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Introduction Of Solution Pattern Of Linear And Quadratic Algebraic Equation

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Abstract: The solutions are obvious using the knowledge about cases when a product equals zero. Using the pq-formula for all other types, the algebraic procedure of solving is not completely visible, so it is called implicit. This classification of the two main groups is according to the terms 'evaluation' and 'manipulation' equations used Lima (2007). In contrast to the linear equations, the cognitive steps do not depend on the fact where and how often the variable appears. The dashed arrows indicate that some equations can be interpreted as special cases of other types of equations. The types of equations differ in the types of the terms appearing. The structure of the terms is indicated by the form of the frames.

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Introduction:

Algebra is a core component of mathematics curriculum, algebra serves as a gatekeeper to higher mathematics and many prestigious occupations, and on the grounds of equity, all students should have access to it (Ahmad & Shahrill, 2014; Lim, 2000; National Council of Teachers of Mathematics [NCTM], 2006; Pungut & Shahrill, 2014; Sarwadi & Shahrill, 2014; Shahrill, 2009). According to Moses (2000), and Strong and Cobb (2000).

This research seeks to understand why and what makes students choose a certain method or strategy in solving problems in algebra. In solving algebraic problems provides one of the ways to assess students' understanding of a concept. If the reasons can be identified, then it should be easier to improve the students' understanding to solve similar algebraic problems in the future. The thinking strategies of the students in solving problems on three sub-topics in algebra, namely, changing the subject of a given formula, factorisation of quadratic expressions and solving quadratic equations using quadratic formula. Thinking strategies had been defined as processes that involve thoughtful and effective use of cognitive skills and strategies for a particular context or type of thinking task where individuals engage in activating schemata and in integrating new subject matters into meaningful knowledge structures. In other words, thinking strategies refer to the processes by which individuals try to find solutions to problems through reflection (Davis, 1992).

Review of Literature:

Resnick (1982) stated "difficulties in learning are often a result of failure to understand the concepts on which procedures are based". Thus, it is important for teachers to develop insights into student thinking in order to identify students' difficulties and errors in understanding in algebra.

According to Lim (2000), students have a choice of either a rote-learned cross-multiplication method or a rotelearned grouping method when factorising a quadratic expression; however, neither was ever related to the distribution law. The selection of the method really depended on what their teachers preferred their students to use. Students remained unable to discover the factor of an algebraic expression, even at the post-teaching stage of factorising an algebraic expression. Kotsopoulos (2007) stated that quadratic relations are one of the most conceptually challenging aspects of the high school curriculum. This is because many secondary students have difficulty with basic multiplication table fact retrieval. Since factorisation is a process of finding products within the multiplication table, this directly influences students' ability to engage effectively in factorisation of quadratics.

According to (Kotsopoulos (2007) most secondary school students and many university students were found to be confused about the concept of a variable and the meaning of a solution to a quadratic equation. For example, even if most students were able to obtain the correct solutions, $x = 3$ and $x =$

5, students thought that the two x's in the equation (x – 3) (x – 5) = 0 stood for different variables.

The students lack relational understanding and relied only on rote learning (Law & Shahrill, 2013; Pungut & Shahrill, 2014; Sarwadi & Shahrill, 2014; Vaiyavutjamai, 2004; Vaiyavutjamai, Ellerton & Clements, 2005; Vaiyavutjamai & Clements, 2006). In addition, when students were asked to solve (x – a) (x – b) = 0, they first expanded the linear expressions and then factorised before finally finding the solutions to that equation. This showed that the students lack understanding of the distributive law which, from a mathematical standpoint, is fundamental not only to the process of factorisation in algebra, but also to the reverse process of 'expanding brackets' (Lim, 2000).

In some cases, secondary students were expected to memorise the quadratic formula and to be able to apply it to solve quadratic equations despite not being taught how this formula could be derived (Lim, 2000). Thus students developed a perception that their main task was only to gain knowledge and to be able to solve quadratic equations using the quadratic formula; there was no real need to really understand why the method works. There are common reasons why students are unable to solve quadratic equations using the quadratic formula (Oliver, 1992). For example, he may not possess the required schema, or, his retrieval mechanism cannot locate his appropriate schema, or, the retrieved schema is flawed, incomplete or inappropriate (Abdullah, Shahrill & Chong, 2014; Chong & Shahrill, 2014; Shahrill & Abdullah, 2013).

As the solution of the problem is wholly determined by the combined information of the used cues and the content and structure of the retrieved schema, the solution will be wrong if the quadratic formula in the schema was flawed. In other words, the schema mediates the solution. On the other hand, changing the subject of a given formula plays an important role in mathematics. It is applied in various mathematical topics including function and its inverse and trigonometry. However, Lim (2000) found that students attempting to solve these equations still used descriptions of doubtful educational worth.

The findings revealed that the majority of the participants only acquired instrumental understanding rather than relational understanding in their algebraic lessons. From the researchers' observations, participants' fundamental knowledge in algebra needs to be improved in order for them to be able to solve any problems that are related to algebra. When tasked to solve problems that required them to change the subject of a given formula, all students used the changing the operation method, namely, by bringing unwanted terms to the other side of the equation.

The researchers believed that if the teacher practiced the appropriate methods of solving this problem (adding or subtracting a number to both sides, or dividing or multiplying both sides of an equation by a number) with students from the earlier stages, then students could see how simple and straightforward this alternative method is. The students could then potentially commit fewer errors on this topic. In the factorising of quadratic expressions, a number of the participants were even unable to apply the correct way of factorisation using trial and error method.

Quadratic equations and flexible algebraic action

Flexible algebraic action is defined as the ability to choose an adequate processing method depending on the specific features of the task and the abilities of the individual. This definition refers to the concept of flexibility in mental calculation (e.g., Rathgeb-Schnierer, 2006; Threlfall, 2002) and a general discussion about what flexibility can mean (e.g., Star & Newton, 2009). The comparison of flexible algebraic action and algebraic action just with one standard routine. For quadratic equations a didactical map can show the complexity of the situation students have to cope with, when they learn to solve this type of equation.

A didactical map is a graphic depiction on an issue which contains important information for didactical considerations under special questioning. To clarify the difference between linear and quadratic equations in situations of learning and regarding the necessity of flexibility, a didactical map of linear equations will be contrasted to a didactical map of quadratic equations. The construction refers to the "Didactical cut" which was first named by Filloy and Rojano (1984, 1989) and later on discussed by several researchers (Herscovics & Linchevski, 1994; Lima & Healy, 2010; Vlassis, 2002).

The linear equations can be divided into two main groups: In the first, the unknown is only appearing once on one side of the equation. These equations can be solved by arithmetical procedures. It is not necessary to act on or with the unknown because they can be solved by using the reverse operations, e.g. $3x + 7 = 19$ can be solved by calculating $(19 - 7) \div 3$. To solve the second group of equations, in which the unknown occurs on both sides or more than once on one side, it is necessary to use algebraic procedures to act on or with the unknown.

According to this classification, Lima and Healy (2010) call these two groups 'evaluation' and 'manipulation' equations which resembles the classification by Filloy and Rojano (1984, 1989) for linear equations, but which is farther-reaching also for classifying quadratic equations. Lima and Healy focus on the activities which are necessary to solve an equation and not on the question, where or how often the variable occurs. In contrast to the evaluation equations, for the manipulation equations it is necessary to manipulate algebraic symbols. The group of manipulation equations can be divided into two subgroups. For the first, where the variable is only appearing on one side but more than once, algebraic procedures are only necessary for the terms on one side. For the second, where the variable appears on both sides, equivalent transformations on both sides of the equation are necessary.

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