INVESTIGATING STUDENTS' UNDERSTANDING OF LINEAR EQUATIONS BASED ON SCHOENFELD'S MODEL

Nurulsheila Binti Jalaludin

Bachelor of Education Mathematics with Honours 2008
INVESTIGATING STUDENTS' UNDERSTANDING OF LINEAR EQUATIONS BASED ON SCHOENFELD'S MODEL

NURULSHEILA BINTI JALALUDIN
This project is submitted in partial fulfillment of the requirements for a Bachelor of Education with Honours (Mathematics)

Faculty of Cognitive Science and Human Development
UNIMAS
The project entitled 'Investigating Students' Understanding of Linear Equations Based on Schoenfeld’s Model’ was prepared by Nurulsheila binti Jalaludin and submitted to the Faculty of Cognitive Science and Human Development in partial fulfillment of the requirements for a Bachelor of Education (Mathematics) with Honours.

Received for examination by:

(Mr. Philip Nuli Anding)

Date:

09/06/08

Grade

A−
BORANG PENGESEHAN STATUS TESIS

Gred: A-

JUDUL: INVESTIGATING STUDENTS' UNDERSTANDING BASED ON SCHOENFELD’S MODEL

SESIE PENGAJIAN: 2007/2008

Saya NURUL SHEILA JALALUDIN mengaku membenarkan tesis ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Malaysia Sarawak
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja
3. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat pendigitalan untuk membangunkan Pangkalan Data Kandungan Tempatan
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tuan
5. **silakan tandakan (✓)

☐ SULIT (Mengandungi maklumat yang berdaur kepentingan seperti termaktub dalam AKTA RAHSIA RASMI 1972)
☐ TERHAD (Mengandungi maklumat Terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐ TIDAK TERHAD

(TANDATANGAN PENULIS) ________________________

(TANDATANGAN PENYELLA) ________________________

No 75, Jalan Ambar 5, Taman Ambar, 43800 Dengkil, Selangor.

Tarikh 16/05/2006

(Catatan: * Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda
** Jika tesis ini SULIT atau TERHAD, sila lamparkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sebab dan tempoh tesis ini perlu diklaskan sebagai TERHAD.)
ACKNOWLEDGEMENT

I would like to dedicate this acknowledgement to those who supported me directly and indirectly in preparing this final year project. First of all, I would like to thank Allah S.W.T for His Grace and Blessing in giving me strength and spirit in completing this research. Special thanks also go to my parents, brother, sister and other family members who supported and encouraged me.

I would like to express my special thanks and gratitude to the Principal of Sekolah Menengah Sains Kuching for giving me the opportunity and allowing me to conduct this study and not forgetting the teachers and also students of Sekolah Menengah Sains Kuching who are the respondents of this study for their cooperation and their time in completing the questions and interview. I sincerely appreciate their commitment in helping me complete this study. My appreciation also goes to my supervisor who helped me a lot through his guidance and comments in the preparation and completion of this project. Thank you for the commitment and contribution. Last but not least, special thanks also go to my friends and my course-mates for their encouragement, advice and support pertaining to my research.
TABLE OF CONTENTS

Acknowledgement i
Table of Contents ii
List of Figures iii
Abstract iv
CHAPTER 1: INTRODUCTION
1.1 Introduction 1
1.2 Background of study 3
1.3 Theories of human information processing 5
  1.3.1 Schoenfeld’s Model of Mathematical Cognition 5
  1.3.2 Atkinson and Shiffrin: Multi store Model of Memory 9
1.4 Problem Statement 10
1.5 Objectives of Study 12
  1.5.1 General Objectives 12
  1.5.2 Specific Objectives 12
1.6 Research Question 12
1.7 Definition of Terms 13
  1.7.1 Conceptual Definitions 13
  1.7.2 Operational Definitions 15
1.8 Conceptual Framework 16
1.9 Significance of the Study 17
1.10 Limitation of Study 18
CHAPTER 2: LITERATURE VIEW
2.1 Introduction 19
2.2 Students Knowledge of Mathematics 20
2.3 Thinking Skills in Mathematics 21
2.4 Knowledge and Understanding of Linear Equation 22
2.5 Schoenfeld’s Model of Mathematical Cognition 24
2.6 Problem-Solving Strategies 25
2.7 The other Related Research 26
CHAPTER 3: METHODOLOGY
3.1 Introduction 28
3.2 Location of Study 29
3.3 Population and Sampling 29
3.4 Operational Framework 31
3.5 Research Instrument 32
3.5 Research Procedures
   3.5.1 Think Aloud Method
   3.5.2 Written Answer
   3.5.3 Interview
3.6 Data Analysis

CHAPTER 4: RESULTS AND FINDINGS

4.1 Introduction
4.2 Results of Analysis
   4.2.1 Conceptual Knowledge of Linear Equation
   4.2.2 Others Conceptual Knowledge
   4.2.3 Procedural Knowledge in Linear Equation
   4.2.4 Others Procedural Knowledge
4.3 Problem-solving Strategies
4.4 Student's Model of Understanding
   4.4.1 Model 1
   4.4.2 Model 2
   4.4.3 Model 3
   4.4.4 Model 4
   4.4.5 Model 5
   4.4.6 Model 6

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 Introduction
5.2 Discussion
5.3 Recommendations
   5.3.1 Teacher and Teaching Process
   5.3.2 Students and Learning Process
   5.3.3 Others Researchers
5.4 Conclusion

References
Appendix
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>Atkinson and Shiffrin’s Model</td>
<td>10</td>
</tr>
<tr>
<td>Figure 1.2</td>
<td>Conceptual Frameworks</td>
<td>16</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>Operational Frameworks</td>
<td>31</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Model 1</td>
<td>52</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>Model 2</td>
<td>53</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>Model 3</td>
<td>55</td>
</tr>
<tr>
<td>Figure 4.4</td>
<td>Model 4</td>
<td>57</td>
</tr>
<tr>
<td>Figure 4.5</td>
<td>Model 5</td>
<td>58</td>
</tr>
<tr>
<td>Figure 4.6</td>
<td>Model 6</td>
<td>60</td>
</tr>
</tbody>
</table>
ABSTRACT
INVESTIGATING STUDENTS’ UNDERSTANDING OF LINEAR EQUATIONS BASED ON SCHOENFELD’S MODEL

Nurulsheila binti Jalaludin

This research is carried out to investigate Form Two students’ understanding of Linear Equations based on Schoenfeld’s model. Schoenfeld’s model is a model about mathematics thinking which includes four information processing components which are (1) the knowledge base, (2) problem-solving strategies, (3) monitoring and control and (4) beliefs and affects. This research applied only the first two components of Schoenfeld’s model. This research investigates what are the conceptual and procedural knowledge used by students when they answer questions about Linear equations, students’ problem-solving strategies and develop models of students’ understanding of Linear Equations. Data collection involves the method of triangulation whereby three types of data collected are the think aloud data, written document and interview. Six questions from the topic of Linear Equations are chosen and used to investigate Form Two students’ understanding of Linear Equations. The analysis of data indicated that there are four conceptual and six procedural knowledge used by students in order to answer questions about Linear Equations. Conceptual and procedural knowledge of fractions and perimeter are also used by students. The findings generate six models of Form Two students’ understanding of Linear Equations. This research is relevant to both teachers and students in teaching and learning of Linear Equations.
ABSTRAK

MENGENALPASTI PEMAHAMAN PELAJAR DALAM TOPIK PERSAMAAN LINEAR BERDASARKAN MODEL PEMIKIRAN SCHOENFELD

Nurulsheila binti Jalaludin

CHAPTER 1

INTRODUCTION

1.1 Introduction

Education is very important as it serves to complement national socio-economic development. Science and technology are crucial aspect to be learnt by the students including mathematics because it is a part of science. According to Curriculum Development Center that is CDC (2004), mathematics which is taught in primary and secondary schools are very important as it gives opportunities for the students to develop knowledge and skills of mathematics as well as promote higher order thinking skills, problem solving skills and applying mathematics in daily lives.
Learning mathematics is not just accepting the knowledge from the teachers, it requires students to explore, think, discover, adapt, modify and be innovative to change and face future challenges.

Research done by Tella (2007) in contemporary Nigeria stated that development of Industrial and Technological field caused students to take up science and related subjects especially mathematics. Mathematics is very important because it contributes towards economics development of a country. Therefore, mathematics is compulsory at all levels of schooling. Unfortunately, the result reported that students’ performance in mathematics at the end of secondary school has not improved in the past decade (Tella, 2007).

In Malaysia, mathematics’ curriculum faced so many changes up to these days. The development of mathematics curriculum is caused by the development of new concepts and techniques that changed the mathematics structure in late nineteenth century (Khoo, 1986). Furthermore, special development of mathematics’ curriculum had a big impact on the successfullness in many areas which involved mathematics such as biology, social science and economy. Other than that, development and extended use of mathematics imply an increase in the needs of specialist in science and mathematics (Khoo, 1986).

In mathematics, there are many topics to be learnt and taught at different ages. In United States, the sub-topics of arithmetic’s and algebra like addition and subtraction are taught at the early ages that are 5 to 7 years old. At the age of 7 to 8 years old, children start to learn multiplication and division (Howe, 1991). This continues with pre-algebra and Algebra I at the age of 11 to 13. Geometry would be the next topic at the age of 14 and continues by Algebra II at the age of 15. The harder topics such as trigonometry and calculus are the last, for students aged 16 and 17 (Howe, 1991). These levels were organized accordingly to students’ level of
acceptance or self-development (Wikipedia, 2007c). As the children get older, they are increasingly likely to make use of strategies and learning plans for effectiveness of learning other topics (Howe, 1991).

In Malaysia, knowledge of mathematics start at an early age of 6 years old at pre-school, then up to primary school, secondary school and university levels. Learning at secondary school level is divided into two which are lower and upper forms. This research focuses on the lower forms and concerns the topic of Linear Equations. The topic of Linear Equations topic is after the topic of Algebraic Expressions I and the fourth topic in the mathematics curricular for Form Two students. Linear Equations require some basic knowledge of algebra and mathematical operations such as addition, subtraction, multiplication and division. Important parts that should be learnt first are the terms used in this topic and the meaning of symbols such as equal sign, plus, minus, division and multiplication signs. At this level, only three learning objectives are stated to be accomplished. The first is to understand and use the concept of equality. Second, is to understand and use the concept of linear equations for one unknown variable and lastly is to understand the concept of solutions of linear equations for one unknown variable (Curriculum Development Centre, 2004).

There are many ways of teaching and learning mathematics (Woolfolk, 2004). The effectiveness of one style depends on the ability of students to accept it. According to Hiebert (1992), learning mathematics had a common accepted goal among mathematics educators that students should understand mathematics and being apart of the learning process. Constructivism is the most commonly used by mathematics educators whereby students participate actively in the classroom setting so that they can develop their own understanding on mathematics (Van de Walle, 2004).
1.2 Background of Study

The traditional method of teaching in the classroom does not prepare students to the modern world. Teacher should give more spaces for students to develop their own understanding and having student-centered classroom is a better way of teaching nowadays. Individual characteristics such as intelligence, cognitive styles and personality play important roles in learning and influence academic achievement (Tella, 2007).

Piaget in his work in 1969 emphasizes on how children go about making sense of their world by gathering and organizing information (Woolfolk, 2004). According to Piaget, there are four stages of cognitive development which are sensorimotor for the age group of 0 to 2 years old, preoperational stage for ages 2 to 7 years old, concrete operational stage for ages 7 to 11 years old and formal operational stage for 11 years old to adults. At operational stage, children are able to assimilate new information into existing schemes and accommodate children altering existing schemes or create new ones in response to new information (Woolfolk, 2004). These abilities help students learn mathematics since learning mathematics is not just accepting information but depends on learner’s activities and efforts.

Mathematics learning nowadays seems more on critical thinking whereby students develop their own understanding of mathematics (Tella, 2007). Developing our own understanding or knowledge is the basic idea of constructivism. Cognitive constructivism, grounded primarily in Piaget’s work, emphasizes individual construction of understanding in a situation. At this stage, social interactions among students offer opportunities for them to gain new knowledge and understanding of new situation (Piaget, 1976). Social constructivism, based on the Vygotsky’s work suggests that the process of social interaction is important in learning because knowledge is influenced by an environment, that is initially exists in the social
environment, and it is eventually internalized by individuals (Vygotsky, 1997). For example, students try to construct their own understanding of linear equations based on the knowledge that they have in the previous lesson which are algebraic equations in linear form and other mathematical operations.

The knowledge that the students received in the classroom enters the process of information processing where it tends to explain how human acquire information, sort and organize information or knowledge, and how to retrieve the knowledge when needed. There are three assumptions proposed on behavioral basis of information-processing processes. The first assumption is that information is processed in stages; (1) attending to sensory input, (2) transforming the input to mental image, (3) comparing mental image with information already stored in memory, (4) assigning meaning to image and (5) acting on the image in some way. The second assumption states that there are limits at every stage where the information can be processed even though there is an infinite amount of knowledge that human can attain at one time. The third assumption is about the idea of human information-processing system which is considered as interactive. The learning could occur when there is an interaction between an environment input and learners who process or transform the information (Hamachek, 1994; Miller, 1983).

Information-processing helps us understand how students learn and remember. This could be clearly defined in some models of human information processing like Schoenfeld's model or Atkinson and Shiffrin's model that would be discussed next.
1.3 Theories of Human Information Processing

There are several models that can be used to investigate students’ understanding of Linear Equations. In this research, Schoenfeld’s model of mathematical cognition is taken as the main model. Other related theories that would support this study are Atkinson and Shiffrin multi store model of memory and problem solving.

1.3.1 Schoenfeld’s Model of Mathematical Cognition

Schoenfeld’s model is one model about thinking. Schoenfeld proposed his model of thinking a few decades ago. Schoenfeld’s model includes four information processing components which are (1) the knowledge base, (2) problem-solving strategies, (3) monitoring and control and (4) beliefs and affects (Pressley & McCormick, 1995). There is also a fifth component which relates to instructional practices that promote effective mathematical cognition. Schoenfeld’s model also involves the information processing hardware which are short-term and long-term memories. National Council of Teachers of Mathematics or NCTM Standards (1991) considered all of the factors which Schoenfeld stated as being important in mathematics thinking and problem-solving. In 1987, Schoenfeld came out with a literature that shows the task of metacognitive reflecting upon students’ existing conceptions and can foster students’ critical, analytical, and reflective thinking. Students can evaluate these levels of understanding by discussing; interacting and negotiating meanings through appropriate learning activities on students centered formed (Afamasaga-Fuata‘I, 2006).

Schoenfeld’s model of mathematical cognition could be concluded as consistent and a good information processing model since it involves knowledge base, problem-solving strategies, monitoring and control and beliefs and affects. It
has a big impact on the development of new models of problem-solving instruction (Pressley & McCormick, 1995). In this study, researcher focuses only on the two components of Schoenfeld’s model of mathematical cognition.

(a) The knowledge base

Knowledge in Schoenfeld’s model involved both declarative and procedural knowledge. Declarative knowledge deals with factual information that involves knowing “what” while procedural knowledge deals with the knowledge of how to do things which usually concerned solving problems (Pressley & McCormick, 1995). There are many differences between procedural knowledge and declarative knowledge. Basically, declarative knowledge could be proved by variety forms such as recall, recognition, application, association to other knowledge and it acquired exposure in learning. On the other hand, procedural knowledge could be demonstrated by only performing the procedure and it has no right or wrong answer as far as the value of procedural knowledge is determined after extensive practice (Pressley & McCormick, 1995; Schoenfeld, 1989).

Both declarative and procedural knowledge are stored in long term memory which has unlimited spaces for storing information. When students deal with the knowledge that seems familiar with what they had already known, procedures operate on declarative information in working memory or short-term memory. Short-term memory is characterized as limited capacity system and handles information that is to be stored for a short period (Houston, 1991). But if the knowledge is new to the students, it will try to fit with the existing schemes and stored in long-term memory (Houston, 1991).
(b) Problem-solving strategies

Problem can be defined as "something that exists when a motivated organism is trying to reach a goal but is blocked from doing so by an obstacle or obstacles" (Houston, 1991). A problem may be simple but some might be very complex. To solve problems, there are many ways that could be used whether heuristics problem solving or algorithmic problem solving (Houston, 1991). Basically strategies for problem solving included understanding the problem, solving the problem and reflecting on the answer and solution (Pressley & McCormick, 1995).

In Schoenfeld’s model of cognition, problem-solving strategies that used are Polya’s strategies. Polya’s strategies consist of four steps which are; (i) analyzing the problem, (ii) clearly stated goals or needs of the problem, (iii) plan and carry out strategies and (iv) look back strategies or verifying the solution (Pressley & McCormick, 1995).

Analyzing and understanding the problem are the most important aspects of problem solving especially in mathematics because it is actually about explaining the question’s need. Stated goal, plan and carry out strategies are the next phase including a discussion of methods used. Mathematics problem usually need students to draw a diagram based on the information given, then look for patterns such as patterns of number and operations. Some students may need to make a table or chart to combine with pattern searching as a means of solving problems or constructing new ideas. Other than that, there is also the strategy of making guesses and checks through trial and error. Lastly, students may use an organized list or teacher’s notes as references. Looking back strategies should be done after a solution has been found in order that students are able to know their mistakes and able to improve their skills in mathematics (Van de Walle, 2004).
(c) Monitoring and control

Solving problems also relates to metacognition which refers to conscious monitoring and regulation of one’s own thought. According to Schoenfeld (1989), a good problem solver monitors their thinking regularly and automatically; “They make conscious decisions to switch strategies, rethink the problem, and search for related content knowledge that may help, or simply start afresh”. Schoenfeld highlighted monitoring as a contribution to self-regulated use of knowledge, including procedural knowledge. Teachers play major roles to coach students during their problem-solving attempts; pose questions in order to sensitize students and become aware of the problem solving strategies and the effects of the strategies they are using (Van de Walle, 2004).

In becoming aware of the strategies used, students acquire metamemory skills that allow them to be good at knowing when the appropriate time to use strategy, choosing appropriate strategy and applying the familiar strategies to unfamiliar situations or problems (Howe, 1991). In older children and students, the learning capacities and experiences become wider and better at monitoring and control of one’s own thought (Howe, 1991). Schoenfeld believes that teachers can improve students’ understanding of mathematics and self-regulated problem solving by given some space for the students to monitor the mathematical concepts and strategies as well as coaching students to monitor and self-regulate even though it takes a long period of time (Pressley & McCormick, 1995).

(d) Beliefs and affects

Students usually construct beliefs about mathematics based on their experiences in the classroom. These beliefs concerned on their abilities to do mathematics and to understand the nature of mathematics that have a significant
effect on how students approach problems and how well they succeed (Van de Walle, 2004). For example, some students might conclude that learning mathematics in school is more about memorizing than reflecting and therefore, the best way to do well in math is to memorize all the formulas. This kind of beliefs has higher potential for discouraging reflective problem solving and students are more likely to follow all the rules stated by the teacher and became discourage to think by themselves (Pressley & McCormick, 1995).

Beliefs affect motivation and hence determine behavior about mathematics. Students who think that mathematics was just memorizing formulas will become permanently unmotivated to think when encounter with problem solving situation. But students with strong beliefs that mathematics problems can have many alternative ways of getting the one and only right answer will become motivated and reflective problem solver who persist in the face of difficulties during problem solving (Pressley & McCormick, 1995).

1.3.2 Atkinson & Shiffrin: Multi store Model of Memory

Another model which relates to information processing is Atkinson and Shiffrin's model, also known as *modal model*. This model focuses on the differences between short-term and long-term memory as well as the third component relating to sensation called sensory memory (Lefrancois, 2006).

In the Atkinson and Shiffrin's model, sensory information first enters at sensory memory. Then the information gets into working memory, also known as short-term memory where it is available as a name, a word or an image. Not all of the information in short-term memory could pass through long-term memory, only some may be encoded for long-term storage, where it might be available for retrieval into short-term memory when needed (Lefrancois, 2006).
Imprint or sensation

Forgotten

Attention

Words, names, maintained by rehearsal working memory

Encoding

Decoding

Concepts

Figure 1.1 Atkinson and Shiffrin’s Model (Lefrancois, 2006)

1.4 Problem Statements

Linear Equations involve two important type of knowledge which is algebra and other mathematical operations such as addition, subtraction, division and multiplication. Problems may occur when students do not master the knowledge of algebra or mathematical operations or both. Students faced difficulties in comprehending the meaning of key concept in the context of problems, justifying solutions and representing coherent mathematical argument. Blanco (2007) confirmed that errors in students’ understanding are due to the product of previous experience in mathematics classroom. In this case, it could be considered as misconception of the concept (Blanco, 2007).

In order to carry out research on Form Two students about students’ understanding of Linear Equations, the researcher did some observations during her teaching practice and found that students easily get confused when the questions were represented in different structure. For example, the students confronted with the problem $8 \times 3$, can easily answer the question but if it represented in a words like “the value of $a$ is 8 and $b$ is three times $a$”, they start to get confused even though it obviously relates to the same answer (Allsopp, 1997). This is actually related to the
problem of memory where students have faulty or inefficient memory retrieval mechanism. Furthermore, students faced problem when they are confronted with multi-step problem solving situations whereby students cannot retrieved from memory what they should do next (Allsopp, 2007).

Other than that, students find it difficult to explain and justify their answers mathematically in terms of the conceptual structure of a topic. This usually happened when the questions need to be explained and solved qualitatively. This manifestation is typically a communication problem resulting from students' inability to understand the meaning of a language that is concepts, principles, theorems and theories used in mathematical discussions and dialogues (Afamasaga-Fuata'i, 2006).

Schoelfeld (1994) added that students tend to use any procedure to get an answer without really checking whether an algorithm is suitable to the problem. On the other hand, Schoelfeld reported that professional spends more time analyzing problem before making the first move to solve a problem (Pressley & McCormick, 1995; Schoelfeld, 1994).

Lastly, beliefs of mathematics differ between students. Beliefs are primarily about “what is true?” and when it is related to mathematics knowledge, it could be such “Is it possible to solve mathematics problems with more than one method?” (Lovell, 2002). Beliefs affect motivation and this will result behavior. If the students are taught using traditional method, the learning process might not help in improving students’ way of thinking. Students should be given opportunities to work beyond the textbook and examination style of questions as to look forward and can see their study in context (Lovell, 2002).
1.5 Objectives of Study

1.5.1 General Objectives

The main purpose of this study is to investigate students' understanding of the topic of Linear Equations based on the two steps in Schoenfeld's model. The two steps in Schoenfeld's model include the knowledge based and problem-solving strategies. The problem-solving strategies are also referred to as Polya's strategies.

1.5.2 Specific Objectives

In this study, the specific objectives are:
1. To identify the conceptual knowledge that students used when they answer the questions about Linear Equations
2. To identify the procedural knowledge that students used when they answer the questions about Linear Equations
3. To identify the strategies that students used to answer questions about Linear Equations
4. To develop model of students' understanding of Linear Equations

1.6 Research Questions

In conducting this investigation, there are four questions posed as guidance throughout this study. These are as follows:
1. What is the conceptual knowledge students used in order to answer questions about Linear Equations?
2. What is the procedural knowledge students used in order to answer questions about Linear Equations?
3. What are the strategies students used when answering questions in Linear Equations?
4. What kind of model could be constructed to represent students’ knowledge of Linear Equations?

1.7 Definition of Terms

1.7.1 Conceptual Definitions

(a) Linear Equations with One Unknown

According to Wikipedia (2007b), a linear equation is an equation in which each term is either a constant or the product of constant times the first power of a variable. These equations are called "linear" because they represent straight lines in Cartesian coordinates. Linear Equations with one unknown are the equation contains an arithmetic operation with one variable and numbers (Bogomolny, 2008). It only has one solution and to find the solution students need to "undo" whatever has been done to the variable. Students have to remember that whatever they do to the one side, they must do the exact same thing to the other side of an equation and this is the concept of equality (Staple, 2007).

(b) Conceptual Knowledge

Conceptual knowledge generally called declarative knowledge is the knowledge of facts, the meanings of symbols and the concepts and principles of a particular field of study (Hiebert & Lefevre, 1986). Conceptual knowledge is a knowledge that is rich in relationships. It can be thought of as a connected web of knowledge, a network in which the linking relationships are as prominent as the discrete pieces of information.