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Algorithm Approach in Teaching Physics among Junior High School Students of Batangas National High School

Norrie E. Gayeta[1] and Miguela M. Atatado[2]

[1]*Faculty, College of Teacher Education, Batangas State University, Batangas City Philippines*

[2] *Student, College of Teacher Education, Batangas State University, Batangas City Philippines*

Abstract: The study aimed to assess the use of algorithm approach in teaching physics for the purpose of proposing courses of action to maximize the utilization of the aforementioned approach in teaching and learning. Specifically, it determined the extent of utilization of algorithm approach in teaching physics and the problems met by the teacher-respondents in utilizing the approach. To maximize the utilization of algorithm approach in teaching physics, some courses of action were proposed.The descriptive type of research was used with the questionnaire as the main instrument in gathering data. Respondents of the study were 42 science teachers from Batangas National High School for the school year 2017-2018. The statistical tool used in the study was weighted mean.

The study revealed that algorithm approach was utilized to a moderate extent in teaching topics in physics such as motion, waves, sounds, and light. Another finding showed that the teachers often met problems in using algorithm approach such as lack of seminars/trainings on algorithm approach, lack of critical and creative thinking ability of the students in solving the problems, unavailability of instructional materials in teaching physics concepts, differences in the students' level of understanding, and lack of students' interest in understanding physics concepts. Attending seminars/trainings related to the use of algorithm approach was proposed courses of action for maximum utilization of algorithm approach. Inasmuch as the proposed courses of action aimed to maximize the utilization of algorithm approach in teaching physics, one recommendation was to conduct seminars and trainings on algorithm approach to address the problems met in the utilization of this approach.

Keywords: Algorithm approach, junior high school science, teaching physics

Introduction

It is said that teaching is the noblest profession. In fact, one recognized definition of teaching is "to teach is to cause to learn." This encompassing scope of learning places a tremendous responsibility on the teachers. Thus, this 21st century society demands highly qualified teachers to be able to attain quality learning. It demands that teachers must possess the required competencies for meaningful learning to take place. The changing environment needs a new generation where the ideas of teaching styles change drastically to promote student-centered learning rather than the teacher-centered approach. Additionally, according to Doyle [1] (2004), to improve the achievement of students, teachers must use effective methods, strategies and approaches to help facilitate teaching and learning process.

As explained by Javier [2] (2012), teaching approach is a term that indicates the nature of teaching-learning situation. It indicates how teaching is to be conducted and how learning is to be acquired. It is also a procedure that employs a variety of strategies to access better understanding and effective learning. Furthermore, Etkina [3] (2005) cited that in teaching a subject, teachers should understand fully the essentials of successful teaching. They should learn to effectively use strategies or approaches which will guide students to understand the concepts and principles more with depth. The study of Rosario [4] (2007) revealed that the teaching approaches used by the teacher must be aligned to the capability of the students. Moreover, Catapang, et al. [5] (2015) suggested that teachers should properly select the best activities suited to the learners.

Problem solving is a complex process that really needs critical understanding which is the result of concentration and reflective thinking. The focus should be on strengthening the basic concepts of any topic in the minds of students. Students are usually able to solve the problems that involve basic equations. But problems that require the fundamental concepts become a hard nut to crack for them. It is a must also for teachers to be more creative in teaching the concepts to get the students' attention. More importantly, their students must understand the essence of problem solving considering that this is one of the lifelong skills that every student has to learn.

Physics recognizes the importance of developing the critical and creative thinking skills of learners. It focuses on the application of its concepts toward the improvement of the environment and promotion of quality

of life. Moreover, the different motivation strategies of teachers to learn physics will be a big help not only for the learners to enable them to respond actively but also to discover that physics has applications to their life activities [6] (Delgado, 2013).

As cited by Cruz [7] (2007), learning physics is not simply learning concepts, principles and theories. It primarily enhances the formation of desirable attitude toward scientific work and accelerates the development of keenness in observation and smartness in making inferences from demonstrated patterns of behavior. Moreover, it harnesses skills for applying concepts learned to real life situations and to other existing phenomena. Trying out various teaching strategies, promotes a deeper understanding of the concepts enriched through experience and adequate enough to carry out the formulation of generalizations from their own observations.

Problem solving is one of the most needed skills in physics where students are required to answer different real-life application problem tasks critically and creatively. Moreover, it involves building the students' self- confidence in their ability to solve meaningful problems and empowering them to build a better future for themselves and others. He added that excellence in physics can be achieved when the course content matches the existing needs and interest of the learner [8] (Nelson, 2016). In addition, for Schwartz [9] (2008) as one gains experience in solving problem, one develops one's critical and creative thinking skills.

Problem-solving activities can be differentiated based on student interests, difficulty of the problem and how much information is given to students. Designing activities intended to develop the problem-solving skills of learners therefore can be difficult to structure and more often, time-consuming to use. Therefore, tasks must be carefully designed so that students are learning multiple concepts or applying multiple skills during the activity [10]. (Valerott, 2007).

Other aspect of problem solving method was mentioned by Silvia [11] (2007). It is a teaching strategy that employs the scientific method in searching for information. This method is used most often in science and mathematics classes. The students are trained to be sensitive to any puzzling situation or to any difficult situation that needs to be solved. Having defined the problem clearly, a tentative solution is solicited.

Algorithm is one of an effective method for solving a problem expressed as a finite sequence of instructions. In the algorithm method, the student is expected to accomplish a task in a certain number of steps. The teacher must give precisely stated steps. Even if this process of problem-solving is very time consuming and takes longer than the shortcut, if done correctly the answer is assured. Moreover, algorithm approach demonstrates specific procedures and situations. Every instruction should be precise, definite and clear. Each instruction should be performed at a definite time and should not be repeated. After the instructions are executed, the user can get the required results. As noted by Clark [12] (2006), students are able to learn merely through exposure to information-rich settings or through experiencing disciplinary procedures such as working like a scientist to uncover science concepts. For Almossawi, [12] 2017) algorithm is a step by step procedure designed to perform an operation, and which (like a map or flowchart) will lead to the sought result if followed correctly. Algorithms have a definite beginning and a definite end, and a finite number of steps.

In this approach once unfamiliar problem, situation or task is presented to the students and they are required to determine for themselves how they will go about solving the problem. This usually occurs through small group work and allows students to utilize their prior knowledge in the topic area and identify the gaps in their knowledge as they attempt to solve the problem. It is a student-centred approach to learning that encourages students to be self-directed, interdependent and independent as they attempt to solve the set problem. [13] (Hmelo-Silver 2004).

Objectives of the Study

The study aimed to assess the use of algorithm approach in teaching physics for the purpose of proposing courses of action to maximize the utilization of the aforementioned approach in teaching and learning.

Specifically, this study sought answers to the following questions:

1. To what extent is algorithm approach utilized in teaching the following topics?
   - 1.1 Motion
   - 1.2 Waves
   - 1.3 Sound
   - 1.4 Light

2. What are the problems met by the teachers in utilizing the algorithm approach?

3. What courses of action may be proposed for maximum utilization of the aforementioned approach?

Research Methodology

The descriptive type of research was used in this study with the questionnaire as the main instrument in gathering data. Respondents of the study were 42 science teachers from Grade 7 to 10 of Batangas National High School for the school year 2017-2018. In order to gather the needed data, a letter of request was sent to the school principal and department head of science of Batangas National High School to seek permission to conduct the study. The statistical tool used in the study was weighted mean. Instrument used was evaluated, validated, administered, tallied and scored according to the accepted practices in research. Interview was also conducted to science teachers to substantiate the findings of the study. The data were submitted to the statistician for treatment after which the data are analyzed and interpreted.

Results and Discussions

1. Extent of Utilization of Algorithm Approach

The extent of utilization of the algorithm approach in different topics in physics, namely, motion, waves, and sound was one of the problems raised in this study.

1.1 Motion**.** Table 1 shows the extent of utilization of algorithm approach in teaching motion.

Table 1: Extent of Utilizing Algorithm Approach in Teaching Motion

Topics	Weighted Mean	Verbal Interpretation
1. Velocity	3.12	Moderate Extent
2. Distance	3.10	Moderate Extent
3. Acceleration	3.10	Moderate Extent
4. Displacement	3.07	Moderate Extent
5. Speed	3.07	Moderate Extent
6. Motion Detectors	3.02	Moderate Extent
7. Law of Inertia	2.98	Moderate Extent
8. Law of Acceleration	2.95	Moderate Extent
9.Law of Interaction	2.95	Moderate Extent
10. Projectile Motion	2.88	Moderate Extent
11. Impulse	2.86	Moderate Extent
12. Momentum	2.86	Moderate Extent
13. Conservation of Linear Momentum	2.86	Moderate Extent
Composite Mean	**2.99**	**Moderate Extent**

As shown in the table, velocity got the highest weighted mean of 3.12, indicating that there was maximum utilization of this approach for this topic. This finding could be due to the involvement of basic concepts that the students need to understand in doing problem solving. It could also mean that teacher-respondents used algorithm approach for lessons involving problem solving skills.

For the lessons on distance and acceleration, both yielded the same weighted mean of 3.10 or moderate extent in the use of algorithm. These subtopics also need problem solving skills involving a very diverse and complex set of processes. Finding shows that the respondents used algorithm approach in teaching physics problems that require different kinds of defined steps to come up with the right answer. As explained by Rouse [13] and Almossawi [12] this step by step approaches can be useful in teaching situations where each decision must be made following the same process and where accuracy is critical because the process follows a prescribed procedure.

It can also be seen in the table that the lessons in motion where algorithm approach was utilized to a moderate extent are displacement and speed with the same weighted mean of 3.07. It only implies that in these lessons the teacher-respondents used the algorithm approach moderately in demonstrating specific procedures that should be precise and clear. These topics require problem solving skills with logical steps that need to be followed accurately by the students in order to arrive at the correct answers. According to Silvia, a successful problem solving method employs the scientific method of searching for information.

The table also shows that three subtopics, namely, impulse, momentum and conservation of linear momentum in motion where algorithm approach was utilized to a moderate extent obtained the lowest mean of 2.86. Results suggest that even though these topics contain problem solving tasks, the teachers could not utilize the algorithm approach very often maybe because the topics were unfamiliar to the students and the teachers may not be able to hold their attention while using the said approach. This finding has similarity with the finding

in the study of Nelson [8] that excellence in teaching physics could be achieved when the course content matches the existing needs and interest of the learners.

1.2 Waves. Table 2 shows the extent of utilizing algorithm approach in teaching waves.

Table 2: Extent of Utilizing Algorithm Approach in Teaching Waves

Topics	Weighted Mean	Verbal Interpretation
1. Types of Waves	2.98	Moderate Extent
2. Amplitude	2.95	Moderate Extent
3. Wave Velocity	2.95	Moderate Extent
4. Wavelength	2.93	Moderate Extent
Composite Mean	**2.95**	**Moderate Extent**

As shown in the table, among the four subtopics types of waves recorded the highest weighted mean of 2.98. This result reveals that algorithm approach could also be utilized in teaching lessons with few problem solving tasks. The use of the algorithm approach in these lessons could be due to the need for specific steps in order to understand clearly and meaningfully the concepts related to waves. This topic cannot be understood completely without relating part by part to the basic concepts because the concepts are interconnected with each other. This finding conforms to the study of Mustafa [14] that to learn a concept meaningfully, students must carry out cognitive processes that construct relations among the elements in the concept.

Algorithm approach was also utilized to a moderate extent in discussing wavelength and got the lowest weighted mean of 2.93. This lesson does not require many computations and so the step by step procedure of the algorithm approach may not be used so frequently. For lessons falling under this type, teachers usually discuss the lessons using the lecture method supported by sufficient instructional materials.

1.3 Sound. The extent of utilizing algorithm approach in teaching the different lessons in sound is presented in Table 3.

Table 3: Extent of Utilizing Algorithm Approach in Teaching Sound

Topics	Weighted Mean	Verbal Interpretation
1. Loudness	2.74	Moderate Extent
2. Quality	2.71	Moderate Extent
3. Pitch	2.69	Moderate Extent
Composite Mean	**2.71**	**Moderate Extent**

Findings show that algorithm approach was used by the teacher-respondents to a moderate extent in teaching the lessons on the three subtopics.

Concerning loudness, the moderate use of algorithm approach can be best explained by the teachers' use of said approach in performing some experiments on loudness where the step by step procedure is required. This finding is somewhat related to the idea of Cruz [7] that laboratory experiments may be used as springboard for the lessons on other topics in physics.

Algorithm was utilized to a moderate extent also in quality of sound. Perhaps the physics teachers were motivated to use the algorithm approach in teaching the concepts related to quality so that their students could gain deeper understanding of them. For sure, the teachers understood very well that if the students have meaningful understanding of the concepts they would be able to apply the concepts in different situations in their daily life. Knowing the concept at a deeper level is required in solving problems in physics which, according to Delgado [6], could lead to understanding the processes and could lead also to the development of literate and effective students.

Pitch got the lowest weighted mean of 2.69 but still algorithm was utilized to a moderately extent in the lessons. Since the lessons on pitch consist mostly of facts, concepts, principles and theories, the use of algorithm approach seemed not that frequent because problem solving, which is one of the features of algorithm approach, was not needed in most of the lessons in this subtopic of sound.

1.4 Light. Table 4 presents the extent of utilizing algorithm approach in teaching light.

Table 4: Extent of Utilizing Algorithm Approach in Teaching Light

Topics	Weighted Mean	Verbal Interpretation
1. Intensity	2.98	Moderate Extent
2. Color	2.93	Moderate Extent
3. Electromagnetic Spectrum	2.90	Moderate Extent
4. Reflection of Light in Mirrors	2.86	Moderate Extent
5. Electromagnetic Effect	2.83	Moderate Extent
6. Refraction of Light in Lenses	2.81	Moderate Extent
7. Electromagnetic System	2.81	Moderate Extent
Composite Mean	**2.92**	**Moderate Extent**

Of the seven subtopics of light, intensity got the highest weighted mean of 2.98, implying that the physics teachers used the algorithm approach more often than in the other subtopics. Perhaps there were more experiments done by the students in this subtopic than in the other six subtopics. As a result of the exposure of students to this approach, it is possible that they attempted to use the same kind of thought process in physics that they used in other subjects.

Coming next is the subtopic on color where algorithm was utilized in moderate extent as given by the weighted mean of 2.93 and closely followed by electromagnetic spectrum which got a weighted mean of 2.90, reflection of lights in mirrors with 2.86 weighted mean, and electromagnetic effect with a weighted mean of 2.83. Results imply that there were lesser opportunities for the physics teachers to use the algorithm approach due to the presence of more concepts which do not require the step by step procedure in teaching them. In cases like these, problem solving which demands the step by step procedure of the algorithm approach was not often utilized. The lesser opportunities for using algorithm in these lessons did not mean that the lessons were not taught very well by the teacher-respondents.

The lowest weighted mean of 2.81 was obtained by the subtopics refraction of light in lenses, and electromagnetic system.

2. Problems Met by Teachers in Utilizing Algorithm Approach

The problems met by teachers in utilizing algorithm approach are presented in Table 5.

Table 5: Problems Met by Teachers in Utilizing Algorithm Approach

Items	Weighted mean	Verbal Interpretation
1. Lack of seminar/training on algorithm approach	3.02	Often Met
2. Lack of critical and creative thinking ability of the students in solving the problem	2.98	Often Met
3. Unavailability of instructional materials in teaching physics concept	2.90	Often Met
4. Differences in the students' level of understanding	2.90	Often Met
5. Lack of students' interest in understanding physics concepts	2.90	Often Met
6. Insufficient time in evaluating the output	2.88	Often Met
7. Lack of mathematical skills of the students in problem solving	2.88	Often Met
8. Too much dependence of students on teacher	2.85	Often Met
9. Difficulty understanding physics concepts	2.83	Often Met
10. Lack of prior knowledge of the students in physics concepts	2.83	Often Met
11. Allotted time is not enough for the approach	2.83	Often Met
12. Poor performance of the students in problem solving	2.80	Often Met
Composite Mean	**2.89**	**Often Met**

It can be seen from the table that the problem encountered by the teachers in utilizing algorithm approach that got the highest weighted mean of 3.02 is lack of seminar/training on algorithm approach. This result reveals that the teachers had no training in using the algorithm approach. For sure, this problem

hindered them from utilizing this approach correctly, efficiently and effectively. This is the reason for Cruzat's [15] advice to teachers to attend continuous trainings, seminars and conferences to enhance their use of different approaches, strategies and techniques of teaching.

Another problem often met by the teachers in utilizing algorithm approach is lack of critical and creative thinking ability of the students in solving the problems with weighted mean of 2.98. It is clear from this result that most of the students did not meet their teachers' expectation in terms of their ability to think creatively and critically as required in solving problems. This inadequacy of the students may be due to insufficient exposure to different instructional materials that could enhance these highly important thinking abilities. This unfavorable situation could have started as early as the previous year levels.

There were three problems that got the same weighted mean of 2.90. These problems often met by the teacher-respondents are unavailability of instructional materials in teaching physics concepts, differences in the students' understanding, and lack of students' interest in understanding physics concepts. This result is not surprising because of the importance of instructional materials in teaching and learning, the need to address differences in the students' ability to learn and the significant role of interest in learning. This was affirmed by the study of Rosario [4] that lack of effective instructional materials contributed to poor performance of students and their level of interest.

The other student-related problems in mathematical skills and problem solving skills gave rise to other problems often encountered also by the physics teacher-respondents such as difficulty of the students in understanding physics, lack of prior knowledge of the students about physics concepts and poor performance of students in problem solving. They got weighted means of 2.83 and 2.80. These problems pointed to the weakness of students in mathematical skills and problem solving skills. These findings were confirmed in the study of Sevilla [16] which revealed that students' had poor performance in physics especially in problem solving because of different factors such as teachers, schedule, interest of students and use of critical thinking, a difficult skill for most students which is required in problem solving.

3. Courses of Action for Maximum Utilization of Algorithm Approach

To get the fullest benefits of using algorithm approach in teaching physics, courses of action were laid down for the teacher-respondents' assessment. The results appear in Table 6.

Table 6: Courses of Action for Maximum Utilization of Algorithm Approach

Items	Weighted Mean	Verbal Interpretation
1. Attendance of teachers to seminar/training related to the use of algorithm approach	3.31	Agree
2. Formulate a procedure that can enhance the creative and critical thinking of the students	3.29	Agree
3. Proper time management	3.29	Agree
4. Use of multimedia in delivering the procedures to be followed by the students	3.29	
5. Provide and explain rubrics in grading the students' output	3.24	Agree
6. Subscriptions by the school of the necessary materials in teaching physics	3.24	Agree
7. Articulate the procedure for enhancement	3.21	Agree
8. Involve the students in different exercises and problem sets that would improve their problem solving skills	3.21	Agree
9. Use higher order thinking skills questions that are aligned to the given activity	3.21	Agree
10. Know the limitation of the approach	3.19	Agree
11. Present the procedure in interactive way	3.17	
12. Express the procedure according to the intelligence/capability of the students	3.10	Agree
Composite Mean	**3.23**	**Agree**

As shown in the table, the respondents agree that for maximum utilization of algorithm approach attendance of teachers to seminars/trainings related to the use of algorithm approach must be provided. This got the highest weighted mean of 3.31. This finding only implies that the teachers recognized the need to undergo trainings on algorithm approach to empower them in using it effectively and efficiently. Without adequate

knowledge and skills in using this approach, it is impossible to expect teachers to carry out all the demands required in the execution of this approach. Both teachers and students are the losers in this case since the teachers lack the competencies in planning the procedure and other requirements to execute the algorithm approach for the development of critical and creative thinking skills of the students, the prerequisite to problem solving. The need to undergo seminars and trainings on the different teaching approaches was highlighted in the study of Cruzat [15] to enable the teachers to acquire the competencies in developing critical and creative thinking skills in solving problems and in constructing knowledge.

Conclusions

Algorithm approach is utilized to a moderate extent in teaching topics in physics such as motion, waves, sounds, and light. The problem often met by the teachers in using algorithm approach in teaching physics is the lack of seminars/trainings on algorithm approach. Thus, attendance to seminars/trainings related to the use of algorithm approach, should be undertaken by the teachers for maximum utilization of algorithm approach in teaching physics.

Recommendations

School administrators should encourage teachers to use algorithm approach in teaching physics to further evaluate its usefulness. In addition, seminars and trainings for teachers should be provided to address the problems met in the utilization of algorithm approach.

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