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Mastery Level of the Biology Tenth Graders: Basis for Remedial Instruction

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Abstract. This study aimed to determine the mastery level in different Biology competencies of tenth graders in one of the public high schools in Misamis Oriental, Mindanao, Philippines, and to determine the competencies not mastered, least mastered, nearly mastered, and mastered to serve as the basis for remedial instruction. Grade 10 learners were purposively sampled. Across all grade levels, there was a lack of mastery in biology competencies. The overall mean percentage score of 56.05 (least mastered) indicates difficulty in meeting the desired outcomes. The obtained score indicates a lack of mastery in the following general topics: animal and plant parts and functions, heredity, biodiversity and evolution, and ecosystem. When grouped according to gender, male and female students do not differ significantly in their mastery level. This finding could imply that biology topics are equally difficult for male and female students. Based on the results, it can be deduced that there was a lack of mastery in biology competencies indicating difficulty in meeting the desired mastery level set by the Department of Education. The Grade 10 and Grade 7 biology competencies in the K to 12 science curriculum most essential learning competencies gained the lowest mastery. Students' prior knowledge of the subject is relatively poor. The best score, and that non-mastery and low mastery of students from the previous grade level resulted in no mastery to low mastery in the succeeding year levels, which was exacerbated during the pandemic when there is limited face-to-face interaction and modular learning is the mode of instructional delivery. Based on the findings and conclusions of the study, the researcher suggests developing contextualized learning modules and strategic intervention materials that can be used for remediation.

Keywords: -

1. Introduction

1.1 Background of the Study

Despite the government's efforts to implement the curriculum, student performance in national and international exams continues to deteriorate. Around twenty-two percent (22%) of Filipino students obtained a Level 2 or higher in the examination according to PISA 2018 results. These students can recognize the proper explanation for widely known scientific occurrences and phenomena and could use that knowledge to assess whether a conclusion drawn from given facts is accurate. Almost no student could perform at level 5 or 6 as a highly competent scientist. These students are capable of independently

applying their scientific knowledge to a variety of problems [1]. Low exam performance may imply that the information presented is not sufficiently retained in subsequent years of study and, as a result, is not transferred for general use in life. One issue that frequently affects science students is their lack of scientific content knowledge, most notably in biology. A study found that helping students advance their knowledge of subjects like biology presents the biggest challenge for teachers. They stated that a variety of elements, including students' prior knowledge, intelligence, and motivation, have an impact on these challenges [2]. Teacher-respondents observed that students have difficulty recalling concepts learned in previous grades. Respondents believed that the student's knowledge of the subject was shallow [3]. This is related to the investigation which demonstrated that vertical enunciation was difficult to follow in all areas of science because students would generally forget what they had learned in the previous grade level [4].

This raises many concerns that must be addressed to improve students' performance. The implementation of the new science curriculum resulted in changes on the part of school administrators, teachers, and, most importantly, students. Among the issues mentioned by teachers were students' mastery of the subject matter and retention of knowledge obtained. The spiral approach used in science creates confusion for students, particularly during the transition of topics at each grade level, which is one of the challenges faced by both teachers and students. When compared to one subject of focus such as the design of the disciplinal approach, the students appeared to struggle with focusing on four (4) areas in a year as a spiral approach. Because the four areas of science were to be taught in one year, the students perceived the division of topics for each area as a challenge. They find it difficult to adjust to shifting lessons from quarter to quarter or grading period, possibly due to the limited time in each quarter, which affects their academic standing [5].

The case described above prompted the researcher to conduct this study to determine the mastery level of students in different Biology competencies and identify which are not mastered, least mastered, nearly mastered and mastered that will serve as the basis for implementing intervention programs and in developing instructional and remediation materials. This study aimed to provide school administrators and educational planners with the baseline data required for better planning and decision-making for improving curriculum implementation and formulating programs and activities that could lead to mastery of the most essential learning competencies in science, particularly in Biology, and assist teachers in becoming aware of the recurring not mastered and least mastered competencies that must be given more emphasis and consideration. This will assist science teachers in focusing on the major and specific skills or competencies that need to be addressed.

2. Objectives of The Study

The study's main purpose was to determine the mastery level and ascertain the not mastered, least mastered, nearly mastered, and mastered competencies in Biology of tenth graders of a public school in Misamis Oriental. In line with the goal of the study, the study sought to determine the level of mastery of respondents in Grades 7,8,9 and 10 Biology competencies; determine the overall mastery level of JHS in Biology competencies; and find out if a significant difference exists in the mastery level of G10 students in terms of gender.

3. Materials and Methods

The study used a descriptive-survey research design using a survey questionnaire as the primary data collection tool to describe mastery level and the not mastered, least mastered, nearly mastered, and mastered abilities of Biology students. A descriptive research design tries to explain what, how, or why something happens. A survey research

design is a form of research design in which surveys are used as the primary technique of data collecting. In this study design, researchers use surveys as a method to acquire a better understanding of individual or group viewpoints on a given concept or issue of interest.

The study's respondents were 160 Grade 10 students from one of the high schools in Misamis Oriental, Mindanao, Philippines, with 82 males and 78 females selected using purposive sampling. The students did not suffer any harm physically or emotionally as a result of their participation in the study. The researcher respected the respondents' preferences and never used their names in the study. The responses of the students were kept totally confidential.

The content-validated instrument was used to measure overall mastery as well as mastery of the most important learning abilities in biology. The test consisted of forty (40) questions based on the Department of Education's curriculum guide for core learning competencies. The questions were organized in a spiral fashion, with elements arranged in increasing difficulty order. The responder was given four options in a multiple-choice test administered by the researcher. The performance test is developed in four stages: planning, test item preparation, pilot testing, and instrument evaluation.

The objectives considered by the researcher in developing the test were drawn from the Department of Education's most essential learning competencies (MELCs). Essential learning competencies are described as what students require or deem indispensable in the teaching-learning process to develop skills that would prepare learners for succeeding grade levels and, eventually, for lifetime learning [6]. Desirable learning competencies, on the other hand, were defined as those that may improve education but are not required for the development of foundational skills. The focus of the test is on mastery level in relation to the study's objectives. To make sure that all competencies are represented, the researcher used a two-way grid table of specifications that included the content areas, number of test items, placement of each item, and the percentage of each item. The test items were then distributed among the test's topics.

The researcher used a multiple-choice test to choose the proper item format, which comprised a problem and a list of possible answers. The elements were either stated directly as a question or as an incomplete statement. The researcher used the Department of Education's current printed scientific modules and textbooks to frame things for the various competencies.

One hundred sixty (160) tenth graders from the same school who were not actual participants were asked to participate in the test tryout. Tenth graders who had completed all of their biology skills were given a questionnaire and instructed to encircle the letter that related to the correct answer. Following the scoring of the test papers, each item was analyzed by estimating its difficulty, assessing its discriminating power, and determining the effectiveness of each choice. Item difficulty and item discrimination are widely employed as test item selection and refining criteria. The Upper-Lower Index Method was employed to analyze test items.

The researcher then proceeded to analyze the instruments by evaluating the research instrument's validity and reliability index after administering and scoring the final version. When constructing this test, the researcher based the test items on the curriculum guide and manuals used for this subject. Jury validation was used in this investigation. Experts in biology, science education, and assessment were asked to use a rubric to analyze each test item to see if it reflected what the test was designed to measure. PSPP was used to compute the Cronbach Alpha reliability test. With a Cronbach's Alpha coefficient of 0.81, the instrument was determined to have acceptable internal consistency.

Permission was acquired from the School Head's office to administer the research instruments to the target respondents during the study. Following the issuance of the permit, the researcher duplicated the surveys and distributed them to Grade 10 students. The study instrument took approximately a week to conduct and recover. After that, the

questionnaires were collected and checked, and the results were counted, tabulated, analyzed, and interpreted. The score and its interpretation below were used to describe performance, overall mastery level, and mastery in each competency.

Table 1. Descriptors for performance

Descriptors	Range
Outstanding	90-100
Very Satisfactory	85-89
Satisfactory	80-84
Fairly Satisfactory	75-79
Did Not Meet Expectations	74 Below

Reference: DepEd Order No. 8, s. 2015

Table 2. Mastery levels and percentage equivalent

Mastery Level	Percentage Equivalent
Mastered	80-100
Nearly Mastered	75-79
Least Mastered	51-74
Not Mastered	50 and below

Reference: DepEd PPST - Module 11

4. Results and Discussion

Table 3 shows low mastery in Grade 7 Biology competencies with an overall mean percentage score of 51.71 % (least mastered). The highest percentage of correct response was acquired in the indicator on differentiating the different biotic and abiotic components of an ecosystem (76%) which is interpreted as "nearly mastered**"**. Least mastery was observed on the following indicators: Identifying the parts of the microscope and their functions (57%), describing the different ecological relationships found in an ecosystem (58%), and differentiating asexual and sexual reproduction (63%) Three competencies were not mastered by respondents. This includes differentiating plant and animal cells according to the presence or absence of certain organelles (27%), explaining why the cell is considered the basic structural and functional unit of all organisms (41%), and describing different levels of biological organization from cell to biosphere (40%).

The low mastery of students in grade 7 biology competencies is in identifying the parts of the microscope and focusing specimens using the compound microscope. The teacher's prohibition on using a microscope, the student's lack of interest, poor retention ability, poor conceptual understanding, and lack of knowledge on handling laboratory apparatuses are all reasons for the students' low mastery [7]. The overall percentage score of 57.71 indicates that students have the least mastery of Grade 7 Biology competencies.

Table 3. Mastery Level of Tenth Graders in Grade 7 Biology competencies

Skills Tested	Frequency of error	%	No. of correct responses	%	Mastery Level
Identify parts of the microscope and their functions	69	43	91	57	**Least Mastered**
Differentiate plant and animal cells according to presence or absence of certain organelles	117	73	43	27	**Not Mastered**
Explain why the cell is considered the basic structural and functional unit of all organisms	95	59	65	41	**Not Mastered**
Describe the different levels of biological organization from cell to biosphere	96	60	64	40	**Not Mastered**
Differentiate asexual from sexual reproduction in terms of: 1 Number of individuals involved. 2 Similarities of offspring to parents	59	37	101	63	**Least Mastered**
Differentiate biotic from abiotic components of an ecosystem	38	24	122	76	**Nearly Mastered**
Describe the different ecological relationships found in an ecosystem	67	42	93	58	**Least Mastered**
Mean Percentage Score				**51.71**	**Least Mastered**

Legend : Not mastered(50 % below), Least mastered (51-74%), Nearly Mastered (75-79%), Mastered (80-100%)

The respondents showed the least mastery in Grade 8 biology competencies with an overall mean percentage of 62.44 as shown in table 5. The highest mean was acquired on explaining ingestion, absorption, assimilation, and excretion (76%) classified as “nearly mastered”. One competency was not mastered by students and that is on explaining the concept of a species (47%). The least mastered competencies are on explaining the advantage of high biodiversity in maintaining the stability of an ecosystem (56%), describing the transfer of energy through the trophic levels(58%), analyzing the roles of organisms in the cycling of materials(59%), comparing mitosis and meiosis, and their role in the cell -division cycle (60%), predicting phenotypic expressions of traits following simple patterns of inheritance (64%), classifying organisms using the hierarchical taxonomic system (68%), and explaining the significance of meiosis in maintaining the chromosome number (74%).

Table 4. Mastery Level of Tenth Graders in Grade 8 Biology competencies

Skills Tested	Frequency of error	%	No. of correct responses	%	Mastery Level
Explain ingestion, absorption, assimilation, and excretion	39	24	121	76	**Nearly Mastered**
Explain the significance of meiosis in maintaining the chromosome number	41	26	119	74	**Least Mastered**
Compare mitosis and meiosis, and their role in the cell -division cycle	64	40	96	60	**Least Mastered**
Predict phenotypic expressions of traits following simple patterns of inheritance	57	36	103	64	**Least Mastered**
Explain the concept of a species	85	53	75	47	**Not Mastered**
Classify organisms using the hierarchical taxonomic system	51	32	109	68	**Least Mastered**
Explain the advantage of high biodiversity in maintaining the stability of an ecosystem	71	44	89	56	**Least Mastered**
Describe the transfer of energy through the trophic levels	67	42	93	58	**Least Mastered**
Analyze the roles of organisms in the cycling of materials	65	41	95	59	**Least Mastered**
Mean Percentage Score				**62.44**	**Least Mastered**

Legend : Not mastered(50 % below), Least mastered (51-74%), Nearly Mastered (75-79%), Mastered (80-100%)

Meiosis, mitosis, and genetics are examples of biological concepts that secondary school students found difficult [8,9]. Students' inadequate competence can be attributed to a lack of interest in the subject, insufficient discussions, poor grasp of concepts, poor recall, a lack of prior knowledge about the topic, and a dislike of science lessons [7].

Table 5. Mastery Level of Tenth Graders in Grade 9 Biology competencies

Skills Tested	Frequency of error	%	No. of correct responses	%	Mastery Level
Explain how the respiratory and circulatory systems work together to transport nutrients, gases, and other molecules to and from the different parts of the body	60	37	100	63	Least Mastered
Infer how one's lifestyle can affect the functioning of respiratory and circulatory systems	35	22	125	78	Nearly Mastered
Explain the different patterns of non -Mendelian inheritance	67	42	93	58	Least Mastered
Differentiate basic features and importance of photosynthesis and respiration	63	39	97	61	Least Mastered
Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment	61	38	99	62	Least Mastered
Mean Percentage Score				**64.4**	**Least Mastered**

Legend : Not mastered(50 % below), Least mastered (51-74%), Nearly Mastered (75-79%), Mastered (80-100%)

Table 5 shows a low mastery in Grade 9 Biology competencies with an overall mean percentage score of 64.4 %. The highest percentage was noted on inferring how one's lifestyle can affect the functioning of respiratory and circulatory systems (78%) which is interpreted as nearly mastered. The least mastered competencies are: explaining the different patterns of non-Mendelian inheritance (58%), differentiating basic features and the importance of photosynthesis and respiration (61%), relating species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment (62%), explaining how the respiratory and circulatory systems work together to transport nutrients, gases, and other molecules to and from the different parts of the body (63%). The general area of genetics continues to pose problems for students, and concepts in biology such as respiration, photosynthesis, physiological processes, and gaseous exchange are perceived as difficult to learn by high school students [8].

Table 6. Mastery Level of Tenth Graders in Grade 10 Biology competencies

Skills Tested	Frequency of error	%	No. of correct responses	%	Mastery Level
Explain the role of hormones involved in the female and male reproductive systems	115	72	45	28	**Not Mastered**
Describe the feedback mechanisms involved in endocrine systems regulating processes in the female reproductive system (e.g., menstrual cycle	109	68	51	32	**Not Mastered**
Describe how the nervous system coordinates and regulates these feedback mechanisms to maintain homeostasis	77	48	83	52	**Least Mastered**
Explain how protein is made using information from DNA	97	61	63	39	**Not Mastered**
Explain how mutations may cause changes in the structure and function of a protein	95	59	65	41	**Not Mastered**
Explain how fossil records, comparative anatomy, and genetic information provide evidence for evolution	67	42	93	58	**Least Mastered**
Explain the occurrence of evolution	77	48	83	52	**Least Mastered**
Explain how species diversity increases the probability of adaptation and survival of organisms in changing environments	71	44	89	56	**Least Mastered**
Explain the relationship between population growth and carrying capacity	76	47	84	53	**Least Mastered**
Mean Percentage Score				**45.66**	**Least Mastered**

Legend : Not mastered(50 % below), Least mastered (51-74%), Nearly Mastered (75-79%), Mastered (80-100%)

Lower means were obtained in the following indicators: explaining the role of hormones involved in the female and male reproductive systems (28%), describing the feedback mechanisms involved in endocrine systems regulating processes in the female reproductive system (32%), explaining how protein is made using information from DNA (39%), explaining how mutations may cause changes in the structure and function of a protein (41%). The obtained mean percentages indicate that these competencies are not mastered by students. Least mastery was also noted on competencies on describing how

the nervous system coordinates and regulates these feedback mechanisms to maintain homeostasis (52%), explaining the occurrence of evolution (52%), explaining the relationship between population growth and carrying capacity (53%), explaining how species diversity increases the probability of adaptation and survival of organisms in changing environments(56%), explaining how fossil records, comparative anatomy, and genetic information provide evidence for evolution (58%). The overall percentage score in Grade 10 biology competencies is 45.66 indicating the least mastery.

Protein synthesis, respiration, photosynthesis, water transport in plants, physiological processes, energy, oxygen transport, gaseous exchange, mendelian genetics, organs, hormonal regulation, mitosis and meiosis, the central nervous system, cells, and genetic engineering are just a few of the biological concepts that high school students may struggle with [8].

Table 7. Mastery Level of G10 Learners in Biology Competencies

Grade Level	Mean Percentage Score	Mastery Level	Rank
Grade 7	51.71	Least Mastered	2
Grade 8	62.44	Least Mastered	3
Grade 9	64.40	Least Mastered	4
Grade 10	45.66	Least Mastered	1
Overall Mastery	**56.05**	**Least Mastered**	

Legend : Not mastered(50 % below), Least mastered (51-74%), Nearly Mastered (75-79%), Mastered (80-100%)

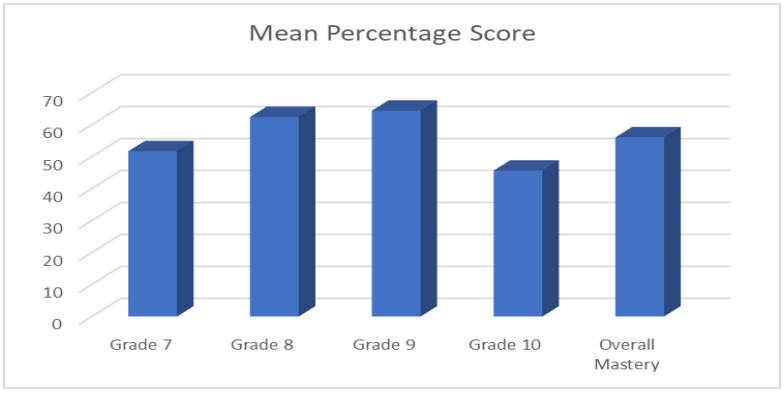

FIGURE 1. *Graphical Presentation of Grade 10 Learners in Biology*

The result showed that Grade 10 biology competencies ranked first among grade levels that obtained the lowest mastery (MPS 45.66, least mastered). The competencies at this grade level are focused on feedback mechanisms, DNA molecule structure and function, mechanisms in inheritance, natural selection, variation, impact of human activities to the environment, and biodiversity. This is followed by Grade 7 biology competencies with a percentage mean of 51.71 (least mastered). The competencies are at this grade level are on the human body, respiratory system, cell division, concept of species, and energy are on levels of organization of the human body and other organisms, reproduction, plant and animal cells, and interaction in an ecosystem.

In Grade 8, the mean percentage is 62.44 (least mastered) and least mastered competencies are on the human body systems such as digestive, respiratory, urinary and excretory systems, cell division, concept of species, energy transfer in an ecosystem. Finally, Grade 9 obtained a mean percentage score of 64.40, also least mastered. The competencies covered in Grade 9 are on digestive, respiratory and circulatory systems,

gene and chromosomes, extinction, photosynthesis and cellular respiration. Overall, the mastery level is 56.05, which indicates low mastery. However, it has to be considered that 2 years have been taught using modular learning which can be a factor of poor performance.

The most significant cause of students' difficulty in learning biology is the topic itself. The primary reasons behind this were that biology includes numerous concepts and that many biological phenomena are invisible to the human sight, that certain concepts are too abstract, and that there are many foreign/Latin terminology. Students in high school failed to understand the relationship between photosynthesis and cellular respiration, as well as the importance of enzymes in both processes [10]. Students had difficulty understanding topics like DNA replication, gene expression, and the link between genes and phenotypes [11]. Students also difficulty with evolutionary mechanisms such as natural selection and genetic drift [12]. Several difficult areas were mentioned by the teachers, including cell structure and function, genetics, and ecology. The researchers hypothesized that these difficulties were caused by the abstract nature of these concepts as well as a lack of laboratory experience [13]. Students' capacity to understand other biological ideas may be hampered if they lack conceptual comprehension in certain areas. Furthermore, biology as a discipline encompasses a wide range of topics, concepts, and issues that students must master. The non-mastery least mastery in most competencies implies that these must be regarded priority areas or major and specific skills and competencies that must be targeted to improve mastery [8].

Table 8. Differences in Mastery Level when Grouped according to Gender.

Gender	N	Mean	Standard Deviation	t-value	p-value	Remarks
Male	82	20.50	3.73	-3.05	.544	Not significant
Female	78	22.26	3.55			

The test gave a t-ratio of -3.05 at p = 0.544 when the t-test for independent mean was performed to evaluate significant differences in the proficiency level in combined Junior High School Biology abilities when grouped by gender. Because the obtained p-value is greater than the 0.05 level of significance, the hypothesis that there are no significant differences in the mastery level of tenth graders when grouped according to gender is accepted, implying that male and female students' mastery levels are not significantly different. This finding could imply that male and female students struggle equally with biological studies. This proves that gender has no effect on students' perceptions of difficult Biology topics. Gender has no statistically significant effect on the difference in performance between males and females [14].

5. Conclusion and Recommendations

The study determined the mastery and performance of tenth graders in the biology competencies based on the different grade levels from grade 7 to grade 10. The not mastered, least mastered, and mastered competencies were also identified. The Grade 10 and Grade 7 biology competencies in the K to 12 science curriculum most essential learning competencies gained the lowest mastery. Mastery levels of Junior High School completers when grouped according to gender do not differ significantly. Mastery level indicates that students were not able to meet the expectations as a result of low mastery in various competencies. Results suggest that prior knowledge of the subject is somewhat relatively poor as revealed by the mean score of the test and non-mastery and low mastery

of students from the previous grade level resulted in no mastery to low mastery in the succeeding year levels which was also worsened during the pandemic where there is limited face to face interaction and modular learning is the mode of instructional delivery.

Based on the findings and conclusions of the study, the researcher suggests developing contextualized learning modules that can be used as one of the interventions in the implementation of the Learning Recovery Plan to increase the level of performance of students and to supplement and augment the delivery of teaching during the pandemic. Teachers can use inquiry-based and hands-on learning activities to help students improve their science skills and reduce the difficulty of the subject matter. Teachers can engage students in a variety of stimulating activities to completely engage them in the science learning process. Students may be given exercises, drills, and brain workouts based on scientific concepts and principles to increase recall. Teachers might plan activities to probe students' prior knowledge and solicit alternative perspectives and misconceptions. Science teachers could use the proposed instructional intervention to help learners learn science more effectively. Administrators may look into the least mastered competencies of the students in biology during the COVID-19 educational disruption. The most essential learning competencies (MELCs) identified by the Department of Education (DepEd) may also be used as a framework to identify the least mastered competencies in biology.

While the findings identified the learners' least mastered competencies and mastery level, there are some limitations that could serve as an avenue for future research. First, the study's findings are limited to the population under study. This may not completely represent or speak for the performance of other Senior High Schools and their lack of biology competency because performance and mastery can be affected by a variety of factors both inside and outside of school, such as student characteristics, teacher effectiveness, and motivation, among others. As a result, it may be worthwhile to broaden the scope of the study to include other senior high schools, both public and private, to validate the consistency of the results. Second, the tool that included multiple-choice questions may not have captured the students' learning as well as a more comprehensive set of questions in other test formats. Finally, using qualitative methods may provide a better and richer understanding of the underlying reasons why students struggle with a specific biology learning competency.

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