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## RESEARCH ARTICLE

### UNCOVERING THE MOST PREFERABLE TEACHER'S PEDAGOGICAL CONTENT KNOWLEDGE FOR THE ASSESSED MOST DIFFICULT SCIENCE CONCEPT IN GRADE 10 QUARTER III

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#### ABSTRACT

**Background:** Declined test scores, performances and the increasing difficulty in science concepts among students is one of the major problems in Philippine education. Department of Education surveys found out that one of the subjects where lower test scores are seen is science. However, despite the efforts of the educational sector, difficulties are still arising and the educational sector are still searching for ways and actions to address the problem. **Objectives:** The objective of this research is to explore the most preferable Pedagogical Content Knowledge as a way of addressing the assessed most difficult science concept among the five public secondary schools in Roxas, Isabela, Philippines. **Methods:** The study utilizes a descriptive-correlational approach in research as it describes and correlates the data gathered from the respondents to establish the basis on finding the most preferable Pedagogical Content Knowledge in addressing the difficulty found among the science concepts. Participants of the research are five (5) teachers and one hundred fifty (150) students across the selected public secondary schools in the municipality of Roxas. **Results:** The research reveals Coordinated Functions of the Reproductive, Endocrine, and Nervous Systems as the most difficult science concept in Grade 10 Quarter III. Moreover, the research also presents a significant relationship between the performance of the students and the pedagogical content knowledge of their teacher, and that Teacher C utilizes the most preferable Pedagogical Content knowledge in teaching the assessed most difficult science concept. **Conclusions:** The Educational sector should consider the pedagogical content knowledge among teachers in reforming, making and developing a curriculum which would cater the arising difficulties in sciences. Results could also be used as a basis on developing programs and seminars to boost and improve the teaching styles and strategies of teachers in teaching sciences.

#### INTRODUCTION

One important factor that has an impact on society is education, which people to fit into the many roles that exist in society. A successful life and even economy are considered as being largely dependent on education and in order to provide the greatest curriculum possible in keeping with societal demands, both the public and private sectors work together. Despite the aforementioned benefits of education, pupils still do not understand its significance and as a result, the achievement exams administered by the educational sectors have seen a fall in test scores and science is one of the main courses given with poor exam results.

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Lower accomplishment scores were also noticeable, notably in primary and secondary surveys supplied by the department of education. The National Center for Education Statistics' highlighted students' performance on international assessments such the Trends in International Mathematics and Science Study (TIMMS) 2004 and 2008 is comparable to the results of the Department of Education's survey (DepEd). Science disciplines in both elementary and secondary school had the lowest PST scores, according to the Philippines Public Education Expenditure Tracking and Quantitative Service Delivery Study (PETS-QSDS), which was financed by the World Bank and Australian Aid in 2016. As a result, a large number of academics, teachers, and other education specialists diligently seek to boost students' interest in science by looking at a variety of aspects and approaches, thereby providing important insights into scientific instruction. The awareness of instructors' instructional material is one of the ideas they have looked at. The most effective analogies, illustrations, examples, explanations, and demonstrations - in other words, the ways of representing and formulating the subject that make

it understandable to others - are included in pedagogical content knowledge (PCK). It also includes an understanding of what makes the learning of particular topics easy or difficult: the conceptions and preconceptions that students of different backgrounds have. No matter how hard education researchers try to identify the best PCK, there are still a number of scientific topics that are tough for students to understand. In order to respond to the problem, the researcher chose to identify the most challenging scientific topic and investigate the pedagogical content knowledge of the instructors employed in a few public high schools near where she lives. As a result, the researcher conducts this study to address the issues and challenges that students face when learning science concepts. To do so, the researcher identifies the most challenging concept in quarter three of grade 10 science, examines the pedagogical content knowledge, and determines which PCK is most preferred by the science teachers of the chosen public high schools in the study. The research specifically aims to address the following questions;

- What is the most difficult science concept in Grade 10 Quarter III as reflected in the number of passers in each class performance tasks?
- What is the most preferable Pedagogical content knowledge in teaching the most difficult science concept as reflected in the number of passers in each class/section?
- Is there a significant difference in each class' average performance tasks scores across the five classes/sections?
- Is there a significant relationship between the difficulty of science concept in each class and the teacher's PCK used?

Thus, evaluating and knowing whether instructors' PCK actually affects students' comprehension which may be the root of any problems that arise might lead and might become a basis in creating several strategies and resource materials that will improve quality of education and raise student's level of understanding in studying science.

## MATERIALS AND METHODS

**Design:** The study utilizes a descriptive-correlational research design. The researcher uses a descriptive design on showing, describing and summarizing data obtained in a survey questionnaire, the CoRe (Content Representation), designed to gather responses from the teacher respondents in evaluating their pedagogical content knowledge (PCK) in teaching biology, in the organized checklist of science concepts for Grade 10 Quarter III, and the rubric which is used to describe the responses in the CoRe instrument. Furthermore, the correlational part of the study is used in obtaining answers for third and fourth statements of the problem of the research, testing the significant differences across class' average quiz scores and significant relationship of the teachers' PCK and difficulty of science concepts in each class.

**Environment:** The research is conducted among the five (5) public secondary schools in Roxas, Isabela; School A, School B, School C, School D and School E.

**Samples and Sampling Procedures:** The participants of the study are 5 public secondary school Grade 10 science teachers, one from each of the public secondary schools included in the study, which are available during the time of data gathering; Teacher A, Teacher B, Teacher C, Teacher D, and Teacher E. Thirty (30) students from each of the Grade 10 class of the

teacher participants are considered as secondary participants of the research, since their performance task scores from the teacher's record will be included in the study. They are selected randomly via the teacher's class records.

**Instrumentation:** The research utilized a checklist, solely based on the content of the Science Curriculum Guide, which determines the percentage of passers at a given performance task on each of the science concepts that decides the level of difficulty as perceived by the students. Moreover, the research also used the CoRe (Content Representation), proven to assess teachers' pedagogical content knowledge (PCK), which John Loughran created and was utilized in various studies. The information obtained by the CoRe is also analyzed through rubric. Lastly, the materials are all encoded on google forms and documents for easier and more efficient administration.

**Treatment of Data:** The performance task scores are summarized via finding the mean for each class. Mean score is also used to summarize the rubric in evaluating the teacher's PCK. In finding the number of students who passed the performance task in each of the class, frequency count is used. Further, ANOVA or analysis of variance is used to determine if there exists a significant difference between the mean score across the five classes. Lastly, chi-square test of analysis is used to determine significant relationship between the teacher's PCK and the level of difficulty of concepts as perceived by the students.

## RESULTS

In light with the information gathered as a result of the methodologies applied in this study, the following are the findings of the research; (a) Table 1 reveals that the total number of passers in each identified science concepts in quarter III and among the five classes varies. The variation only indicates that the level of understanding of the students differ in each concept. Moreover, the table reveals which among the concepts are perceived by the students as difficult and which is not. The scores that are obtained in each of the 5 classes are all results of the class's performance tasks, summarized and interpreted by the researcher. The scores are then assessed through frequency count, finding which among the students obtained a score half of the total points to be earned (passers) in a certain activity in each science concept. The concept of Ecosystems showed the highest number of passers (150) which only indicates that the students have the highest level of understanding in this concept. The concept of Biodiversity and Evolution and Heredity: Genetics and Variation follows with 134 and 117 number of passers respectively. However, the concept of Coordinated Functions of the reproductive, endocrine and nervous system showed the lowest number of passers which is 86 out of 150 students or 57% of the total number of respondents in this study. Therefore, the data claims that Coordinated Functions of the reproductive, endocrine and nervous system is the most difficult science concept in Grade 9 Quarter III. (b) The uncovering of the most preferable PCK among the five teachers also depend on the class with the highest number of passers in the concept of Coordinated Functions of the reproductive, endocrine and nervous system. In the data obtained, Class C where there are 26 students who passed the performance task or 87% among the class passed is the highest. Therefore, the most preferable PCK to use in teaching Coordinated Functions of the reproductive, endocrine and

**Table 1. Summary table of the total number of passers in each science concept and classes**

| CONCEPT  | Number of Passers (per class) |         |         |         |         | Total number of passers (per concept) |
|--|-------------------------------|---------|---------|---------|---------|---------------------------------------|
|  | Class A                       | Class B | Class C | Class D | Class E |                                       |
| A.Coordinated Functions of the Reproductive, Endocrine, and Nervous System | 18                            | 15      | 26      | 16      | 11      | 86                                    |
| B.Heredity: Inheritance and Variation                                      | 30                            | 30      | 18      | 15      | 24      | 117                                   |
| C.Biodiversity and Evolution   | 20                            | 30      | 30      | 28      | 26      | 134                                   |
| D.Ecosystems   | 30                            | 30      | 30      | 30      | 30      | 150                                   |

**Table 2. Responses of Teacher C obtained from the CoRe instrument**

| Coordinated Functions of the Reproductive, Endocrine, and Nervous System               |  |   |   |   |
|--|--|---|---|---|
|  | 1. Parts of the reproductive system and their functions  | 1. Parts of the reproductive system and their functions | 1. Parts of the reproductive system and their functions | 1. Parts of the reproductive system and their functions |
| What you intend the students to learn about this idea                                  | <ul style="list-style-type: none"> <li>The processes of fertilization, development and birth</li> <li>The structure of male and female reproductive system and their function</li> <li>Transmission, prevention and treatment of STD</li> <li>The events during the female reproduction cycle</li> <li>How hormones take part in reproduction</li> <li>The role of Nervous System and its parts</li> <li>Coordination and regulation of the Nervous system</li> <li>The Sense organ transmission of nerve impulse through different receptors</li> </ul> |   |   |   |
| Why is it important for students to know this  | <b>For them to:</b> <ul style="list-style-type: none"> <li>Give importance and care for the reproductive system</li> <li>Advocate the preservation of life</li> <li>Know the function of hormones in the body</li> <li>Understand how humans undergo developmental changes</li> <li>Give importance of the nervous system and the senses in responding to the situation</li> </ul>   |   |   |   |
| What else you might know about this idea (that you don't intend students to know yet)  | <ul style="list-style-type: none"> <li>Artificial reproduction</li> <li>Ways on how to prevent reproduction</li> <li>Other factors to maintain homeostasis</li> <li>Using Stem cell to replenish worn out nerve cell</li> </ul>  |   |   |   |
| Difficulties/limitations connected with teaching this idea                             | <ul style="list-style-type: none"> <li>Upon teaching reproduction, we must use decent words</li> <li>Introduce the new vocabulary for the student to perceive/interpret the lesson</li> </ul>  |   |   |   |
| Knowledge about students thinking that influences your teaching of this idea           | Curiosity of the youth in sex education<br>Why do we react /respond when we feel pain etc.   |   |   |   |
| Other factors that influence your teaching of this idea                                | Treasuring one's life<br>Teach the youth the responsibilities of a parent<br>Comprehend how reflexes works   |   |   |   |
| Teaching procedures (and particular reasons for using these to engage with this idea). | KWL chart to caters what the student know what they want to know and what they learn after the given topics, Organizing graphically / using Audiovisual presentation such as video to provide students pictorial representation of the major points in the given topics  |   |   |   |
| Specific ways of ascertaining students understanding or confusion around this idea     | <ul style="list-style-type: none"> <li>Asking 5 higher- order thinking questions related to the content/ Pair up and talk about the ideas in the lesson/ Paper and pencil evaluation</li> </ul>  |   |   |   |

**Table 3. Summary/Mean Scores of performance tasks in each class**

|         | Average in Percentage |         |         |         |         |
|---------|-----------------------|---------|---------|---------|---------|
|         | Class A               | Class B | Class C | Class D | Class E |
| Average | 84                    | 87.22   | 88.21   | 63.37   | 63.75   |

**Table 3.1 Test of Difference across five classes (Table 2)**

| ANOVA          |                |     |             |        |      |
|----------------|----------------|-----|-------------|--------|------|
| average        |                |     |             |        |      |
|                | Sum of squares | df  | Mean Square | F      | Sig. |
| Between Groups | 19205.267      | 4   | 4801.317    | 51.864 | .000 |
| Within Groups  | 13423.419      | 145 | 92.575      |        |      |
| Total          | 32628.686      | 149 |             |        |      |

**Table 4. Test of Relationship between the Difficulty of science concept and the Teacher's PCK**

| Chi-Square Tests                   |                     |    |                       |                      |                      |
|------------------------------------|---------------------|----|-----------------------|----------------------|----------------------|
|                                    | Value               | df | Asymp. Sig. (2-Sided) | Exact Sig. (2-Sided) | Exact Sig. (1-Sided) |
| Pearson Chi-Square                 | 50.000 <sup>a</sup> | 1  | .000                  |                      |                      |
| Continuity Correction <sup>b</sup> | 47.531              | 1  | .000                  |                      |                      |
| Likelihood Ratio                   | 67.301              | 1  | .000                  |                      |                      |
| Fisher's Exact Test                |                     |    |                       | .000                 | .000                 |
| Linear-by-linear Association       | 49.667              | 1  | .000                  |                      |                      |
| N of Valid Cases                   | 150                 |    |                       |                      |                      |

a.0 cells (.0%) have expected count less than 5. The minimum expected count is 20.00. Computed only for 2x2 table

prior knowledge which was then supported by what Lawless (2019) says in her article. Teacher C is also aware of what is difficult to teach and what limits his/her teaching allowing him/her to know which should he/she be focusing and learning more in order to successfully teach it because presenting knowledge clearly and helping students learn can only happen if and only if teachers possess more than extensive knowledge of subject matter (Feiman -Nemser, 2020). According to Shulman (1986) in an article by Cochran, pedagogical content knowledge contains the aspects of content most relevant to its teachability where teachers are able to relate the things they already know about teaching and what they already know about what they are teaching, therefore having a good PCK as of teacher C is necessary to make learning meaningful. The study also proved that the five classes differ in students' level of understanding which proves how the five teachers have varying styles of teaching and motivating students. The differences obtained implies a lot of reasons why and one is the presence of different teaching strategies employed by the teachers in the different classes to reach diverse learners (Stephens, 2015) since teaching causes a desirable change in every learner (Physics catalyst, 2018). In addition, study also found out that the students' performance is associated or have a significant relationship with the teaching style or the teacher's PCK. Evaluating teacher's PCK is important for it is the heart of effective content teaching (Solis, 2010).

It embodies the identification of what makes specific concepts difficult to learn, the conceptions of the students, and the teaching strategies applicable to a specific teaching situation. In an article by Silva (2020), among the 8 factors that affect student's motivation which plays a large role in student's performance and results is teacher behavior and personality and teaching methods. A number of causes and influences lead to varying performance of students when it comes to learning; school conditions; other teachers' influence (previous and current subject teachers, tutors & specialists); curriculum materials; class size and other factors, but the teacher plays a major role in motivating learners to achieve high performance in school (Shavelson, Linn, Baker, et.al., 2010). Good and effective teaching concerns the students' general development (Barberos, Gozalo, & Padayogdog, 2020). Teachers must be able to consider individual differences, adjust instructions, responsible to a range of complex to simple jobs, and understand the need to be motivated in order to motivate the learners inside the classroom. Moreover, when students are motivated, learning can easily take place and would result to higher performances in the classroom. In a study by Olfos, Goldrine & Estrella (2014), it was proven that the constructivist-oriented approach of the content knowledge of the teacher and socioeconomic factors both showed a significant association with student learning, however, the teacher's experiences did not.

## Conclusion

The alarming difficulty of science concepts determined by the underlying decline of test scores in sciences in many studies and in the surveys performed by DepEd is one of the battles that the Philippine Educational sectors are still facing right now. They are striving to find ways on researching student difficulties and looking for ways to address it, however, despite their efforts in solving this problem, difficulties are still arising. This the main reason why the researcher made the research possible. The study revealed a difficulty which occurred in one of the sciences (BIOLOGY) concepts covered

in Grade 10 Quarter III among the secondary public high schools in Roxas. This finding can be used as a guide for the teachers, the administrators and even the DepEd authorities as to where and how to boost the level of understanding of students and even improve the teaching styles and review the curriculum itself. The study did not end with finding the most difficult science concept itself. It also proven that the performance of the teachers has an effect on the performance of their students, though a lot more surely have an effect (socioeconomic status, influence of a previous or current teacher, interest and many others). It is for this reason that the researcher also studied the different pedagogical content knowledge of the teachers hoping to suggest a more preferable teaching style that could have a positive effect on student understanding and performance, to the teacher respondents and school administrators as well. Moreover, the proven varying levels of understanding of students determined by the significant difference of the performance task scores from each class with different teachers in the study could also be an important insight to the teachers and administrators that proves how teaching styles could have a great impact on learner's level of understanding. The same concept could be easy, or difficult and even both easy and difficult for a class, depending on the way it was taught to them. In general, the study and its findings could give an advantage to the students, the science teachers, the school administrators, and even the DepEd authorities because it helps in identifying difficulty among the students, be able to find a factor that possibly caused it and suggest a basis as to how to improve the current curriculum and strategy they are utilizing. The study can be a basis of choosing what kind of instructional material to use in teaching the most difficult science concept, how to make it even more interesting to students, how to make it look more motivating, and how to use it in a way where the concept could be taught effectively which can help in making progress when it comes to student performances.

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## Glossary of Abbreviations

ANOVA- Analysis of Variance  
CoRe- Content Representations  
DepEd- Department of Education  
PCK- Pedagogical Content Knowledge

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