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The Teaching of Science: The Content and The Appropriate Pedagogy and Approaches

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Abstract — This research delves into the multifaceted realm of science education, exploring the integral components of content, pedagogy, and teaching approaches, while underscoring the necessity of continuous teacher training through a survey-questionnaire using google forms, on how to keep abreast of the new era of becoming an effective and competitive science teacher. Majority, among others, collaborative learning, demonstrations and experiments and integration to real-life examples prevailed as the appropriate pedagogies and teaching approaches in science. That the appropriate strategies have an observable impact to learners and one must consider the environment as conducive for learning. Moreover, that upon the level of familiarity of the teachers in utilizing science equipment, teachers' motivation prevails among others. To capacitate teachers in teaching science, the most prevalent training needed is the pedagogical training of teachers. The researchers did not employ sampling techniques. The collection of data was undergone through google forms which was automatically tallied in graphical presentation.

Keywords — Teaching of Science, Pedagogy, Content, Approaches, Trainings

I. Introduction

The teaching of science involves both the content and the appropriate pedagogy and approaches. The content should cover fundamental scientific concepts, theories, and practical applications, while the pedagogy should focus on engaging students through hands-on activities, experiments, and critical thinking exercises. Incorporating real-world examples and encouraging inquiry-based learning can enhance students' understanding and interest in science. Additionally, using technology and multimedia resources can further enrich the learning experience and foster a deeper appreciation for the scientific method. The goal is to make science accessible, relatable, and enjoyable for students of all ages.

Schaefer (1979) argues that if the concepts taught at school are not related to students' everyday lives, they may fail to use them adequately outside the school. Thus, their knowledge may remain in the form of acquired isolated knowledge 'packages'. Effective learning requires students to apply newly acquired concepts or skills to different contexts (Schollum and Osborne, 1985; Wallberg, 1991; Good and Brophy, 1994; Gallagher, 2000; Yip, 2001). As a result, they can achieve higher learning outcomes and use their knowledge or skills to solve the problems in their everyday life. For these reasons, teachers should create opportunities that allow students to apply their knowledge to real life situations. Gallagher (2000, p.313) suggests that teachers should:

"*...identify practical applications of concepts, use practical experiences and applications to make connections between concepts and 'real world' experiences in ways that enrich understanding of concepts, and show how knowledge of one set of concepts forms the foundation for learning about other concepts*."

Kozoll (2020) explains that the construction of a science teaching identity that relies on both personal and professional contexts, and considers experiences with science across time, offers deepened insight into teachers' use of reform-based science teaching practices. Schwab (1958) reiterates that the formal reason for a change in present methods of teaching the science lies in the fact that science itself has changed. A new view concerning the nature of scientific inquiry now controls research. Bybee (2010) cites the importance of teachers' understanding the nature of scientific knowledge and their students' roles in learning science. It centers on the science teacher and has direct implications for professional development.

When it comes to science education, it is essential to focus on both content and appropriate teaching methods and approaches. Content should be comprehensive and cover key scientific concepts and theories. This allows students to have a solid foundation in scientific knowledge. Content should also be presented in a way that is engaging and accessible to learners of all levels. This can be achieved through the use of hands-on experiments, real-life examples, and interactive multimedia resources.

Rudolph (2019) believes that no one would doubt, certainly, that students are taught something different now compared to what they were taught two centuries ago. But the most significant changes have come not in the way most of us might think. To be sure, the steady march of scientific research over the years has added even more content knowledge to student textbook. The latest concepts, models and theories about the natural world are now taught in place of the less refined ideas of the past- and so there's more to know and more accurate science for students to master than there used to be.

The science of learning has made a considerable contribution to our understanding of effective teaching and learning strategies explains Weinstein, Y., Madan, C.R. & Sumeracki, M.A. (2018). This is important for teachers to help students construct their own understanding and knowledge. This requires teachers to help students activate their existing ideas and conceptions, be aware of them and in the light of scientifically accepted knowledge, modify, change or develop them further explains ÇİMER (2007). According to Oh and Oh (2010) in the science classroom, not only teachers but also students can take advantage of models as they are engaged in diverse modelling activities. The overview presented in this article can be used to educate science teachers and encourage them to utilize scientific models appropriately in their classrooms.

From a pedagogical and approach perspective, it is important to use a variety of teaching methods to suit to different learning styles. This includes integrating group work, discussion, and problem-solving activities into the science curriculum. Thus, students can actively participate in

the learning process and are able to develop critical thinking and problem-solving skills. Technology can also greatly improve science education. Virtual simulations, online resources, and educational apps can provide students with a more interactive and immersive learning experience.

Students find science relevant to society, but they do not find school science interesting. Students who are interested in school science or think that school science is relevant in everyday life would like more creative activities such as brainstorming and project work. Results indicated that understanding the connection between student interest and teaching method preferences, especially interpreting interested students' desire for creative activities, are important aspects for future research discussed Juuti (2009). Mohan (2019) emphasizes that in order to import thorough understanding among the students, a science teacher should not only have adequate understanding of science but also be familiar with the process of science. Olufunke (2012) explains that science laboratory with adequate equipment is a critical variable in determining the quality of output.

Friedlander (2004) discusses on their article that the teachers were actively and personally involved in the implementation of the contents of the training program, and in personal relation with a continuously available mentor, their personal experiencing of the innovation could be expected to make their learning meaningful. Science teaching self-efficacy may be one area of importance which has been over-looked in implementing change to improve science teaching in elementary schools says Gasserts,Shroyer & Staver(1996).

Science education in general should be approached with enthusiasm and optimism. By providing students with a solid foundation of scientific knowledge and applying effective teaching methods and approaches, we can empower our students to learn throughout their lives and think critically in science.

Statement of the Problem

This study aims to assess how teachers teaches science through its content, appropriate pedagogy and approaches. Specifically, it seeks answers to the following sub-problems:

1. What are the appropriate pedagogy and approaches applied by the teachers in teaching science?
2. Does the appropriateness of the pedagogy and approaches affect the attainment of the topic or content?
3. What is the level of familiarity of the teacher in utilizing science equipment?
4. What trainings are needed to capacitate teachers in teaching science?

Scope and delimitation of the Study

This study will provide and inform the teachers of public schools and the curriculum developers about how the teachers teaches science. The teacher-respondents are the teachers who are public schools' teachers teaching science.

Significance of the Study

This study will be of great help to learner, science teachers and implementers about the teaching of science about the content, appropriate pedagogies and approaches, the familiarity of the teachers in utilizing science equipment and the needed trainings and professional development of teachers to capacitate their needs.

The result of the study can be beneficial to the following:

Learners. This will cater the learner needs to acquire the concepts and handling the science concepts and equipment.

Teachers. This will aid them the training needed to capacitate their needs in content, equipment, approaches and pedagogies.

School Administrators. This will help them to encourage their teachers to full potential to enhance the skills and professional development of teachers especially in teaching science.

Program Specialists. This will help them to create a program that capacitate and equip science teachers on teaching the content, appropriate pedagogy, approach and level of familiarity about the teaching of science,

Future Researchers. This study will further enhance and add to the research academe about the teaching of science as reference for future studies.

Gap Bridge by the Study

With the results of the study, it will add up to the research academe how teachers teach science content, the appropriate pedagogy and approaches, the level of familiarity of the teachers in handling and utilizing the science equipment and laboratory tools and the proper training for them.

II. Methodology

This includes the description of research method used. Particularly, it discusses the sampling technique, respondents of the study, sources of data, instruments to be used, statistical treatment in the analysis and interpretation of data, data gathering procedure and statistical treatment.

Research Design

Descriptive-survey method of research was utilized in this study. As pointed out by Lancy (1993), qualitative research is typically thought of a social method with a set of procedures for conducted research. Wiersma and Jurs (2005) reiterated that it is a purest sense follows a naturalist paradigm and the meaning derived from research are specific to that settings and its conditions. This approach is a holistic interpretation of a natural setting.

The researchers used this method wherein the data gathered from this study served as its basis to come up with a tool/guide in teaching science with the appropriate pedagogy and approaches.

Sources of Data

The data gathered came from the two sources- the primary and the secondary sources. The primary data was generated from the survey-questionnaire through google forms which was sent by the researchers to the teacher-respondents through shared links via messenger applications.

Related studies, books, newspapers, social media sites that are relevant to the study will be used as the secondary source.

Respondents of the Study

Respondents of the study were the Science teachers of public schools in the Philippines.

Table 1

Sample Population of the Teacher-Respondents

Name of School	Number of Teachers
School A	12
School B	8
School C	8
Total	**28**

Table 1 exhibits the teacher-respondents on the sample population. For School A nine (12) teachers, School B eight (8) teachers, School C eight (8) teachers with a total of 28 teacher-respondents.

Sampling Techniques

The researchers did not employ sampling technique, because according to Andaza, E.G., Bermudo PJ V., and Rasonabe, M.B. (2009), there is no need to sample when the target population is small. In the case of this proposed study there were only twenty-eight (28) prospective teachers and gathering and retrieving data was very easy for the researcher. (See Table 1)

Instruments

In gathering data or in conducting a research, the researchers utilized varied data gathering methods from the teacher-respondents through a survey-questionnaire using google forms which was given to the teachers of Schools A, B, and C. The first statement of problem is what are the appropriate pedagogies and approaches applied by the teachers in teaching science. The second statement of problem is the appropriateness of the pedagogy and approaches which affects the attainment of the topic or content. The third statement of problem is what is the level of familiarity of the teachers in utilizing science equipment. The fourth statement of problem is what trainings are needed to capacitate teachers in teaching science.

The instrument was personally prepared by the researchers with the assistance of their professor. The researchers revised and improved the instrument according to the professors' suggestions and recommendations. Thereafter, the researchers conducted a survey through google forms.

Data Gathering Procedure

The search for new knowledge is the layman's definition of research. In gathering and collecting data, the researchers followed some protocol. First, the researchers wrote a letter to the Dean of Graduate School to allow them to conduct the study. The researchers crafted a questionnaire with the help of research adviser for correction, critiquing, comments, suggestions and recommendations. Furthermore, the researchers finalized the set of questions and submitted it for validation. With the approved letter from the Dean of Graduate School, the researchers conducted and distributed the survey-questionnaire to the teacher-respondents.

The researchers administered the survey-questionnaire herself through google forms. Moreover, the gathered data upon its retrieval was interpreted and analyzed using statistical tools. Furthermore, the researchers determined the findings, summarized them, concluded and made recommendations. All these were used as bases for appropriate pedagogies and approaches in teaching science.

Statistical Treatment

The data was collected through google forms which will be automatically tallied according to the respondents through a graphic presentation. In order to answer the research questions, the study utilized different statistical methods.

To answer problem one about the appropriate pedagogies and approaches applied by the teachers in teaching science, researchers employed a four-point rating scale to interpret the results and calculated the average weighted mean to collect the necessary data.

Numerical	Number	Interpretation
3.50-4.00	4	Strongly Agree
2.50-3.49	3	Agree
1.50-2.49	2	Disagree
0.01-1.49	1	Strongly Disagree

To answer problem two about the appropriateness of the pedagogy and approaches affect the attainment of the topic or content.

Numerical	Number	Interpretation
3.50-4.00	4	Yes, Strongly Agree
2.50-3.49	3	Yes, Agree
1.50-2.49	2	No, Disagree
0.01-1.49	1	No, Strongly Agree

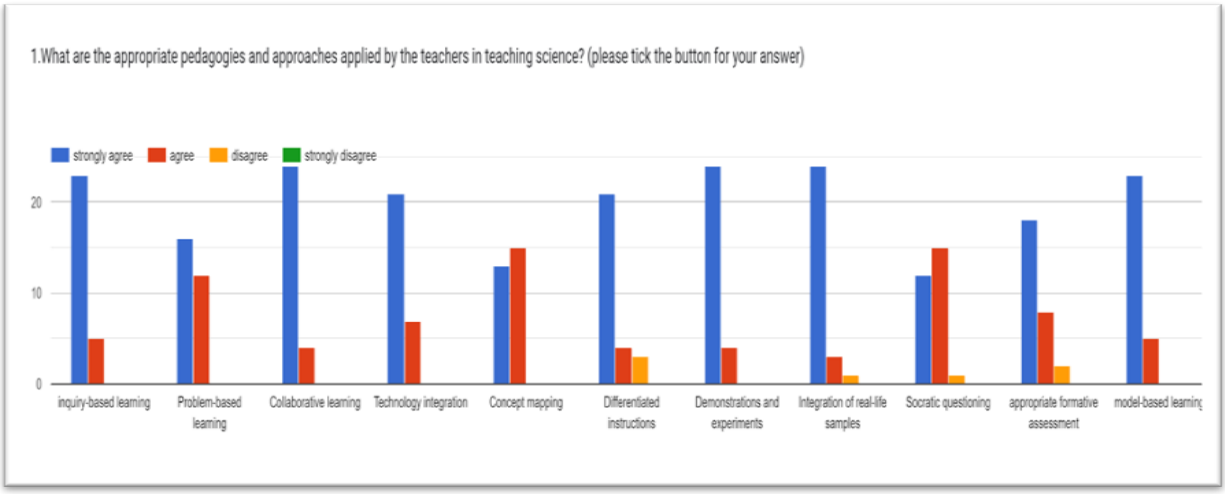
To answer problem three about the level of familiarity of the teachers in utilizing science equipment.

Numerical	Number	Interpretation
3.50-4.00	4	Very Familiar
2.50-3.49	3	Partially Familiar
1.50-2.49	2	Moderately Familiar
0.01-1.49	1	Less Familiar

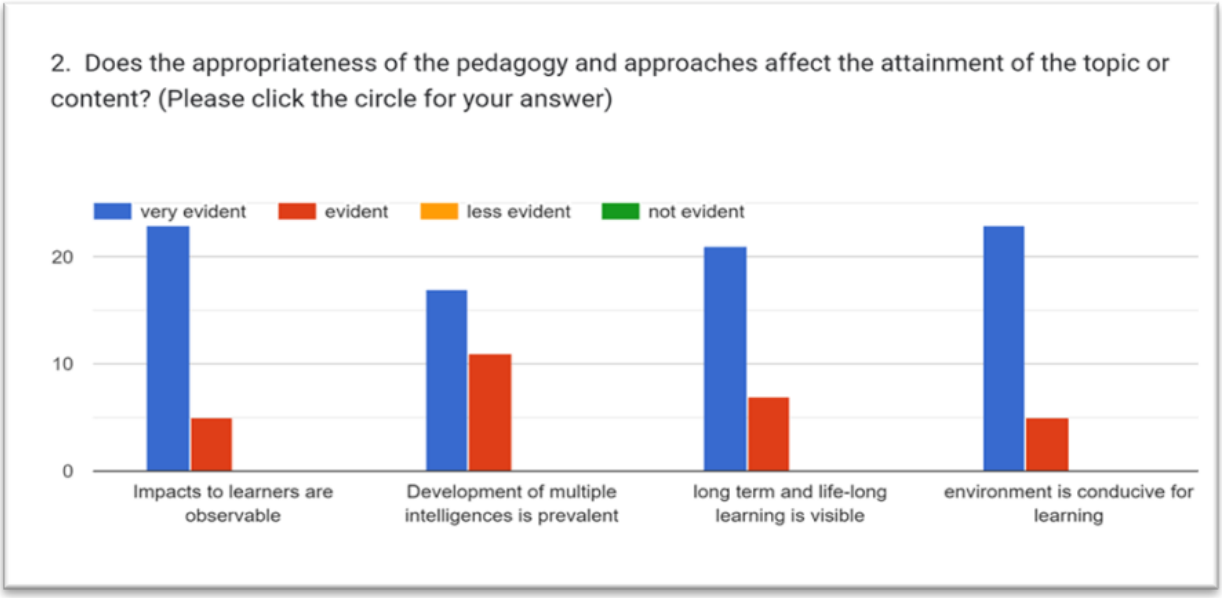
To answer problem four about the trainings needed to capacitate teachers in teaching science respondents offered to enhance teachers' appropriate pedagogy and approaches, they are allowed to select recommendations/suggestions that they think needed or not.

III. Results and Discussion

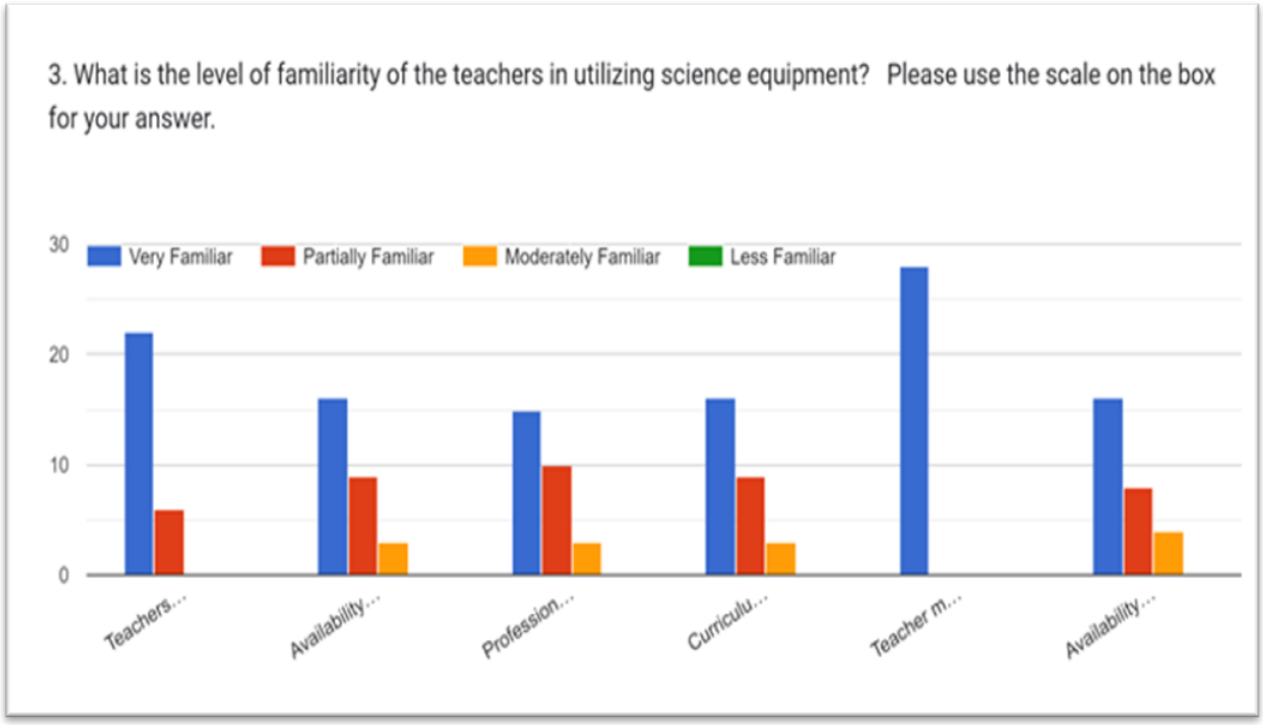
Choosing the most appropriate pedagogies and approaches is significantly important to delivering the content in Science effectively.



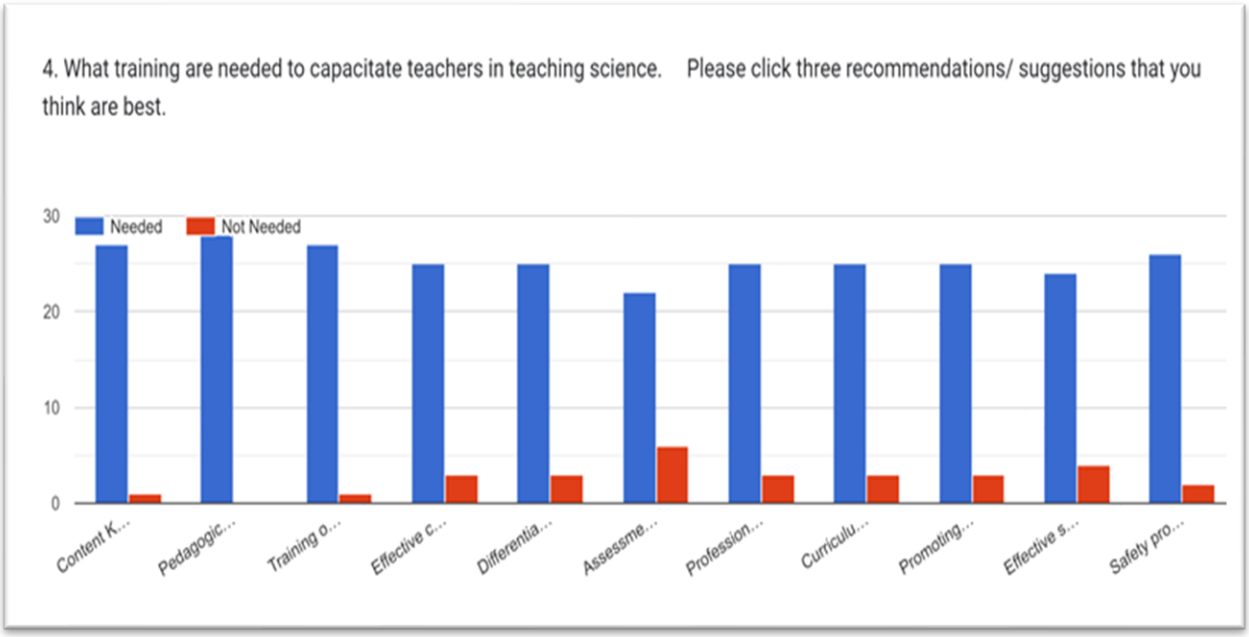
It prevails that the appropriate pedagogies and approaches applied by science teachers are collaborative learning, demonstrations and experiments and integration of real-life samples which is 24 (85.71%) strongly agree.



Twenty-three (23) strongly agrees that impacts are observable and environment is conducive to learning prevails which is 82.14%.



The level of familiarity of the teachers in utilizing science equipment prevails teachers' motivation which is 28 (100%) which is very familiar.



The training needed to capacitate teachers in teaching science prevails pedagogical training which is 28 from 28 respondents (100%) which is very evident.

IV. Conclusion

Collaborative learning is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product says Laal and Ghodsi (2012). The choice of teaching approaches adds another layer of complexity. By embracing student-centered methodologies and collaborative learning environments, teachers can instill a sense of ownership in the learning process and mirror the collaborative nature of scientific exploration.

Pedagogical competence directly and significantly affected the success of teachers in teaching (Hotaman, 2010). Pedagogy emerges as a pivotal factor, as it is the bridge between content and comprehension. Employing diverse teaching strategies, such as experiential learning, inquiry-based approaches, and technology integration, enables educators to engage students effectively, fostering critical thinking and problem-solving skills.

As teacher motivation has been identified as a key determinant for student motivation and teaching effectiveness, it is particularly useful for educational administrators as well as teachers to formulate practical strategies to stimulate students' motivation to learn and improve the outcomes of both teaching and learning (Han and Yen,2016).

Hence, the successful teaching of science necessitates a harmonious synchronization of content, pedagogy, and approaches, supported by ongoing training. By immersing themselves in a dynamic cycle of learning and adaptation, educators can not only enhance their own teaching prowess but also inspire a new generation of scientifically literate individuals prepared to thrive in an ever-changing world.

V. Recommendations

1. Collaborative learning, demonstration and experimentation, and inclusion of real examples are pedagogical methods that can make learning more effective and efficient.
2. Using appropriate pedagogy and approaches has measurable impacts and conducive to learning.
3. The level of familiarity of the teachers in utilizing science equipment is the teachers' motivation.
4. To capacitate teachers in teaching science pedagogical training is needed.

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