



Constraints of Students' Mathematical Problem Solving and Proving Skill Competences, the Case of Four Preparatory Schools in Guraghe Zone

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Abstract

The objective of this research study was to assess the constraints in the students' mathematical problem solving and proving skill competences and propose solutions in order to overcome these problems (or the constraints). A mixed design (quantitative and qualitative designs) approach was used to collect data from the concerned stakeholders involved in the teaching and learning of mathematics. The study was carried out at four preparatory schools in four Woredas of Guraghe zone. Purposive sampling approach was used to select the sample Woredas and preparatory schools and simple random sampling approach was used to select sample section and sample students. As a result, 293 students were taken (70 students were from Yaberus Secondary and preparatory school, 62 students were from Emdibir, 72 students were from Butajera and 89 students were from Abafiransua secondary and preparatory school). Questionnaires were administered to these students in order to collect the data for the study.

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Results of the research showed that some of the constraints identified were students' poor potential: to identify and use appropriate mathematical problem solving and proving strategies and mathematical keywords or indicators, to put connections among mathematical concepts and procedures as well as mathematical ideas with different real world situations, to transform givens in to solutions or required, family and society negative attitudes about mathematics. Moreover, teachers' method of teaching mathematics and lack of opportunity for using any type of technology (computer program and software) aggravated the problem. It was found that the problems are multifaceted and accordingly the solutions require overall effort from all concerned stakeholders.

Keywords: Mathematics; skill; Preparatory.

1. Introduction

1.1 Background of the study

In view of growing worldwide importance of the usage of mathematics in science, technology and everyday life, research on problem solving skills and students' learning and teaching in school and university have become a prominent topic in the recent decades. Professed that prioritization of mathematics teaching and learning in the bid for national development is in inevitable [10]. Mathematics is the aggregates of mathematical problem solving, statement proving skills and the theoretical knowledge. Problem solving is the process through which required solutions for a given solving as "a process of moving from a given state to a goal state with no obvious way to progress from one state to the other state" (mathematical problem solving encompasses the use of knowledge, skills and strategies to solve problems" [11]. "Problem solving is the most important component of mathematics" [12]. The ability to solve and justify problems is the ultimate goals of mathematics" [13]. The mathematical processes that support effective learning in mathematics include problem solving, reasoning and proving". The prominent and powerful tools for a person to have good competencies in solving and proving mathematical problems, which are marked by different investigators, are the general problem solving strategies and methods of mathematical proving, ability to identify key words during mathematical problem solving and proving, use of appropriate diagrams for mathematical problems solving and proving, use of worked examples for the development of problems solving and proving skills, ability to personalize and relating mathematical problems with real word experience, language and culture similarity in the learning of mathematics, students' positive attitude towards mathematics and use of technology for mathematical problem solving and proving. The core study of this research is thus, to identify the existing constraints around the students and to improve students' mathematical problem solving and proving skill.

1.2 Statement of the problem

Incorporating general problem solving strategies in teaching mathematical problem solving and proving is very mandatory for alleviating the difficulty that students faced while they are solving and proving mathematical statements. Problem-solving strategies, according to [13], are what we do in our heads as we make sense of and solve problems.' They are our tools for simplifying problems and revealing the possible paths to solutions'. Developing students problem-solving abilities can be a challenging task. Building problem-solving skills

through the teaching of strategies requires attention to building mathematical skills and the thinking process [13]. One of the most commonly referenced approaches to teaching problem solving involves the use of keywords. This also has been described as direct translation. Students are taught to look for particular cue or indicator words in their word problems. The typical strategy is to search for a keyword information such as “more” which can sometimes mean “to add”, and use this information to directly translate the problem into its computational form [14]. It is, of course, also easy to write story problems with key words alone, that suggest incorrect operations for the problems. Problems related to learning Mathematics are common Phenomenon among students around the world [15]. This holds true in the Ethiopian context too. As Mathematics teachers in secondary Schools, Preparatory schools, Colleges of Teachers Education and University, we had the opportunity to observe closely the overall competencies of students in mathematics problem solving and proving skills, which is unsatisfactory. According to the Collins English Dictionary, a constraint is something that limits or controls what you can do. These initiated us to do research on the problem.

1.3 Objectives of the study

1.3.1 General Objective of the study

The general objective of this research was to assess the constraints in the students’ mathematical problem solving and proving skill competences.

1.3.2 Specific Objective of the study

The specific objectives of this research were:

- To assess existing problem in relation to the teaching and learning of Mathematics.
- To identify the major reasons for students' inability to solve mathematical problems.
- To identify the major reasons for students' inability to prove mathematical statements.
- To indicate solutions for the identified problems.

2. Materials and Methods of the study

In this chapter, the study presents: the basic research questions, the research design and Methodology of the study. Methodology of the study presents the following: study population, sampling techniques, sample size selection, tools of data collection, procedures of data collection and techniques of data analysis.

2.1 Basic Research Questions

This study was intended to answer the following basic research questions:

- a. What were the basic problems that exist in the teaching and learning of preparatory schools

mathematics?

- b. What were the major reasons for the students' inability to solve mathematical problems?
- c. What were the major reasons for the students' inability to prove mathematical statements?
- d. What actions to be taken for the problems to be identified based on the finding?

2.2 Research Design

To investigate the constraints in the students' competencies of mathematical problem solving and proving skills, it was preferable to use different data collection strategies. That is different designs and instruments (triangulation of instruments). The more we use different designs and instruments, the more our data will be deep, reliable and valid. If you generate a finding by a qualitative method, perhaps you can check it by using a quantitative data collection method, [16]. In this research study, the researchers used mixed designs of quantitative and qualitative designs.

2.3 Methodology of the study

2.3.1 Study population

The study population was Preparatory schools students in Guraghe Zone, SNNPR, Ethiopia.

2.3.2 Sampling Techniques

1. Sampling is defined as:

- the act, process, or technique of selecting a suitable sample; or
- Specifically: the act, process, or technique of selecting a representative part of a population for the purpose of determining parameters or characteristics of the whole population or
- A small part selected as a sample for inspection or analysis ask a sampling of people which candidate they favor the introduction or promotion of a product by distributing trial packages of it.

In this research study the researchers had used two types of sampling techniques. These were purposive sampling technique and simple random sampling technique. The researchers used purposive sampling technique for selection of the sample preparatory schools and sample Woredas and Simple Random sampling technique for selection of the sample students and sample section. The reasons why the researchers used the two sampling Techniques are seen below: Purposive sampling (also known as judgment, selective or subjective sampling) is a sampling technique in which researchers rely on his or her own judgment when choosing members of population to participate in the study. Purposive sampling is a non-probability sampling method and it occurs when "elements selected for the sample are chosen by the judgment of the researchers. Researchers often

believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money”. And

A simple random sampling is a subset of a statistical population in which each member of the subset has an equal probability of being chosen.

2.3.3 Sample Size Selection

This research study was planned to be studied on the entire population of all preparatory schools in Guraghe Zone. But, it was difficult to do this and therefore it is a must to settle a sample. According to [17], sample was a portion of elements taken from a population that is considered to be representative of the population. Taking this in to consideration, among the thirteen Woredas in Guraghe Zone four (4) of them were selected by the method of purposive sampling for the study. These were Abafiransua secondary and preparatory school, Yaberus secondary and preparatory school, Butajira secondary and preparatory school and Emdibir secondary and preparatory school. In order to collect data from the selected secondary and preparatory schools, questionnaire was used for social and natural sciences students. As this size of population is large, selecting sample from the total population was necessary.

Using yemane’s sample size determination formula for determining the sample size of this study:

$n = \frac{N}{1+Ne^2}$, Where N refers the total population and in 95% confidence level, e refers the error.

$$n = \frac{1100}{1+1100*(0.05)^2} = 293.3333333333333.$$

Thus, using simple random probability sampling method 293 students were selected as sample students for the study. This is supported by [18] cites, “sample sizes larger than 30 and less than 500 are appropriate for most research.”

2.3.4 Tools of data collection

In this research study the tool that was used to collect data was Questionnaire for those sample students to assess students’ background about using important and relevant inputs for solving and proving mathematical problems. General Information concerning about students experience in solving and proving different type of mathematical problems in the classroom, the researchers included students and mathematics teachers as a source of data to build constructively the study. A written questionnaire (self-administered questionnaire) is data collection tool in which written questions are presented that are to be answered by the respondents in written form [19]. So, the researchers designed questionnaires/ Likert Scale for the sample students to obtain the right information. The main reason why the researchers used questionnaire/Likert Scale was that the researchers believe that the questionnaire/Likert Scale enables students to explain their lived-in-it experiences about the study.

2.4 procedures of Data Collection and Techniques of Data Analysis

In this research study in the process of data collection, series of steps were taken. The first step in this process was simply administering those questionnaires for the sample students to gather right information about students' mathematics background, students' mathematical feeling, and students' family support for developing important mathematics skills etc. This was planned to collect relevant information about their teaching or instructional approach and students' general experiences in mathematics learning. To analyze the data generally statistical method of data analysis (SPSS) was used. In the data analysis three procedures have been put in to considerations. The first procedure was organizing the collected data based on each items of the questionnaires. The second procedure was presenting the data using different SPSS options. The third procedure was analyzing and discussing data collected from students' questionnaires.

3. Result and Discussions of the study

In this research study 293 students were included from four preparatory schools selected randomly from Gurage zone. i.e. 70 students were from Yaberus preparatory school, 62 students were from Emdibir preparatory school, 72 students were from Butajera preparatory school and 89 students were from Abafiransua preparatory school. For data analysis SPSS software was used.

Descriptive analysis

Note that:

SA= strongly agree, A= agree, U = undecided, D = disagree, SD = strongly disagree

Statement on attitude and self-confidence versus student's response

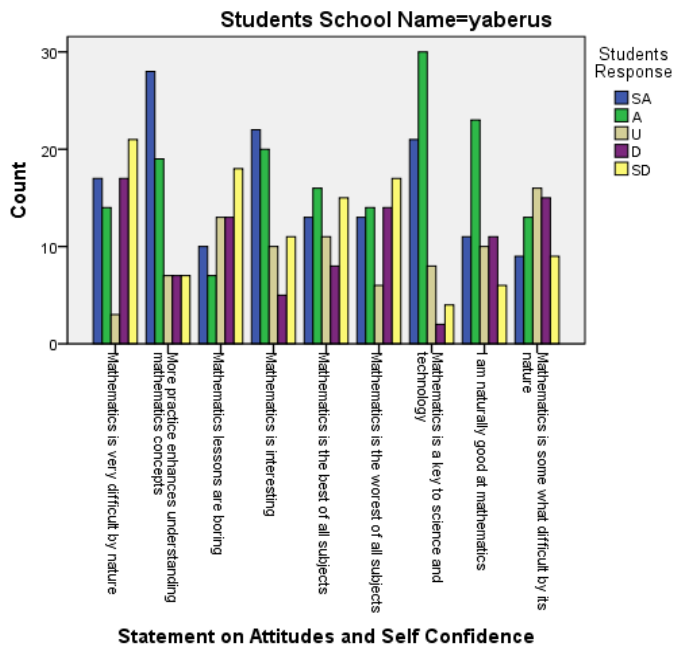


Figure 3.1: Bar char

Result of descriptive analysis from figure 3.1 indicates that students in Yaberus preparatory school have no attitude problem towards mathematics subject.

Statement on attitude and self-confidence versus student's response

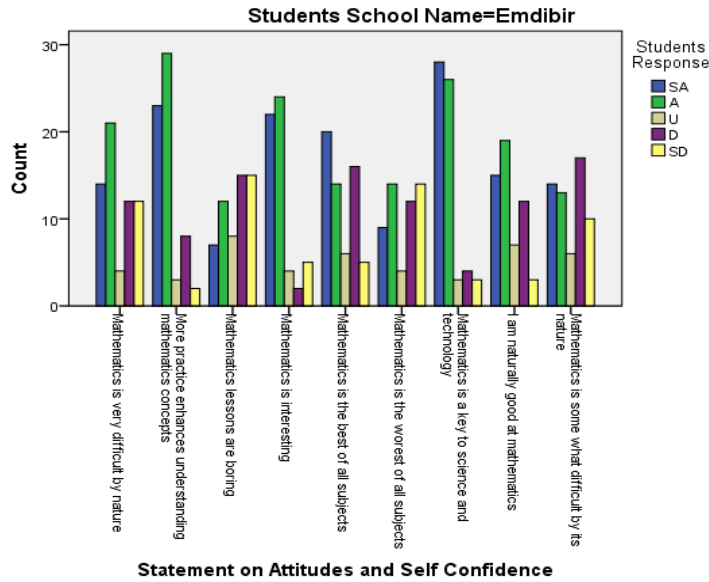


Figure 3.2: Bar chart

The result in the Figure 3.2 indicates that there is problem of attitude towards mathematics subjects that is wrong assumption which assume that mathematics subject is very difficult by its nature.

Statement on attitude and self-confidence versus student's response

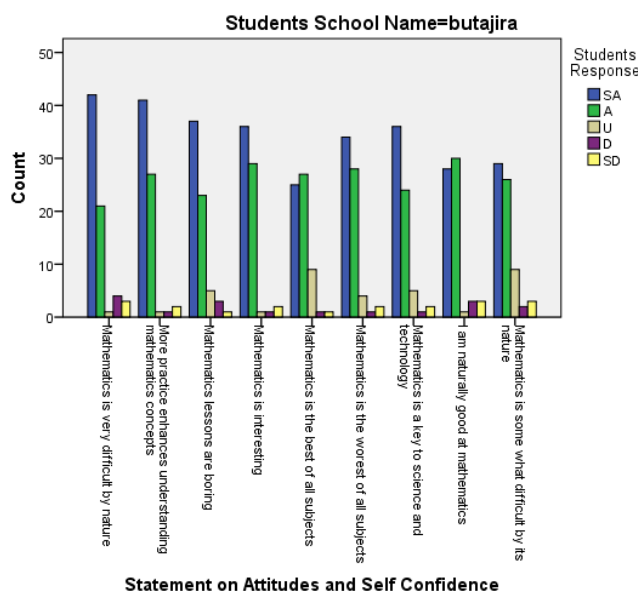


Figure 3.3: Bar chart

The above results from Figure 3.3 indicate that there is problem of attitude towards mathematics subject in Butajera preparatory School relative to Yaberus and Emdibir preparatory Schools. This means students assume that mathematics subject is very difficult and its lessons are boring.

Statement on attitude and self-confidence versus student's response

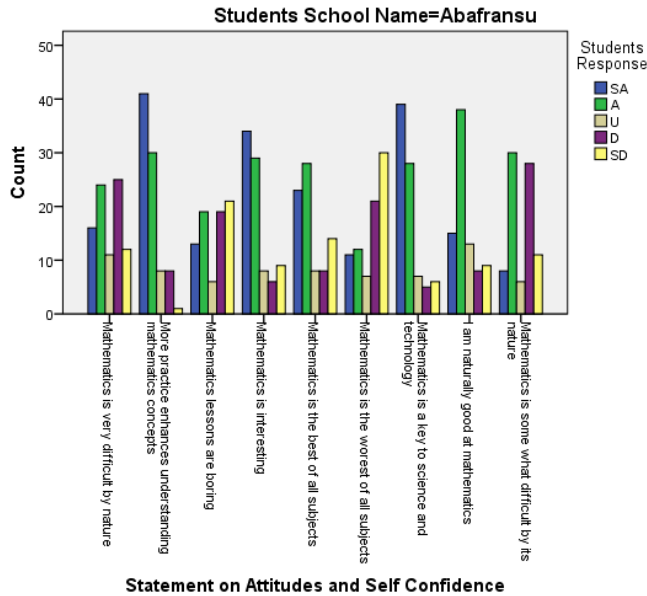


Figure 3.4: Bar chart

The result of analyses from Figure 3.4 indicate that attitude towards mathematics subject is not big problem in Abafiransua school.

Teaching Resources * Frequency of Teaching resource used

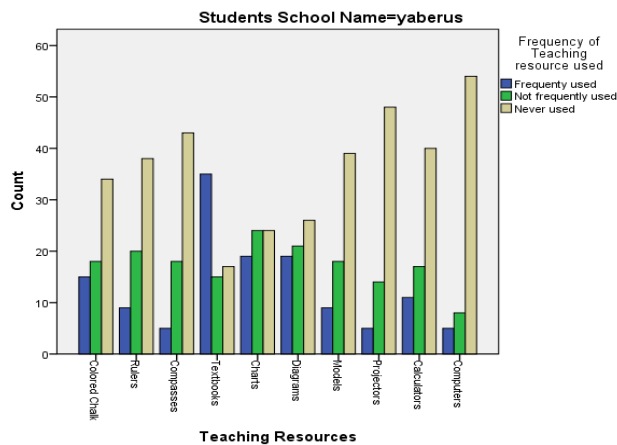


Figure 3.5: Bar chart

The result of analysis in the Bar chart in the figure 3.5 indicate that in Yaberus School except text book

materials like colored chalk, rulers, compasses, charts, diagrams, models, projectors, calculators and computers are not frequently used. This indicates that in this school only text book is frequently used for learning and teaching process.

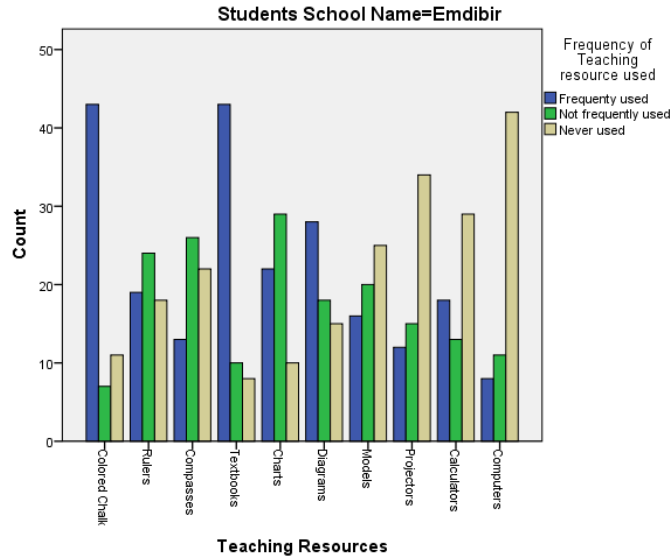


Figure 3.6: Bar chart; Teaching Resources * Frequency of Teaching resource used

The result of analysis from figure 3.6 show that materials such as colored chalk, text books and diagrams are frequently used in Emdibir school. The result also indicate that teaching materials like computer, calculator, projector models are never used but rulers, compasses and charts are materials that are not frequently used.

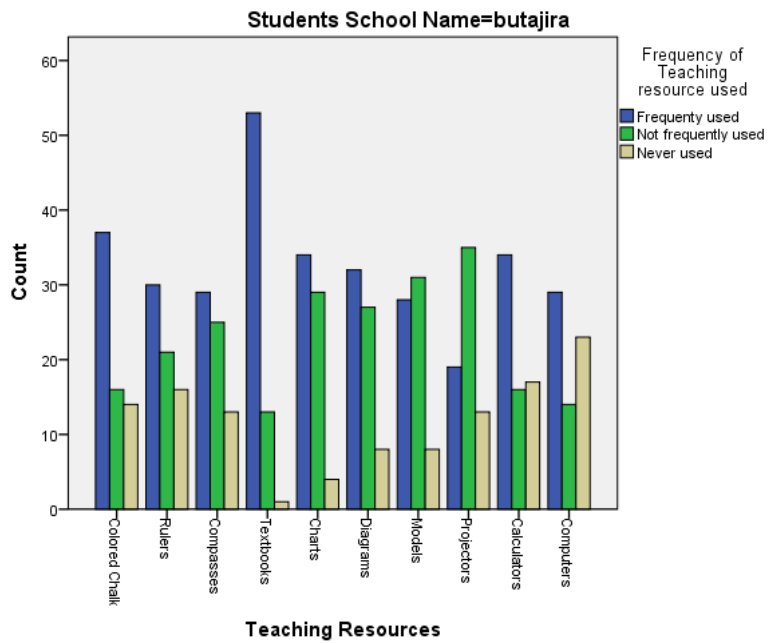


Figure 3.7: Bar chart; Teaching Resources * Frequency of Teaching resource used

Both result of analysis in the figure 3.7(frequency) indicate that materials like models and projectors are not frequently in Butajera preparatory school used but others materials in this school are frequently used.

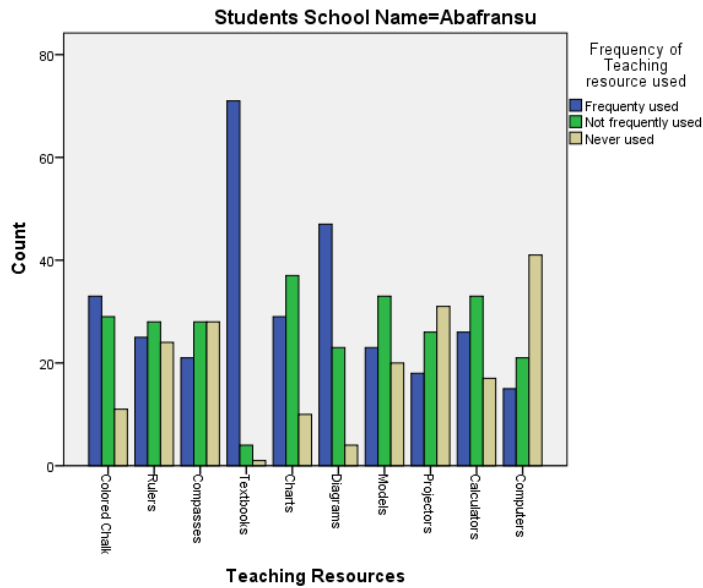


Figure 3.8: Bar chart; Teaching Resources * Frequency of Teaching resource used

The result of the analysis from Bar chart in figure 3.8 shows that there is shortage of materials like computers projectors, rulers and compasses in Abafiransua Preparatory School but Text book and Diagrams are frequently used materials in this school.

4. Conclusion

The main objective of this study was to assess the constraints in the students’ mathematical problem solving and proving skill competences. The study was based on the primary data collected from four preparatory schools i.e. Abafiransua, Yaberus, Emdibir and Butajera preparatory schools.

Based on the result analysis in the chapter 4, this study concludes that a class interaction of students is not a big problem on the students’ mathematical problem solving and proving skill competences.

This study conclude that there is shortage of materials like computer, projectors, compasses, charts, and models in the schools but there is no shortage of text book based on the data.

This study also conclude that there is attitude problem towards mathematics subject in some school that is the wrong assumption that mathematics is very difficult and its lessons are boring by its nature.

From the result we can conclude that student’s parent provides mathematics materials and encouragement for their students that improve students’ mathematical problem solving and proving skill competences.

This study also conclude that students’ ability, skill and experience towards solving and proving mathematical

problems is not a big problem based on the result of the study.

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