Research Article

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Teachers' Experiences and Self-Assessment in Teaching Biology in Senior High School in the Philippines

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Abstract

In support of the various studies for the ongoing Philippine Senior High School(SHS) curriculum, Analysis phase of the analysis, design, development, implementation, evaluation (ADDIE) model of instructional design is presented in this study. The main objective is to evaluate biology teachers' experiences and self-assessment in teaching Biology II in the science, technology, engineering, and mathematics (STEM) Track of the K12 Basic Education Program during its first two years of implementation 2016-2017 and 2017-2018(face to face)in Iloilo Province, Philippines. A descriptive survey using a questionnaire from the K12 Science Curriculum composed of two parts: biology II complex topics, and biology teachers' self-assessments. Five Biology experts from Western Visayas, Philippines, were asked to evaluate the researcher made survey instruments. Mean and standard deviation were employed to interpret the collected data using SPSS version 21. The results showed that the four primary areas of complex knowledge were Systematic Based on Evolutionary Relationships, Evolution and Origin of Biodiversity, Organismal Biology, and Genetics. According to rank, the most challenging topic was "Systematic Based on Evolutionary Relationship," and the easiest was "Genetics." On the self-assessment of Biology teachers, all topics were in "Moderate Mastery," and Genetics was "High Mastery." Also, a significant relationship between the content topic difficulty and Biology teachers' mastery level. The findings show no relationship between self-assessed knowledge and self-assessed skills of Biology Teachers. Proper training and encouraging teachers for professional development is a must. Teachers must be trained to teach Biology II, become effective and efficient through professional development. Also, the national government should assess the implementation of the new curriculum based on the experts' recommendations. Thus, this study recommends encouraging SHS teachers to take graduate studies aligned with their undergraduate program to master the area of specialization. The national government must support scholarship programs in STEM for biology educators..

Keywords: *K to 12 Senior High School, ADDIE, analysis phase, STEM Biology II , Self-Assessment, Biology Education*

1. Introduction

Biology education has had a significant impact on society for many years. Biology as a subject defines the mastery of every individual in a particular community regarding *scientific concepts, ideas, and principles* (Santos et al., 2021). Biology is a science that also requires understanding terms and laboratory work. In learning Biology, teachers and students encountered a lot of scientific terms and

sometimes formulas. And most of the time, they conduct laboratory experiments outside and inside the four corners of the classroom. Learning Biology is entertaining and exciting; thus, Biology teachers are creative, innovative, scientists, researchers, and many more roles into one. Biology is about everything that surrounds humans because Biology is defined as the study of living things; thus, Biology is essential (Imm, 2021).

Implementing K12 Basic Education Programs causes problems in the science, technology, engineering, and mathematics (STEM) curriculum (Antipolo and Rogayan, 2021). There were many complaints that the education systems in the country were not ready due to a lack of facilities, instructional materials, and teachers to teach the subjects. Many experts confirmed that all these backlogs on the new curriculum will affect the program's implementation. Biology is no excuse; as one of the core subjects in the new curriculum, discussion and experimentation are the key factors. One intervention that significantly improved Biology teaching and learning is the Strategic Intervention Material (SIM) (Acosta, 2020). As evident in local and international assessments, the new curriculum helps save the old problematic education system(Tupas and Laguda, 2020). But for almost ten years, similar problems were encountered due to its abrupt changes(Barcelo, 2019). Thus, this study was formulated to assess the experiences of SHS Biology teachers in teaching the subject areas. In the academic year (AY) 2017-2018, after two years of employing the senior high school (SHS), many studies were conducted but not focused on teachers' experiences and self-assessment. These were some of the study's recommendations: related training geared toward teachers' professional growth, conducting consistent onsite observing, and providing need-based backing and resources for teachers' up-skilling and re-skilling (Bacus and Alda, 2022). After five years of implementation, what are the new curriculum's different positive and negative impacts? According to Antipolo and Rogayan (2021), based on the results of their studies, to spearhead the review of the syllabi and conduct more training and workshops related to the STEM – Biology curriculum.

K to 12 SHS was first announced in the Philippine Educational System in 2016 as the first year where grades 11 and 12 were offered to continue primary and secondary education in Philippine public and private school educational settings (Pillay and Panth, 2022). Grade 12 STEM Biology II was offered in 2017. Inspired by the simplicity of the 4A model presented by the Department of Education (DepEd) during the 2016 Mass Training of Teachers (MTOT) for SHS teachers, the idea of developing instructional material for SHS biology teachers took shape. The researcher pooled various references to develop the contextualized 4A instructional material (IM). As a starter, the biology curriculum guide grade 7-10 (to assess the familiarity of teachers in terms of biology topics in Junior High School (JHS), and the basic Biology syllabus for tertiary education (to assess where tertiary biology begins) were studied. Second, the SHS curriculum guide for STEM Biology II was examined in detail. The curriculum guide was used to assess the topic difficulties of SHS STEM Biology teachers in terms of knowledge (of the four primary learning contents in Biology II) and terms of skills (identification of the various learning competencies under each content topic (FutureLearn, 2022).

Considering the DepEd view of the K to12 curriculum, the approaches in teaching science are multi and interdisciplinary, science-technology-society-based, contextualized learning, problem/issue-based learning, and inquiry-based. "*The approaches are based on sound educational pedagogy, namely: constructivism, social cognition learning model, learning style theory, and brain-based learning."*This K to 12 framework focuses on a contextualized learning approach in teaching and constructivist educational pedagogy (Department of Education,2016; Barcelo, 2019).However, many factors affect the implementation of the SHS tracks, like the availability of the facilities, teachers' qualifications, and the offering of tracks due to application requirements (Uy and Martinez, 2019).

Science, Technology, Engineering, and Math (STEM) Strand is one of the academic strands in the K12 curriculum. Pertains to the career path for engineers, medicine, pilots, nursing, biology, physics, computer studies, information technology, and other related sciences (Itorralba, 2022). In the science curriculum, teachers are trained as educators, not scientists. This is found in the pedagogical content knowledge (https://narst.org/research-matters/pedagogical-content-knowledge). There are very few schools offering STEM tracks due to facilities and teachers. They also

have problems in hiring qualified teachers. The demand for students to take the STEM tracks was also limited(Uy and Martinez, 2019).One study revealed not all STEM graduates enrolled in science and technology courses at the tertiary level. State universities and colleges (SUCs) faculty could also offer SHS tracks. They showed that many were qualified due to the many available graduate programs and facilities. However, one of the common problems encountered is using laboratory facilities (Tupas and Matsuura, 2019). This calls for all teachers to integrate approaches and strategies in STEM tracks (Rafana et al., 2020).

In the study about teachers' perception of the STEM curriculum, support is the critical solution for effectively employing the programs. Also, helping one another and prior engagement and attending professional development would help the quality of the curriculum (Margot and Kettler, 2019).

In learning Biology, one study about using informal science: for instance, going into a natural science museum. Learners have the autonomy to study. However, many schools take for granted biology as a subject (Reiss, 2018). Hence, it is vital to make mechanisms and policies to implement effective and efficient biology teaching and learning. It is a fact that biology is essential to all human aspects.

The theoretical foundation guiding this research study on teachers' experiences and self assessment in the context of biology education is part of the bigger framework analysis, design, development, implement, and evaluate (ADDIE) known for guiding instructional material (IM) design for educators(Handrianto , et. al.,2021; Bouchrika, 2024). This study dwells primarily in the first phase(the building block), which is analysis phase, of the five phases of the ADDIE model for IM design. This study explores the assessment and analysis of the nature existing Biology educators in the province of Iloilo teaching Biology II in the Senior High School(SHS) curriculum. In the first phase of ADDIE, analysis entails various methods of gathering information by defining the problem, identifying the source of the problem and determining possible solutions. Reseacrh techniques during the analysis phase includes needs analysis, problem identification, and task analysis. In this phase the researcher needs to investigate what are the needs of the respondents(teachers), and what is the problem on the situation they are currently working on. The results of the investigation in this phase will be used for the next phase. Results may include teaching goals such as contextualization of a lesson plan, how to do the lesson plan, where to get ideas for the lesson plan, how to make activities for the lesson plan, what topics should be simplified or deepened, and what modification of teaching approach is needed for the instructional materials. In this study, the researcher utilized a researcher made checklist in ascertaining the self-assessed knowledge and self-assessed skills of Biology II teachers in the SHS-STEM strand in the Philippines.

2. Methods

The research design uses a descriptive survey to gauge the experiences of Biology Teachers in SHS and self-assessment toward Biology II in the STEM strand. The contents of the survey questionnaires were taken from the Learning Competencies of Biology 2 Curriculum Guide and was evaluated by five experts in Biology from Western Visayas, Philippines. The instruments underwent reliability, and face-and-content validation by experts from a Higher Education Institution, Science of Biology expert (Biological Science Education Specialist), and a senior high school biology teacher (Master Teacher).The survey instruments were divided into two parts. Part 1 is about Difficulties Topics encountered by Senior High School Biology Teachers in Iloilo Province, and Part 2 is about the Self-assessment of Biology Teachers' Skills. Included in the main survey questionnaires were additional questions regarding age, educational background, years of teaching experience in biology subjects.

Convenience and Purposive-cluster sampling were utilized in this study. Convenience sampling meant that Biology teachers who attended Department of Education(DepEd) Schools Division of Iloilo mass training of teachers(MTOT) in SHS in 2016-2017 and 2017-2018 (face to face) were given survey questionnaires. Purposive sampling which entailed only SHS STEM Biology II teachers were

targeted. Cluster sampling in terms of identified congressional districts offering SHS STEM. The total participants of this study were twenty nine Biology teachers from the five congressional districts of the Province of Iloilo, Philippines. There are five congressional districts and in each district, municipal national high schools offering STEM tract were identified and SHS Biology teachers, specifically those handling Biology II were chosen respondents through the Schools Division of Iloilo master list of teachers- Biology II teachers. Each target participant respondents were communicated via email, cellular phone numbers or facebook messenger regarding their availability to travel, answer survey questionnaires face to face or via online. The researcher asked permissions, following protocols in proper communications, the researcher wrote letters signed by research adviser, to respective office heads for the intended research study. The researcher personally visited the biology teachers from selected SHS STEM classes, conducted a pre-survey, and attended class observation. The researcher also interviewed the teachers to determine if they were equipped(content knowledge) with the STEM curriculum. Researcher –made survey questionnaires were face and content validated by Biology experts prior printing and dissemination to respondents. The researcher distributed the survey questionnaires and consent forms, gave them two weeks, then, the questionnaires were collected. Results were analyzed and interpreted. In interpreting the results, SPSS was utilized. The statistical tools were mean, standard deviation, t-test, One-way ANOVA, and Pearson r.

The consent form consisted of the name of the participant, title of this study that he/she is participating, name of the researcher, and the school curriculum the researcher is enrolled, the purpose of the study, the role of the participant in the survey, and the importance of the participant as grade 12 Biology II teacher. It also stated that participation was voluntary and the participant could refuse without being disadvantaged as a consequence. The consent form also informed the participant of the absence of risks, and consumption of participant's time. In return, participation in the survey would give the participants insights and use them in their own teaching strategies. The participants also allowed the researcher to publish the results of the study with their names/identity kept anonymous. Lastly, agreement was signed by both researcher and participant.

Limitations of the study include unavailability of SHS STEM track in some municipalities of respective congressional districts, thus no Biology II teachers were available from these national high schools considering they also have SHS programs. Another would be limited time of the respondents to travel because of duties and responsibilities in their respective schools. Some survey questionnaires were sent via email and received via email because of difficulty of travel and time constraints to respondents.

3. Results

Table 1 shows the complex topics according to senior high school biology teachers in Iloilo Province.

Table 1. The Difficult Topics in Senior High School Biology as Observed by Biology Teachers in Iloilo Province

Knowledge: Content Topic (Biology 2 Curriculum Guide)	***SD***	***M***	**Descriptive Rating**	**Difficulty Rank**	**Remarks**
Systematics Based on Evolutionary Relationship	0.97	3.17	Difficult	1	Hardest
Evolution and Origin of Biodiversity	0.90	3.62	Very Difficult	2	
Organismal Biology	0.95	3.76	Very Difficult	3	
Genetics	0.99	3.86	Very Difficult	4	Easiest
Over-all Mean		3.60	Very Difficult		

Note: 4.51-5.00 (Most Difficult); 3.51-4.50 (Very Difficult); 2.51-3.50 (Difficult); 1.51-2.50 (Slightly Difficult); 1.00-1.50 (Not Difficult).

Biology teachers who are teaching in the K to 12 senior high schools for the years 2016-2017, 2017-2018, have self-assessed their knowledge (in terms of biology content topics) of the curriculum guide of

Biology 2 STEM and have signified that Genetics is the most familiar topic while Systematics Based on Evolutionary relationship is the most unfamiliar. According to the responses of the Biology Teachers in the Province of Iloilo, the problematic topics were Systematic Based on Evolutionary Relationship, Evolution and Origin of Biodiversity, Organismal Biology, and Genetics with a mean score of 3.17 (Difficult), 3.62 (Very Difficult), 3.76 (Very Difficult), and 3.86 (Very Difficult), respectively.

Table 2 shows the self-assessment of Biology teachers' skills based on learning competencies of the Biology 2 Curriculum Guide.

Table 2. Self-assessment of Biology Teachers Skills Based on Learning Competencies of Biology 2 Curriculum Guide

CG Content/ Category LC Code	Skills: Learning Competency Details	SD	Mean	Descrip-tion	Rank	Re-marks
Genetics STEM_BIO11/12IIIa-b-7	discuss the applications of recombinant DNA	1.13	2.93	Moderate Mastery	1	Hardest
Systematics Based on Evolutionary Relationship STEM_BIO11/12IIIhj-16	describe species diversity and cladistics, including the types of evidence and procedures that can be used to establish evolutionary relationships	1.31	3.00	Moderate Mastery	2	Hard
Genetics STEM_BIO11/12IIIa-b-6	outline the processes involved in genetic engineering	1.25	3.07	Moderate Mastery	3	Hard
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-10	show patterns of descent with modification from common ancestors to produce the organismal diversity observed today	1.25	3.07	Moderate Mastery	4	Hard
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-12	explain evidences of evolution (e.g., biogeography, fossil record, DNA/protein sequences, homology, and embryology)	1.19	3.14	Moderate Mastery	5	Hard
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-13	infer evolutionary relationships among organisms using the evidence of evolution	1.26	3.17	Moderate Mastery	6	moderate
Systematics Based on Evolutionary Relationship STEM_BIO11/12IIIhj-14	explain how the structural and developmental characteristics and relatedness of DNA sequences are used in classifying living things	1.24	3.21	Moderate Mastery	7	moderate
Systematics Based on Evolutionary Relationship STEM_BIO11/12IIIhj-15	identify the unique/distinctive characteristics of a specific taxon relative to other taxa	1.24	3.21	Moderate Mastery	8	moderate
Organismal Biology STEM_BIO11/12IVi-j-3	describe examples of homeostasis (e.g., temperature regulation, osmotic balance and glucose levels) and the major features of feedback loops that produce such homeostasis	0.99	3.24	Moderate Mastery	9	moderate
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-9	explain the mechanisms that produce change in populations from generation to generation (e.g., artificial selection, natural selection, genetic drift, mutation, recombination)	1.20	3.34	Moderate Mastery	10	moderate
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-11	trace the development of evolutionary thought	1.32	3.34	Moderate Mastery	11	easy
Organismal Biology STEM_BIO11/12IVi-j-2	explain how some organisms maintain steady internal conditions that possess various structures and processes	1.08	3.38	Moderate Mastery	12	easy
Evolution and Origin of Biodiversity STEM_BIO11/12IIIc-g-8	describe general features of the history of life on Earth, including generally accepted dates and sequence of the geologic time scale and characteristics of major groups of organisms present during these time periods	1.12	3.41	Moderate Mastery	13	easy
Genetics STEM_BIO11/12IIIa-b-2	explain sex linkage and recombination	1.15	3.48	Moderate Mastery	14	easy
Organismal Biology STEM_BIO11/12IVa-h-1	compare and contrast the following processes in plants and animals: reproduction, development, nutrition, gas exchange, transport/circulation, regulation of body fluids, chemical and nervous control, immune systems, and sensory and motor mechanisms	0.10	3.55	Moderate Mastery	15	easy
Genetics STEM_BIO11/12IIIa-b-3	describe modifications to Mendel's classic ratios (gene interaction)	1.06	3.55	Moderate Mastery	16	easy
Genetics STEM_BIO11/12IIIa-b-5	diagram the steps in DNA replication and protein synthesis	1.40	3.55	Moderate Mastery	17	easy
Genetics STEM_BIO11/12IIIa-b-4	illustrate the molecular structure of DNA, RNA, and proteins	1.35	3.76	High Mastery	18	easy
Genetics STEM_BIO11/12IIIa-b-1	predict genotypes and phenotypes of parents and offspring using the laws of inheritance	1.27	4.03	High Mastery	19	Easiest

Note: 3.67-4.99, High Mastery, 75%-100% Mastery of Skills to execute the Learning Competency; 2.34-3.66, Moderate Mastery, 25%-74% Mastery of Skills to execute the Learning Competency; 1.00-2.33, Poor Mastery, below 25% Mastery of Skills to execute the Learning Competency.

In terms of self-assessment, the results showed that the most complex topics were Genetics and recombinant DNA, and the easiest was Genetics with the topic genotypes and phenotypes. Some of the topics from Systematics Based on Evolutionary Relationships were hard, moderate, and easy.

Table 3 shows the relationship between content topic difficulty and biology teachers' mastery level.

Table 3. Relationship Between Content Topic Difficulty Level and Biology Teachers' Mastery Level.

Correlations			
		Difficult Level	*Mastery Level*
Difficult Level	Pearson Correlation	1	-.325
	Sig. (2-tailed)		.174
	N	19	19

The mean difference is significant at the 0.05 level.

The study's results showed a significant relationship between the content topic difficulty and Biology teachers' mastery level. The Sig. (2-tailed) was .174, more significant than the .05.

Table 4 represents the relationship between self-assessed knowledge and self-assessed skills of Biology Teachers.

Table 4. Relationship Between Self-Assessed Knowledge and Self-Assessed Skills of Biology Teachers.

ANOVA			
		Difficult Level	*Mastery Level*
Difficult Level	Pearson Correlation	1	.668
	Sig. (2-tailed)		.000
	N	19	19

Correlation is significant at the 0.01 level (2-tailed).

The table shows that the relationship between self-assessed knowledge and self-assessed skills of Biology Teachers was .000 (Sig. (2-tailed)), which is lower than 0.01; thus, the results were interpreted as no relationship.

Table 5 shows the demographic profile of Biology teachers in SHS within the province of Iloilo offering STEM Track in the Schools Division of Iloilo.

Table 5. Profile of Participants (SHS Biology Teachers)

Variables		**Percentage**
Sex		
	Male	21
	Female	79
Age		
	35 and below	72
	36 and above	28
Educational Preparation		
	With units or CAR in Masters	69
	With units or CAR in Doctoral	31
Specialization		
	Biology	79
	Non-Biology	21
	Education	72
	Non Education	28
Work Experience		
	Teaching 3 yrs and above	72
	Teaching 2 yrs and below	28
	Teaching Prior Entry to SHS	86
	Non-Teaching Prior Entry to SHS	14
	Government employment prior entry to SHS	66
	Private employment prior entry to SHS	34

Variables		Percentage
Entry Item in SHS		
	Teacher I-III	55
	Master Teacher I-II	42
	Special Science Teacher	3
School Geography		
	Agricultural Lowland	41
	Agricultural Highland	7
	Agricultural-Fishery	52
Internet Access		
	Accessible	76
	Conditional	24

The table shows the demographic profile of twenty nine SHS STEM Track Biology II teacher respondents during the analysis phase of the ADDIE Instructional Design research study. The variables include sex, age, educational preparation, specialization, work experience, entry item (salary grade/rank) in SHS, school geography and internet access.

4. Discussions

Genetics is perceived by Biology teachers as the easiest, with a mean score of 3.86 (with an SD of 0.99) as it came last in the difficulty rank. This is so because of their familiarity of the topic as specified by content standards under Genetics as introduced in the spiral curriculum of JHS Science. While the content topic *Systematics Based on Evolutionary Relationship* is perceived by Biology teachers as the hardest with a mean score of 3.17(with an SD of 0.97) and came first in the difficulty rank. According to Biology teachers' interview, the content standards specified under this content is of higher Biology and unfamiliarity is the possible reason for its being perceived as the most difficult content topic.

The familiarity of teachers (as per interview) with the three content topics Organismal Biology, Genetics, and Evolution may be attributed to the fact that most of the introductory concepts were already introduced in the spiral progression nature of the Grades 7 to 10 biology curriculum, while concepts related to systematics are only introduced in college biology subjects prior the introduction of the new K to 12 curriculum. University of the Philippines National Institute for Science and Math Educational Development confirms the rate of complexity progression of topics found in the K to 12 curriculum(Ferido,2013). The structure and content of senior high school biology is divided into two, Biology I and Biology II, both of which were tackled and introduced in a spiral manner in Grades 7-10 biology classes with progressing complexity as per DepEd K to 12 Curriculum Guide Science Grade 3 to 10 in 2012. Grade 10 science is composed of four parts: Chemical Reactions (Chemistry) for the first grading; Living Things and Their Environment (Biology) for the second grading; Fire, Motion and Energy (Physics) for the third grading, and Earth and Life Science for the fourth grading period. The following figures show the content of grade 10 second grading science curriculum guide.

The highest content topics found in Grade 10 biology is composed of only three Biology topics, and these are: Coordinated Functions of the Organs of the Reproductive System; Heredity: Inheritance and Variation, and Evolution. This confirms the non-inclusion of Systematics, resulting in the non-familiarity of most SHS biology teachers surveyed, this is also true if SHS teachers were previously teachers of Grade 7-10 biology of the Junior High School. It should be noted that 21% of SHS biology teachers surveyed(in the Schools Division of Iloilo) were non-biology in specialists and 14% had no teaching experience prior to opening of SHS curriculum(table 5).

Self-assessment of SHS Biology II teachers in terms of skill mastery, expressed as Learning Competencies (found in Biology 2 Curriculum Guide) in the survey, were rated by SHS Biology teachers whether they had high mastery, moderate mastery, or poor mastery if the said competencies would be carried out inside the classroom as lesson. The hardest (with a mean of 2.931 and an SD of 1.132) to execute in terms of teacher skills as to the corresponding learning competency was to discuss the applications of recombinant DNA under the Content Genetics. Third on the difficulty rank (with

a mean of 3.069 and with an SD of 1.252) also under the content Genetics given the learning competency to "outline the processes involved in genetic engineering. These two, and three more Learning Competencies that ranked top five as the hardest topics to execute as classroom skills were chosen as basis of topics for which an enriched instructional material would be created in the form of 4A contextualized lesson plans. The three other learning competencies that surfaced as difficult to execute in terms of skills are: to describe species diversity and cladistics, including the types of evidence and procedures that can be used to establish evolutionary relationships"-rank 2, with a mean score of 3.000 and with an SD of 1.309 under the Content Systematics Based on Evolutionary Relationships"; the remaining two other learning competencies that are difficult to execute in terms of skills are under the Content Evolution and Origin of Biodiversity with Learning Competencies- to show patterns of descent with modification from common ancestors to produce the organismal diversity observed today", ranked 4 with a mean score of 3.069 with an SD of 1.252, and lastly, the Learning Competency to "explain evidences of evolution (e.g. biogeography, fossil record, DNA/protein sequences, homology, and embryology)"-ranked 5 with a mean score of 3.1379 and SD of 1.187. Thus, of the nineteen Learning Competencies in the curriculum guide of Biology II, the top five Learning Competencies that are hard or difficult to execute as skills, according to Biology teachers' self-assessment, are Genetics, Systematics, and Evolution. Majority of SHS Biology teachers rated themselves good to average in terms of Biology II knowledge; also, majority rated themselves with moderate mastery in Biology II skills. Self-assessment of teachers of their knowledge and skills needed in SHS Biology can be further explained by their background experiences prior to their being hired as SHS Biology teachers(table 5).

In terms of the biology teachers' self-assessed skills, Genetics, though the most familiar, also have topics (learning competencies)which Biology teachers find difficult to teach and these are (a) to discuss the applications of recombinant DNA and (b)outline the process involved in Genetic Engineering. The existence of these two learning competencies as skills that teachers should be passing from their end to the students as evidence of learning is worth getting attention. These two topics are usually mentioned in class superficially, because most schools are not performing DNA recombination techniques in the laboratory nor producing genetically modified organisms. Approaches rely only in learning materials such as textbooks, teaching guides, online videos, and documentaries.

Genetics, Evolution, Organismal Biology, and Biodiversity are the major topics in Biology II in the STEM strand in SHS in the Philippines. Further, these topics are relevant subjects in biology-related courses. Also, experts discovered that Cytology, Cytogenetics, and a little Taxonomy are important in Fishery Education (Camara, 2020). Thus, SHS teachers must have the necessary Biology Curriculum skills and knowledge. Those identified complex topics are relevant to some higher education curricula. But in terms of experiences, one study revealed that Biology teachers in the Philippines are well-skilled and competent to teach the subjects in terms of science process skills. While in critical thinking skills, educational attainment is the crucial factor (Andarino, 2021). This showed that to improve the knowledge of Biology Teachers on the four major topics complex, more training is required and recommended.

Support from the government should be provided to enhance the facilities (Uy and Martinez, 2019; Tupas and Matsuura, 2019). Providing state-of-the-art facilities is a significant factor in making teachers and learners have fun and interest in the subject areas. Hands-on enhances expertise and skills since Biology is not only memorizing scientific terms but also laboratory work. STEM teachers should undergo retooling or pursue advanced studies related to the field of specialization (Rafanan and De Guzman, 2020). Encourages Biology teachers to take advanced study related to their areas. Thus, support from peers and key officials can result in quality service (Margot and Kettler, 2019). Some college courses, like majoring in Fisheries, have topics likes, Biochemistry, Cell Biology,

One finding showed that 7th and 8th graders in biology competencies were least mastered and were found significant correlations. Hence, teachers were encouraged to employ inquiry-based and hands-on learning activities (Santos et al., 2021). This revealed that if teachers have limited

knowledge of the subject, students grasp very low.

Academic achievement depends on teachers' instructional delivery; therefore, teachers must have the necessary knowledge and skills (Bibon, 2022). Also, the implementation of spiral progressions had a significant effect on a deep understanding of scientific concepts. However, the availability of instructional materials helped teachers and students retain needed concepts (DeRamos-Samala, 2018).

Proper integration should be made upon the results of self-assessed knowledge and skills. Learning opportunities to improve the teaching and learning process should be available immediately. Furthermore, the instruments used for self-assessment must be enhanced (Max et al., 2022).

In understanding the gaps or disconnect with available biology materials such as Curriculum Guide (CG), Teaching Guide (TG), and creation of adoptable lesson plan templates, teachers need to contextualize their instructional materials to enhance the teaching process and learners' learning. The various sectors of the local education system in the Province of Iloilo are highly encouraged to explore and give alternative strategies of contextualization for Biology teachers in the senior high school curriculum.

Teachers/facilitators of Senior High School (SHS). The output of this study is highly recommended for use, critique and improvement for local teachers (especially of District I-V of the Department of Education, Division of Iloilo) to facilitate their teaching delivery for difficult topics in Biology II for Grade 12 STEM. Soft copies through Department of Education, Schools Division of Iloilo should be available for access to those in need. It is also highly encouraged that teachers handling biology II for STEM tract should engage themselves win professional development.

The Department of Education(DepEd). It is also highly recommended that the DepEd critique the output of this study to see its applicability to other provinces and regions. The Department of Education may use this analysis phase of ADDIE model to enrich instructional materials, adopt it and recommend it for national level instructional consumption/ utilization. Also, given the implications of surfaced topic difficulties, DepEd increase their support for teachers to engage in additional / continue professional development.

Students/Learners. To deal with the constant change in the needs of learners in the adaptation of the new curriculum, it is recommended that students, using the output of this study should take part in critiquing the existing contextualization of their science lessons.

Curriculum Developers/Experts. With consideration of the results in this study, new insights from the output of this study should be extended to curriculum developers and experts in enhancing the approach to this subject Biology II of SHS STEM.

Researchers. Researchers may make use of the findings of this study as baseline in developing their own ADDIE instructional material design.

This data for difficult topics in Biology II may serve as baseline and stimulus to allow teachers to adopt or modify the their instructional materials or lesson plans and approaches into higher forms of subject delivery through their own improved contextualized, localized, and indigenized instructional materials.

5. Conclusions

Senior high school (SHS) biology teachers find genetics the most familiar topic and systematics the least familiar. Regarding skills, two topics from genetics, two from evolution, and one from systematics came out as the top 5 most challenging learning competencies to teach. The teachers in the newly introduced K to 12 Grade 12 Biology STEM are adjusting to the new level of subject content and, simultaneously, converting teaching strategies into effective ones through the preferred concept of contextualization (localization or indigenization). SHS Biology teachers come from diverse backgrounds upon entry to the SHS curriculum and have a positive outlook. Their diversity in background can enrich their teaching strategies for Biology contextualization. The study results

showed that more training and workshops are required and recommended to enhance the knowledge and skills of Biology Teachers in the four identified major complex topics.

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