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Students Problem-Solving Difficulties and Implications in Physics: An Empirical Study on Influencing Factors

M. Vijaya Bhaskara Reddy[1*] Buncha Panacharoensawad[2]
1.Faculty of Public Health, St. Theresa International College, 1Moo 6, Rang Sit, Nakhonnayok Road, Klong 14, Bungsan, Ongkharak, Nakhonnayok- 26120
2.Faculty of Education, St. Theresa International College, 1Moo 6, Rang Sit, Nakhonnayok Road, Klong 14, Bungsan, Ongkharak, Nakhonnayok- 26120, Thailand

Abstract
In twenty first century, abundant innovative tools have been identified by the researchers to evaluate the conceptual understandings, problem solving, beliefs and attitudes about physics. Nevertheless, lacking of wide variety of evaluation instruments with respect to problem solving in physics. It indicates that the complexity of the domain fields of physics. The study was aimed to evaluate the student's problem-solving skills and the factors influences the problem-solving difficulties in physics. A population of 303 Bachelor of education students of physics in Piler Mandal, Chittoor district, Andhra Pradesh, India. The results of the study indicate and revealed that poor mathematical skills and lacking of understanding the problem are the major obstacles in the domain of problem solving skills in physics. To overcome these obstacles teachers, need to give enough assignments and need to recruit well qualified physics teachers.
Keywords: Physics, Problem Solving skills, Perception, physics teachers, and mathematical skills

1. Introduction

Teaching and learning process is complex in nature and can take variety of forms. Traditional education is bounded by age, time, space, money and area. Physical presence of a student and teacher is mandatory for the whole time of study. Traditional education provides interactive relationship between student and teacher and among the students; this interaction promotes better understanding of the contents and opportunities to learning with peers. Sciences especially physics playing vital role in technological development, innovations in medical sciences of developing and developed countries. Biological Sciences has been and will continue to be of monumental significance in human life, due its exceptional ability to describe day to day life bioreactions, in treatments of diseases and Nano particle sciences. In view of these vital roles, physics apparently a contingent on mathematical language in the aspects of quantitative and qualitative calculations. Researchers emphasized the need of mathematics in sciences with special reference to physics are becoming indispensable (Abdulahi A 1982).

Physics, being an elemental science, due to its dominant problem-solving nature primarily attain its esteem as an arduous subject. Furthermore, all aspects of physics considered as mathematical exactitudes and physical quantities aspects. The word "Problem-solving" defined as in various manners emphasized by the renowned researchers. A form of discovery of learning, bridging the gap between the learners existing knowledge and the solution of the problem (Ausubel DP 1971), while (Gagne RM 1970) contemplated problem solving as the assembling of existing rules to set new rule which is existing and allow to solve the physics complex problems with ease. "A situation, and a challenge, unsolved which is not immediately resolved. Problem solving defined as a pioneer of cognitive process to achieve the goal when obvious to the solver (Meyer RE1992) From these definitions, an individual to be able to solve a problem, person must be endowed with the pertinent information, reason, analysis, grasp and critical thinking to solve the problem. In other words, the individual should read and try to comprehend the problem. The individual should be able to determine the principles, physical laws, and equations involved in the problem. need to track and make a graph, drawing to envision the description of the problem. eventually, the individual should be able to index the sums involved in the problem and assigning the symbols (Meyer RE1992, Johnson N 2012).

Critical thinking has turned out to be a standout amongst the most vital esteemed domains of science investigations, especially physical science and chemical science (Meyer RE1992, Johnson N 2012, Ayodele O. Ogunleye 2009). Unfortunately, in recent studies have been found that most of the students perform mathematical calculations, algorithms by rote memorization of formulae without having a basic understanding of specific concepts. The rationale of the difficulty in problem solving in physics have been identified numerous researchers as physics students fail to construct meanings of the problem statement, unable to interlink the meaning of the statement. Most of the students lacking the appropriate knowledge on structural construction in specific content area (Ayodele O. Ogunleye 2009).

The fundamental research on problem solving was identified first time by (Polya G 1975) and proposed a four-stage model (recall, planning, implementation and evaluation) for problem solving in sciences. (Frazer JB and Butt LW (1982). Developed a similar four-stage model which inherently constitutes of defining the problem,

selecting the appropriate information, combining the separate pieces of information and evaluation. Similarly, a five-stage model which consists reading the text, elucidate the concepts, redeem relevant information from subconscious memory, constructing a solution plan, and further proceeds the operations required to solve the problem (Greeno JG 1973).

(Schoenfeld AH 1992) adapted the research work of Polya (Polya G 1975) and distinguished between five episodes of cylindrical stages in solving problems are: 1) problem survey, 2) stimulation and initiation of knowledge, 3) make a plan, 4) carry out the plan, and 5) check the answer.

(Stewart, J Rudolph J 2001) based on the contemplating nature scientific problems divided in to two types model data fit problems and conceptual problems. Model-Data Fit Problems, solvers deal with available data, which later fit into an appropriate illustrative model and where as in Conceptual Problems, solver must correlate with explanatory model and hypothetical coherence of explanatory model.

Number of studies have been carried out to determine the rationale why the educational students fail to solve the scientific problems. Most of the investigations are in general concepts and out of the field of physics. Moreover, most recent researches reported on general concepts and did not consider student's perceptions. In addition, there is a lacuna on student's perceptions on problem solving difficulties. The current study aimed to attempt to investigate the student's perceptions on inability to solve the physics problems. It could be serve as an instrument to solve the physics problems and basis for further investigations in the field of physics education.

Specifically, this study aimed to investigate physics student's opinions on:

1. to find out the perceptions towards the physics problems and reasons student's inability to solve problems
2. precautionary measures to overcome the obstacles in problems solving

2. Methodology

A 5-point scale (Likert-type) attitude questionnaire was constructed, a primary pilot study was conducted and tested. The data was collected from 303 high school physics students. This is an opportunity to the students to express their opinions about difficulties in physics problem solving, try to express their possible remedies to understand the root cause of the problem-solving difficulties in physics. stated that the "any research on learning and teaching that fails to take into account the feelings, reactions and opinions of pupils is not worthwhile" (Maloney, D P 1993). On the other hand, physics teacher's involvement, would helped to collect the rich source of information on student's problem-solving difficulties in physics. The questionnaire contained three sections designed for physics students. Section A consists general demographic information of the subjects. Section B consists 10 questions which presents reasons for student's difficulties in solving physics problems, two of which were:

1. Lack of ability in remembering related equations
2. Lack of books or materials on problem-solving in physics.

3. Results and Discussion

Table 1. Influencing factors on Problem-Solving difficulties and implications in physics.

Parameter	SA (%)	A (%)	DA (%)	SD (%)	UND (%)
Lack of ability in remembering related equations	174 (57.4)	70 (23.1)	24 (7.59)	19 (6.27)	16 (5.28)
Lack of books or materials on problem-solving in physics.	78 (25.7)	82 (27.0)	52 (17.1)	37 (12.2)	54 (17.8)
Insufficient laboratory practice towards the specific domain of physics subject	115 (37.9)	67 (22.1)	45 (14.8)	39 (12.8)	37 (12.2)
Lack of practice on problem solving during the classes	167 (55.1)	79 (26.0)	27 (8.9)	21 (6.9)	9 (2.9)
Lack of understanding the fundamental basics of the physics problem	154 (50.8)	82 (27.0)	27 (8.9)	24 (7.9)	16 (5.2)
Poor mathematical skills on necessary understanding of the physics problem	139 (45.8)	110 (36.3)	22 (7.2)	19 (6.2)	13 (4.2)
Poor comprehensive skills on definitions, laws, and basic principles of physics	103 (33.9)	97 (32.0)	38 (12.5)	37 (12.2)	28 (9.2)
Lack of motivation from the physics teachers and inexperience of the teacher	122 (40.2)	71 (23.4)	33 (10.8)	37 (12.2)	40 (13.2)
Inadequate exercises on specific unit wise physics problems	114 (37.6)	99 (32.6)	29 (9.5)	46 (15.1)	15 (4.9)
Confusion arise from unit to unit and its reflections on physics problem	56 (18.4)	101 (33.3)	65 (21.4)	74 (24.4)	9 (2.9)

In this study 303 subjects were included from high school physics students. Out of 303 children 174

(57.4%) children were perceived that the lack of ability in remembering related equations is one of the most influencing factor in physics problem solving difficulties. Followed by Lack of practice on problem solving during the classes (55.1%), Lack of understanding the fundamental basics of the physics problem (50.8), Poor mathematical skills on necessary understanding of the physics problem (45.8%), lack of motivation from the physics teachers and inexperience of the teacher (40.2), Inadequate exercises on specific unit wise physics problems (37.6%), Poor comprehensive skills on definitions, laws, and basic principles of physics (33.9), lack of books or materials on problem-solving in physics (25.7%), and Confusion arise from unit to unit and its reflections on physics problem (18.4%) respectively.

The results of the investigative study reported and revealed that the index of agreement of the physics students on problem solving difficulties as follows:

1. Lack of ability in remembering related equations in physics subject.
2. Lack of practice on physics problem solving during the classes.
3. Lack of understanding the fundamental basics of the physics problem.
4. Poor mathematical skills on necessary understanding of the physics problem.
5. Lack of motivation from the physics teachers and inexperience of the teacher.
6. Inadequate exercises on specific unit wise physics problems.
7. Poor comprehensive skills on definitions, laws, and basic principles of physics.
8. Lack of books or materials on problem-solving in physics.
9. Confusion arise from unit to unit and its reflections on physics problem

The study elevates the typical validation for student's class room perceptions on physics problem solving difficulties. The results of the study revealed the inconclusive association between students' perceptions and their attitudes on problem solving difficulties and individualized physics classes, trainee teacher interpersonal behaviours on problem solving and physics laboratory experiments to encourage the students to learn how to solve the problems in physics showing significance as an indicator of students' attitudes toward physics. Having a standardized set of items for the assessment of achievement was shown to give more comparable sample results. Physics laboratory classes' attitudes had a positive effect on both the five scales of ICEQ and PLEI. In terms of the QTI scales, the influence and proximity: students in highly motivated classes had a more favourable perception of their trainee teachers. Finally, this study only found an association between students' perceptions and their attitudes toward physics variables associated to students' perceptions.

RECOMMENDATIONS AND SUGGESTIONS TO IMPROVE THE STUDENTS PERFORMANCES IN PHYSICS PROBLEM-SOLVING WITH REFERENCE TO THEIR ACADEMIC SUCCESS

Possible suggestions were identified from the pooled results of the study to reduce student's difficulties in problem-solving in physics. In accordance with the pooled survey suggestions are as follows:

1. Teachers need to give enough homework and assignments from each topic.
2. Need to conduct the mock tests on each topic before the final exams.
3. Schools especially private schools need to recruit qualified (Ph.D.) teachers and at least one teacher must have 5-10 years of teaching experience in physics.
4. Prepare and execute a detailed blueprint on physics.
5. Teachers need to prepare summary notes on key topics and how to solve the physics problems.
6. Need to emphasize in explaining the basic equations to be used in solving physics problems.
7. Laboratory based problem solving should be performed with special reference to physics.
8. School must provide good textbooks, which emphasise on problem-solving.
9. Providing organized tutorial on how to solve problems with easy way and each time a problem is to be solved.
10. Revise the key and fundamental topics in physics and mathematical skills.

4. Summary and Conclusions

The results of the study revealed that the high failure rate in physics due to their inability to understand the basic subject matter content, principles of physics in formulas. It leads to lack of remembering problem based equations in physics. To overcome these obstacles, it is recommended that each student should be given the ample time and opportunity to solve the physics problems during the process of learning physics. Science educators and curriculum developers need to incorporate and emphasize on mathematical concepts which are necessary to the understanding of physics and its new dimensions. Eventually, the study has revealed that the stakeholders should take initiative steps to strengthen the educational practices. It is clear that the lack of problem solving skills in physics in nationwide is of alarming magnitude, but also of great intricacy.

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