgubalane.com/2016/01/k-to-12-senior-high-tracks-strands.html

Hodson, H. (2013). Why Experiences is More Important than Knowledge. Elephant Journal – Its About the Mindful Life. Retrieved from https://www.elephantjournal.com/2013/08/why-experience-is-more-important-than-knowledge/.

Jugar, R. R. (2017). Immersion Program in the Philippines Senior High School: The Case of the University of San Carlos. Philippine Education Conference, Manila, Philippines.

Lapiz, G. B. (2015). Faculty Qualifications across the Vertically-Articulated Colleges of Cebu Normal University in the Philippines: The Policy Framework. *European Scientific Journal*, *11*(16).

Magulod Jr, G. C. (2017). Factors of school Effectiveness and Performance of Selected Public and Private Elementary Schools: Implications on Educational Planning in the Philippines. *Asia Pacific Journal of Multidisciplinary Research*, *5*(1), 73-83.

Mallick, H. (2012). What is the Concept of Science Curriculum? PreserveArticle.com. Retrieved May 11, 2019 from http://www.preservearticles.com/2012041630472/what-is-the-concept-of-science-curriculum.html

Matthews, W. J. (2003). Constructivism in the Classroom: Epistemology, History, and Empirical Evidence. *Teacher Education Quarterly*, *30*(3), 51-64.

Montebon, D. T. (2014). K12 Science Program in the Philippines: Student Perception on its Implementation. *International Journal of Education and Research*, *2*(12), 153-164.

Office of Senior High School. (2019). (Government Permit (Region VI) No. SHS 273. S. 2016) Permit to Operate the Senior High School Program. Northern Iloilo Polytechnic State College, Estancia, Iloilo.

Ontal, M. (ND). The Integration of Career Guidance in the K to 12. Retrieved from http://ro12.dole.gov.ph/fndr/mis/files/DEPED%20The%20Integration%20of%20Career%20Guidance%20in%20the%20K12.pdf.

Patrinos, H. A. & Al-Samarria S. (2016). Weighing the Benefits of Senior High School in the Philippines. The World Bank Group. Retrieved from http://blogs.worldbank.org/education/weighing-benefits-senior-high-school-philippines.

Espinosa, A. A. (2014). Strategic Intervention Material-Based Instruction, Learning Approach and Students' Performance in Chemistry. *International Journal of Learning, Teaching and Educational Research*, *2*(1).

Orale, D. H. S. R. L., & Sarmiento, D. H. (2016). Senior High School Curriculum in the Philippines, USA, and Japan. *Journal of Academic Research*, *1*(3), 12-23.

Saysay, K. L. (2011). *A Qualitative Study on Pilipino American Students Relative to Their High School Success and Career Choices*. University of Southern California.

Trifiletti, L. B., Gielen, A. C., Sleet, D. A., & Hopkins, K. (2005). Behavioral and Social Sciences Theories and Models: Are They Used in Unintentional Injury Prevention Research?. *Health Education Research*, *20*(3), 298-307.

Tupas, F. P. & Matsuura, T. (2012). A Comparative Study of Science Lessons in Elementary and Secondary Education in Japan and the Philippines. Journal of Hokkaido University of Education (Education), *62*(2), 87-94.

Tupas, F. P. & Matsuura, T. (2011). Comparative Studies of Science Education Curricula between in Japan and the Philippines. The Journal of the School Education Society of Hakodate, *16*, 13-22.

Tupas, F. P. & Matsuura, T. (2011). Comparison of Science Textbooks for Public Schools in Japan and the Philippines. Journal of Hokkaido University of Education (Education), *61*(2), 219-228.