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A study of Physics Problem Solving Practices in Enhancing Real-Life Problem Solving Competencies in Secondary Schools of Hawassa City Administration, Ethiopia: The case of Alamura Secondary School

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Abstract: The purpose of this study was to explore the way general secondary school physics teachers solve physics problems in helping learners develop real-life problem solving competencies. The study used qualitative research methodology as a guiding framework. In order to judge the appropriateness of problem solving strategies relevant criteria were developed by the researcher and validated by experts. Grades nine, ten, eleven and twelve teachers were used as data sources in order to find evidence about the ways physics problems are solved. One class was observed two times and a total of 24 classrooms were selected for classroom observation. It was found from the study that most of the problems were provided without their context and solved without relating the problems with their respective concepts. Most of the teachers insert numerical values into their respective formulas by following certain steps to arrive at solutions that do not require conceptual understanding to arrive at solutions. Generally based on the findings of the study it can be concluded that the problem solving strategies used by teachers were not appropriate in enhancing real-life problem solving competencies in dealing with problem situations. Based on the conclusions made the study suggested the need for providing context rich problems by textbooks and also the need for providing trainings for teachers on their approach of solving problems so that they can help their students develop real-life problem solving competencies.
Key words: Physics, real-life problem solving, conceptual understanding, competencies

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I. THE PROBLEM AND ITS APPROACHES

1.1. Introduction

Because scientific thinking is a form of problem solving scholars argue that science education curricula and teaching practices should focus on the development of problem solving competencies so that learners are able to develop real-life problem solving competencies that would help them deal with the problems they encounter in their lives (Dunbar &Fugelsang, 2004; Kim and Jae, 2002; Mbajiorgu& Reid, 2006). The significance of developing genuine problem solving competencies is advocated by the constructivists' theories of knowledge and learning. Learning from the constructivists' perspective is seen as an active construction of meanings on the part of learners (Bodner, 1986; Packer &Goicoechea, 2002; Glasersfeld, 1990). This view of meaning-making implies that learners are intellectually generative individuals; rather than empty vessels waiting to be filled (Rockmore, 2005). The emphasis on meaningful learning demands students to be creative and imaginative in dealing with their natural and social environment is suggested by scholars (Özdemir, 2007; Yilmaz, 2008; Bichelmeyer& Hsu, 1999).

Problem solving is one of the major strategies suggested by the constructivists' educators that could help students develop critical abilities, creativity and imagination. Very often learning science is equated with developing problem solving abilities, and achievement is measured by the number of problems which a student has correctly solved on a test (Bascones et al, 1985). From the constructivists perspective problem solving in physics should give opportunities for students to use their theoretical understanding about problem situations qualitatively before they use mathematical algorithms to solve problems. From this perspective problem solving is not only working on quantitative problems, as traditionally been done, but also requires applying the necessary concepts, theories, principles, laws, etc. (Bichelmeyer& Hsu, 1999).

Problem solving also requires understanding the meaning of the phenomenon/observable fact and using theories and finally representing the concepts using variables (Scott et al, 1991). It is not only working on quantitative problems but also it requires applying the necessary concepts, theories, principles, laws, etc to deal with real-life problem situations (Mbajiorgu& Reid, 2006). In order that students develop such capabilities constructivists suggest the importance of designing problems that demand conceptual understanding and require students to use their theoretical understanding to deal with real-life problem situations (Monk & Osborne, 1997; Mbajiorgu& Reid, 2006;Dunbar &Fugelsang, 2004).

In problem solving mathematical manipulation of formulas should not be seen as the end of physics learning as traditionally was practiced in many situations. However, this does not mean that mathematical manipulation is not important or useful but it means that equations are needed only after students have understood the qualitative meanings of the problem situations and then apply principles and laws to describe the problem situation qualitatively (Leonard, 1999).

Problems should also be chosen that illustrate key problem solving skills and help students learn how to use physical reasoning and concepts as an essential part of problem solving. They should also require careful qualitative reasoning that explicitly connects conceptual understanding to problem solving. Therefore, in order that students develop real-life problem solving competencies, problems should be designed and solved by placing students in real life problem situation in which they can use their theoretical understanding to deal with problem situations. In this circumstance students identify the relevant concepts and principles and justify the solution they have made and then describe how to apply the concepts and principles to find solutions (McDermott, 1990).

Despite the above arguments, research reports reveal that very often high school and college students often attempt to solve science problems by only focusing on mathematical manipulation rather than using their scientific reasoning skills (Halloun, 1996). Regarding students' problem solving competencies, some studies were conducted on students' problem solving competencies in physics. For instance, Malcolm et al (1995) have reviewed some studies conducted on students' problem solving competencies in physics. They noted that in many cases though students practiced problem solving very often their problem solving strategy was plug-and-chug problem solving without applying the necessary concepts that are used to describe and explain problem situations in real situations. Other scholars (e.g. Heuvelen, 1991; Thacker, et al, 1994; Leonard, 1999) also noted that although in physics problems should be seen in terms of basic concepts many students often use primitive formulae centered problem solving strategies. They further noted that although students could solve quantitative problems very-well they simply solve the problems without understanding the physics concepts that are used to deal with real-life problem situations.Hence they do not often understand the process of using conceptual knowledge to understand and explain natural phenomena (Scott, et al, 1991).

In problem solving mathematical manipulation of formulas should not be seen as the end of physics learning as traditionally has been practiced in many situations. However, this does not mean that mathematical manipulation is not important or useful but it means that equations are needed only after students have understood the qualitative meanings of the problem situations and then apply principles and laws to describe the problem situation qualitatively (Leonard, 1999). Problems should be chosen that illustrate key problem solving skills and help students learn how to use physical reasoning and concepts as an essential part of problem solving. They should require careful qualitative reasoning that explicitly connects conceptual understanding to problem solving.

Despite this, research reports reveal that very often high school and college students often attempt to solve science problems by only focusing on mathematical manipulation rather than using their scientific reasoning skills (Halloun, 1996). They also focus on equations and start manipulating them in an attempt to isolate the desired unknown, often inserting numerical values from the very beginning of the process (Leonard, 1999). When problem solving focuses on algorithmic manipulation without understanding the concepts that are used to describe the problem situation students are likely to reject scientific reasoning as irrelevant to any real-world decision making (Chinn &Malhorta, 2002**)**. Moreover, they tend to view solving a physics problem mainly as a task for selecting mathematical formulas to relate variables in the problem (Hammer, 1994). Hence, in order that students develop real-life problem solving skills, it is significance to place more emphasis on the semantic or the interpretation of physical situation rather than syntactic- the rules of knowing (Monk & Osborne, 1997; Mbajiorgu& Reid, 2006). Therefore, in order to understand the extent to which problem solving practices enhance real-life problem solving competencies among students it is significant to assess teachers' problem solving strategies.

As a result of traditional approaches many studies revealed that often problem solving is perceived by students as manipulating mathematical algorithms instead of viewing the underlying principles to solve problems. They also tend to view scientific theories as algorithms which can be used to answer problems (McDermott, 1990). In the traditional approach to problem solving many students solve problems without deeper analysis of problem situations or by engaging themselves in superficial mathematical manipulations (Redish& Steinberg, 1999). Hence they do not often understand the process of using conceptual knowledge to understand and explain natural phenomena (Scott, et al, 1991).

Scholars argue that the ability to solve problems depends not only on the learning of procedures but also on the ability to draw an appropriate ancillary knowledge (McDermott, 1990; Rief, 1995). However, due to the exclusive emphasis on algorithmic manipulation research revel that there is little correlation between students' ability to solve physics problems and their understanding of physics concepts. For instance, In Korea, Kim and Jae Pak (2002) made a study on the relation between the number of problems solved and their understanding of physics concepts. They found that althoughthe students did not have much difficulty in using physics formulas or mathematics in their problem solving experience, common difficulties in understanding basic concepts were observed. Finally, they came to a conclusion that there was little correlation between conceptual understanding and the number of solved problems (Kim and Jae Pak, 2002). Therefore, although students have enough experience in solving problems they would not develop real-life problem solving skills. This implies that solving as many problems as possible doesn't necessarily enhance students' competencies in solving real-life problems unless they are designed appropriately and solved by applying the necessary concepts in meaningful ways. Therefore, unless problems are designed that demand conceptual understanding it is less likely that they develop genuine real-life problem solving competencies (Trumper, 2006).

Research reveals that despite the increasing focus on the development of genuine problem solving competencies very often students approach to problem solving focuses on simply manipulating mathematical formulas that doesn't require usingtheir scientific reasoning skills in dealing with real-life problems. Research results also reveal that despite the inclusion of various problems in textbooks, many students were found to have serious difficulties in solving real-life problems (Idar&Ganiel, 1985). As a result, problem solving is viewed by students as an attempt to determine the value of one or more unknown quantities. Students' solutions to these problems are almost entirely formula centered – devoid of qualitative sketches and diagrams that contribute to understanding.

The researcher argues that one of the major problems related to students' difficulties in solving real-life problems is absence of providing context rich problems and require conceptual understanding in solving problems. In the Ethiopian context I couldn't find any effort made by science education researchers to assess the appropriateness of the problem solving strategies. Therefore, it is important to study the extent to which physics problem solving strategies employed by teachers enhance students develop real-life problem solving competencies.

1.2. Basic questions

The study attempted to find answer to the following basic questions.

- To what extent do physics teachers provide problems with their contexts
- To what extent do physics teachers demand students conceptual understudying in solving problems
- What are the major approaches that have been used by secondary school teachers in solving physics problems?

1.3. Objectives

The study was aimed at assessing the extent to which secondary school teachers provide and solve physics problems to help students develop real-life problem solving competencies. More specifically it was aimed at:

- To examine the extent to which the problems provided by teachers are conceptually demanding
- To assess the extent to which physics teachers relate problems with real-life situations and contexts
- To explore the dominant problem solving strategies teachers employ in solving problems

1.4. Significance of the study

This study could provide new insight about the problem solving practices that are employed by physics teachers. Most physics education researches have focused on the adequacy of problems given in textbooks and classroom practices. Others have focused on the capability of students in solving problems. However, this study focused on the appropriateness of the problem solving strategies. This study is not a mere repetition of what have been studied in certain contexts; rather it has raised new issues in science education research that could be used as a starting point for further investigation. Moreover, this study doesn't only provide new area for further investigation but also curriculum experts and textbook writers can benefit from the results of the study by considering their problem solving approaches and practices

1.5. Scope of the study

The study is conceptually delimited to identifying the problem solving strategies used by teachers in solving physics problems by assessing the appropriateness of physics problem solving strategies in enhancing real-life problem solving competencies. This study is delimited to Alamura secondary school of Hawassa city administration. Therefore, the conclusions that are made by this study only reflect the situation at the specified school.

II. RESEARCH METHODOLOGY

2.1. Research design

This study the researcher used a qualitative research methodology as a guiding framework in exploring the problem solving strategies used by teachers because of the following reasons. The first rationale for using a qualitative methodology was from my beliefs that understanding the actual classroom practices of teachers demands a close look at into the instructional process and this is only allowed in qualitative methodology (Guba and Lincoln, 1994; Wahyuni, 2012; Creswell & Plano, 2007; Göran, 2012; Higgs & Cherry, 2009). The second rationale for choosing qualitative methodology was due to my axiological assumptions that neutrally observing the realities of the world is impossible (Hill, 1984). In this regard, a qualitative research methodology gives freedom to generate meaning subjectively that would otherwise difficult using quantitative approaches (Guba& Lincoln, 1994; Thomson, 2011; Hsieh & Shannon, 2005; Cohen et al, 2000). The third rationale for choosing qualitative methodology was the freedom it gives to purposely focus on certain activities that could provide relevant data; rather than gathering evidence from large amount of data using random sampling (Kreuger and Neuman, 2006). Due to these reasons the researcher found a qualitative research design useful to collect, analyze and interpret data and draw meanings out of observational data.

2.2. Research methods

2.2.1. Subjects, Source of data and sampling techniques

After deciding on the research methodology and design it is important to decide on the sources of data. In order to understand the problem solving approaches employed by teachers in enhancing real-life problem solving competencies among secondary school students the researcher selected Alamura secondary school of Hawassa city administration purposely. The subjects of this study were physics teachers teaching at Alamura secondary school. In this study the researcher used grade nine, ten, eleven and twelve physics teachers as data sources. At Alamura secondary school there are 24 science stream classes. Out of these 12 classes i.e. 50% were selected randomly and each class was observed two times. Therefore, the number of observations made were 24.

2.2.2. Instruments of data gathering

In this study unstructured observation checklist was used. In order to determine the appropriateness of the ways teachers solve physics problems in helping students develop genuine real-life problem solving competencies the researcher developed criteria of assessment which was validated by both physics instructors and curriculum experts. The criteria were developed after thoroughly examining relevant literature and consulting physics teachers teaching at Hawassa University and Hawassa College of Teacher Education.

2.3. Validity and reliability

While qualitative research is recognized for its value in providing contextual and in depth understanding of research problems it is often criticized about the legitimacy of the outputs of qualitative inquiries because of their failures in ensuring validity and reliability (Kelliher, 2005;Shentton, 2004). In this regard, the researcher argues that because qualitative research is based on entirely different assumptions, have different research purposes, and also the inferences they made are quite different from quantitative researchers the use of similar criteria of rigor for judging qualitative inquiries is inappropriate (Thompson, 2011; Bashir et al, 2008; Hsieh & Shannon, 2005). Therefore, it is important to ensure the findings of qualitative inquiries to be valid and reliable by adapting relevant criteria.

One of the key criteria addressed by positivist researchers is that of internal validity, in which we seek to ensure that whether a certain study measures what it actually intended to measure (LeCompte&Goeth, 1982). In qualitative research analysis this means that the extent to which the researcher is able to present data as it is without distortion (Merriam, 1998; Guba and Lincoln, 1989). In this regard, the researcher attempted to record the whole process and then transcribe later so that the data are presented without distortion. Moreover, to make the findings validthedata were directly quoted from the observation so that one can judge how consistent is the discussions and conclusions with the data.

The other criticism from quantitative researchers to qualitative studies is the issue of external validity. The notion of external validity, which is concerned with the ability to generalize from the research sample to the population using the principle of randomization and applying statistical tests, is one of the key criteria of determining the quality of good quantitative research (Kreftng, 1991, Merriam, 1998, Shenton, 2004, Mays & Pope, 1995). However, in qualitative research because the sampling is purposive the researcher cannot extrapolate from the sample to the population (White and Marsh, 2006). In order to ensure external validity attempts were made to describe the whole process of data collection, data coding and interpretation in order to allow other researchers follow the same procedure to repeat the research process so that they can apply it in other situations and contexts. This would enable other researchers to analyze the same data in the same way and come to essentially the same conclusions (Mays & Pope, 1995)

The other important issue is the issue of reliability. Reliability is related to objectivity and is measured in quantitative content by assessing inter-rater reliability. However, in qualitative research findings are confirmed by establishing clear links between the data and the conclusions (White and Marsh, 2006). In other words, it is concerned with reporting the findings from the perspectives of the data sources rather than from the researcher's point of view (Thomson, 2011). In this study the researcher attempted to be objective by linking the data with the interpretations and the conclusions. Thus, to ensure reliability the researcher attempted to show how the necessary relationships that exist between the raw data, the discussions and the conclusions(Bashir et al, 2008; Thomson, 2011; Thomas, 2006). The researcher provided typical data together with the analysis and interpretation. Reliability in qualitative research can also be done by providing evidence how the researcher accounts for changing conditions in the phenomena (Merriam, 2002; Morrow, 2005). Because this study was conducted within a very short period of time the issue of reliability is not a problem.

2.4. Method of data analysis

Data analysis and interpretation in qualitative content analysis requires coding raw data and generating certain analytical categories followed by interpretation or giving meaning to raw data **(**Starks & Brown, 2007; Given, 2008; Elo&Kynga, 2007).

2.4.1. Data coding and category construction

Data analysis and interpretation in qualitative content analysis requires coding raw data and generating certain analytical categories followed by interpretation or giving meaning to raw data (Starks & Brown, 2007; Given, 2008; Elo&Kynga, 2007). Categories are analytic units developed by qualitative researchers to conceptually organize findings related to a phenomenon (Given, 2008). In qualitative studies categories are mainly determined after data gathering and will cover the main areas of the content (Cohen, et al, 2000). However, categories must reflect the purpose of the research, must be exhaustive and mutually exclusive (Cohen, et al, 2000). In this study the researcher developed categories after thoroughly examining relevant literature and after going to the textbooks and then validated through peer reviews. The data obtained from the observation were tabulated into their respective categories because of categories are analytical tools to organize raw data (Given, 2008; Zeinaloo, 2004). After all the data were coded openly the researcher organized the raw data into their respective categories for analysis. After relevant data were brought into their analytical units or the indicators selected they were interpreted with respect to the criteria developed.

III. DISCUSSION OF FINDINGS

The study was aimed at assessing the extent to which secondary school teachers provide and solve physics problems to help students develop real-life problem solving competencies. More specifically it was aimed at:

- To assess the extent to which physics teachers relate problems with real-life situations and contexts
- To examine the extent to which the problems provided by teachers are conceptually demanding
- To explore the dominant problem solving strategies teachers employ in solving problems

To enhance students' problem solving competencies teachers have provided and solved many problems and solved in the classrooms. However, engaging students in problem solving activities doesn't necessarily help students to develop real-life problem solving competencies unless the problems are provided with their contexts and solved in such a sway that they demand conceptual understanding (Monk & Osborne, 1997). In order that students benefit from problem solving activities it is important to provide context-rich problems that could place the students in real life situations. It was also argued that problem solving is not only working on quantitative problems and learning of procedures but also it demands qualitative reasoning that explicitly connects conceptual understanding to problem solving by identifying and applying relevant concepts and principles to solve real life problems.

The problems provided and solved by teachers were categorized into three groups. In the first category were grouped problems that are provided by describing the physical situations of the problems and solved without relating to their theoretical concepts. In this category were also placed those problems that only apply mathematical formulas to arrive at the solutions of the problems. In the second category were placed the problems that were provided with their contexts or descriptions of the physical situations of the problem but are solved without conceptual analysis and by only relying on mathematical formulas to arrive at the solutions of the problems. These two categories are similar in their emphasis on mathematical algorithms and their absence of qualitatively describing the relationship between or among the variables and are only different in the ways they provide problem situations. In the third category were grouped the problems provided with their contexts, solved by integrating physical and mathematical reasoning. In the table below are given the number and percentage of observations in each category.

Table 1: Number and percentage of occurrence based on the three categories

Grade level	Frequency of observation	Problems given without their contexts and solved only mathematically	Problems given with their contexts and solved only mathematically	Problems given with their contexts, solved conceptually
	N=24	N(%)	N(%)	N(%)
9	6	1 (16.6)	5 (83.33)	0 (0)
10	6	2(33.33)	4 (66.66)	0 (0)
11	6	3(33.33)	3 (50)	0 (0)
12	6	1 (16.6)	4 (66.66)	1 (16.6)
Total	24	7 (29.16)	16 (66.66)	1 (4.1)

In the following three sections are presented the data obtained from classroom observations together with discussions with typical examples.

3.1. Problems without contexts and solved only mathematically

Based on the data obtained from classroom observation there are 7 i.e. 29.16% of the problems were provided without describing the physical situation of the problem and solved by simply manipulating mathematical formulas. The following case is taken from one classroom observation at grade nine.
The teacher wrote on the blackboard the following question.

Calculate the increase in length of a 50cm brass rod that is heated from 35^oc to 85^oc.
After writing the questionthe teacher directly solved the problem in the following manner.
Given
Lc=50cm=0.5m, To= 35^oc, Tf= 85^oc, C= 1.9 x 10^{-5} /^{o}c
Solution:
Use the formual ΔL= Lc$C\Delta$T
ΔT= Tf-To= 85^oc-35^oc = 50^oc
ΔL = 0.5mx1.9 x 10^{-5} /^{o}cx 45^oc= 95mx 10^{-5} m= 0.00095m

This problem should have been given by first describing the problem situation, for instance by drawing a diagram to show how a brass rod expands when it is heated. In solving thisproblem,the teacher should have been describe the problem situation in such a way that for instance, by telling students that when a certain material is heated it expands and the extent to which the material is expanded depend on certain physical quantities. After doing so it was also important to relate the physical situation with the variables qualitatively. This can be done by describing that before the rod was heated it was at a temperature of 35^oc and after heat was supplied its temperature was increased to 85^oc therefore, the change in temperature becomes 50^oc. After this it was important to give the mathematical expression of the law of linear expansion i.e. ΔL= LcΔT. it is after this that mathematical manipulation is important. However, the above problem is solved by directly applying the mathematical expression without any qualitative analysis.

Three important things are missed in the above case. The first one is lacking to provide the problem situation. The second one is lacking to explain the meanings of the physical quantities as well as how they are interrelated to each other qualitatively. The third one is absence of justifying the solution of the problem in any ways. This problem was provided with its context and also didn't require any sort of conceptual understanding. The following case is taken from grade ten classroom observations.
"Find the kinetic energy of a rotating body with moment of inertia 0.004kg and angular velocity of 0.5 rad/s."

Use KE= 1/2Iw^2. Substitute in known values: KE= ½ x 0.004x 0.5^{2} = 0.0005J

In the above problem the teacher should have described the problem situation by showing the nature of the rotating object using diagrams by qualitatively describing the relationship among kinetic energy, moment of inertia and angular velocity. After doing that the teacher should have been explained how an increase or decrease of moment of inertia and angular velocity affect the magnitude of the kinetic energy of the rotating body before applying the mathematical expression to solve the problem. However, the above problem on the one hand is not provided with its context and on the other hand is solved by only applying the formula, KE=1/2Iw^2 by following certain steps to arrive at the solution of the problem.

From the above two cases it is possible to infer that they do not only lack to describe the physical situations of the problems or place problems in their contexts but also lack to qualitatively explain the physical relationship between or among the variables of the mathematical expressions that are used to solve problems. They are algorithmically oriented that do not demand any conceptual analysis.

3.2. Problems given with their contexts and solved only mathematically

Based on the data obtained from classroom observation, there are 16 i.e. 66.66% of the problems were provided by describing the physical situation of the problem.Although these problems are given with their contexts similar to the previous cases they were solved only by mathematical manipulation of equations at the expense of qualitative analysis of problem situations. The following case is taken from grade 9 classroom observation. The topic was motion in a straight line. “Imagine a ball dropped from a height of 4.0m. How long would it take to hit the ground?”

The teacher solved the problem in the following manner. First he wrote the formula on the blackboard. $S=ut+1/2at^2$ and then he directly applied it for solving the problem. The only thing he did was telling the students how they can find the solution using the formula. In solving this problem, the teacher should have been described the law quantitatively that the path covered by the falling ball is the product of its initial velocity and the time taken to reach at the ground plus half of the products of acceleration and the square of the time taken. After this it is possible to find the unknown variable by algorithmically manipulating the variables of the mathematical formula. Despite this in solving the above problem exclusive emphasis is placed on manipulation of mathematical formula at the expense of qualitative analysis of the problem situation.

The following case is taken from Grade 10 physics textbook page 9.

An arrow is fired vertically with an initial velocity of 35m/s. find its velocity after 3seconds. Using the table layout seen earlier we get:

S(m)	U(m/s)	V(m/s)	a(m/s2)	t(s)
Unknown	-35	?	9.81	3

Notice we have entered -35m/s for the initial velocity. We are therefore setting the downwards direction as positive. V=U+at. V=-35m/s + (9.81m/s^2 x 3s). V= -5.6m/s (to 2 significant figures). Notice the velocity is still negative as it is still travelling upwards

In the above case the writers’ attempted to show the problem situation by describing how an arrow fired with certain velocity is going upwards to reach a certain point after 3 seconds. In order to solve this problem the textbook should have described the nature of the motion qualitatively and provide the relationships among the variables of the concept still in a qualitative manner and finally applying mathematical expressions to arrive at a solution. However, the above problem is solved only by recalling the mathematical expression and inserting the numbers given to the formula to arrive at the solution. The writers do not describe why a negative sign was entered into the expression and also do not make clear of the actual path of the arrow by indicating the different points that it could pass. Therefore, instead of trying to explain the motion qualitatively by describing how variables are interrelated to the other relationship between the variables of they directly apply the mathematical formula in solving the problem. On the other hand the justification they made to believe the results of the solution is exclusively mathematical than physical. The justification made to believe the solution of the problem computational correctness; rather than integrating both mathematical and physical reasoning.

The following case was taken from classroom observation of grade eleven. The question was provided in the following manner.

The driver of a train travelling at 40m/s applies the brakes as the train enters a station. The train slows down at a rate of 2m/s. The platform is 400m long. Will the train stop in time?

The teacher solved the problem in the following manner. Given: u=40m/s, v=o m/s and a=2m/s^2.

The teacher wrote on the blackboard the formula and then directly applied it for finding the solution. Regarding the waysthe problem was provided, the teacher attempted to describe the motion by giving real life example. This problem doesn’t only require to find numerical answers but to find whether or not the train stops in the specified time. However, in solving the problem the teacher didn’t describe the problem situation qualitatively and also he directly stated the equation that would be used to solve the problem. The problem solving strategy is identifying the known variables for which numerical values are and are not given and then selecting the mathematical expression to solve the problem by only manipulating the formula to find the answer. Generally, from the observations made although the problems were provided with their context as they are presented in the textbooks, the ways teachers solve these problems were not conceptually demanding. Instead they use traditional problem solving strategy that do not demand any conceptual analysis

3.3. Problems given with their contexts and solved conceptually

Based on the observation made there are 1 i.e. 4.1% of the problems wereprovided with its context by showing the problem situation so that students are able to make sense of the phenomena and relate to their real-life experiences and is solved by conceptually integrating the physical and mathematical reasoning by qualitatively describing and explaining the problem situation and the variables and finally trying to arrive at the solution by both interpreting the problem situation and mathematical manipulation.

The following case is taken from grade twelve classroom observation. The problem was provided in the following manner.

A capacitor of capacitance 0.00100 μF has a 12.0V battery connected across it, as shown in figure. (a) Calculate the charge in the capacitor (b) A break develops in the circuit A. The two ends of the wire at the break are near to one another, so they behave as a capacitor of capacitance 20 pF.The circuit effectively the circuit in figure 4.61(b). When this broken circuit is on, with both capacitors initially uncharged, what will be: (i) the total circuit capacitance? (ii) the charge on each capacitor? (iii) thep.d. across each capacitor?

The teacher solved the problem by trying to relate the problem situation with students' real-life experiences. More emphasis was placed on the physical or geometrical aspect of the problem situation so that students are able to understand the problem situation and use their physical reasoning and mathematical skills in solving the problem. The problem required students first to understand the qualitative meaning of the problem situation then solving them by applying their physical and mathematical reasoning to justify the solutions

IV. CONCLUSIONS

Regarding problem solving the researcher argues that unless students are able to understand the qualitative meanings of concepts they less likely develop genuine problem solving competencies. Although many problems were provided together with their contexts so that students are able to relate to their daily experiences most of the problems were solved by following certain mathematical steps to arrive at solutions. As has been presented in the preceding section most i.e. worked examples were given with their contexts. However, these problems were solved in the classroom without making any conceptual analysis. On the other hand, out of the 24 observations made only in one class that problem was given with its context and solved con conceptually. Only 7 i.e. 29.16% of the problems were given without their contexts and solved mathematically.

Almost all classroom worked examples i.e. about 95.83% emphasize on manipulation of formulas in solving quantitative physics problems that provide detailed prescriptions on what steps students should follow in order to find numerical answers. Moreover, most of the problems are solved by employing the very traditional "Given, Required and Solution" approach that describes what variables are included in the questions, to which variable/s is/are numerical values are or are not given and then apply formulas to find correct answers. Very often first the formulas are provided, the numerical values of the variables are given, what is required is given, and finally the numerical values of the variables are inserted to the formula to reach at the solution. In solving these problems what is needed is only to remember the formulae and identify the unknown variables and insert the values given in the formula that doesn't demand any qualitative understanding of the problem situation without giving meaning or interpreting the physical situations. The other but somewhat similar strategy employed by the textbooks in solving physics problems is what educators call "Means-end analysis". Means-ends analysis means that searching for equations or formulas in an attempt to isolate the desired unknown by inserting numerical values to determine the solution.

In this approach the teachers state the principles without describing how the variables involved can be connected to the variables specified in the problem by collecting information to determine whether variables are known or desired. They often begin with the desired quantities and look for equations including that quantity then go to looking for the unknown physical quantity; rather than decomposing the problem situation in to its constituent elements to find the answer from the given information. They also focus on searching for equations or formulas in an attempt to isolate the desired unknown by inserting numerical values to determine the solution without making any association between the problem situation and the underlying physical principles. Therefore, it can be concluded that the ways physics teachers solve problems doesn't help students develop real-life problem solving competencies.

V. RECOMMENDATIONS

Based on the findings of the study the following suggestions were made. It is argued in the preceding sections that in order that students develop real-life problem solving competencies problems should be designed in such a way that they are rich enough in describing problem situations and require students to apply their conceptual understanding in dealing with real-life problem situations. Moreover, problems should also require students to give meaning to problem situations qualitatively before they are going to solve problems algorithmically. In contrary when problems are designed by focusing on algorithmic manipulation at the expense of conceptual analysis studentstended to look problem solving as simply manipulation of mathematical expressions that doesn't demand any sort of conceptual understanding. The study concluded that the ways physics teachers solve problems doesn't help students develop real-life problem solving competencies. This is evident from the observation data collected from Alamura secondary school of Hawassa city administration. However, it should be noted unless problems are given in such a way that they require students conceptual understanding it is less likely that they develop real-life problem solving competencies. Although the study is conducted in one school from the reviewed literature and the data sought from the specific school the researcher beliefs that the problem is prevalent in the Ethiopian secondary schools. Therefore, the study recommends that the government of the ministry of education of the federal democratic republic of Ethiopia to revise its physics education textbooks and teaching practices consistent with contemporary educational theories. Moreover, Hawassa city administration should try to arrange relevant trainings for physics teachers so that they will be equipped with relevant knowledge and skill of teaching physics specifically on their problem solving skills.

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