

CONFERENCE PROCEEDING

Enhance the Understanding of Gifted and Talented Muslims Student's on Quadratic Functions Using GeoGebra

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ABSTRACT

GeoGebra is one of the teaching tool conducted by educator implement into their lesson plans to improve teaching and learning quality, make the classroom lesson more enjoyable, creative and innovative. Students can construct a graph, modify and observe the effects of changing graph shape. Moreover, students can be saved all their works documents for future reference systematically. The aim of this research was to analyse the application of GeoGebra on mathematics achievement in relation to the quadratic functions among gifted and talented Muslims student's at Kolej GENIUS Insan, Universiti Sains Islam Malaysia. The effects of changing the coefficients values on the graphs of quadratic functions was identified. The results illustrate that changing in value of coefficient a on quadratic functions affects the shape and width of the graph, but, not the y -intercept. The position of the vertex on y -axis is only affected by changing the value of coefficient b , but the shape of the graph and the y -intercept remain unchanged. The shape of the graph is unaffected by changing the value of coefficient c , which only affects the location of the graph vertically upwards or downwards. Students' performance in understanding the effect of quadratic graphs improves when they use GeoGebra software.

Keywords: *Geogebra, gifted and talented Muslims students, Mathematics achievement, Quadratic Functions*

INTRODUCTION

Nowadays, technology is becoming an important powerful component. Many educational academics have conducted their classroom on incorporating technology into education in attempt to improve teaching and learning quality (Preiner, 2008). Teaching and learning are the two fundamental components of mathematics education that are acknowledged by the use of digital technology in the classroom (Laborde, 2014). Several research has been conducted into how students use digital technology and how educators implement GeoGebra into their lesson plans.

According to Pannen (2014), digital technology, such as GeoGebra as an integrated component of teaching and learning, especially in learning experiences to become more innovative, accelerated, and improved, and also increasing academic skills performance and students learning. Furthermore, GeoGebra use in mathematics education not only helps students construct their visual representation of mathematical ideas and concepts, summarize and analyse data, and interpret data, but also enables them to investigate every area of mathematics, such as geometry, algebra and statistics (Hohenwarter *et al.*, 2009).

Markus Hohenwarter was developed GeoGebra in year 2001, and it is a free program that could be downloaded from www.geogebra.org. (Hohenwarter *et al.*, 2008). This software has been translated into 36 languages so that it can be used by

people from all around the world. As a result, it looks to be a user-friendly software that can be used intuitively and does not required advanced knowledge to use (Domènech, 2009; Dogan & İçel, 2011; Saha *et al.*, 2010).

According to Furner and Marinas (2012), GeoGebra may be used to teach and study mathematics in a variety of ways such as for demonstration and visualization, GeoGebra may provide diverse representations, provides basic characteristics of Computer Algebra System (CAS) to bridge gaps between geometry, algebra, and calculus, and it may be used as a building tool because it can create shapes.

In basic and secondary education, however, mathematics is concerned with abstract concepts (Okafor & Anaduaka, 2013). At these levels of education, mathematics syllabus such as geometry, algebra, and calculus are deemed overly abstract and hence difficult to understand by a huge portion of the students. As a result, both skill and interest in mathematics have decreased (Fahlberg-Stojanovska & Stojanovski, 2009).

According to previous research, many educators implement GeoGebra in their lesson plans, particularly when teaching geometry concepts (Battista, 1999; Dogan & İçel, 2011; Dolbilin, 2004; Domènech, 2009; Furner & Marinas, 2012; Idris, 2006; Kaushal & Chun-Yen, 2015; Laborde, 2014; Mammana & Villani, 1998; Saha *et al.*, 2010). The teaching of Euclidean geometry should begin in the primary school years. Students should be able to recognize and investigate various geometrical shapes and their attributes (Mammana & Villani, 1998).

According to Dolbilin (2004), many studies have proven that teaching and understanding mathematics, particularly geometry, is challenging. The visualization and exploration skills required for geometrical concepts, problem-solving skills, and geometry reasoning are frequently neglected by students (Battista, 1999; Idris, 2006). According to Idris (2006), students are discouraged by their lack of comprehension of geometry, which leads to reduced performance in the subject.

In this research, the application of GeoGebra software on mathematics achievement in relation to the quadratic functions was analysed and the effects of changing the coefficients values on the graphs of quadratic functions was identified among gifted and talented student's at Kolej GENIUS Insan, Universiti Sains Islam Malaysia.

QUADRATIC FUNCTIONS IN MATHEMATICS

A quadratic function in one variable is a function whereby the highest power for the variables is two. The general form of quadratic function is written in the form of:

$$f(x) = ax^2 + bx + c \quad (1)$$

where a , b and c are constants and $a \neq 0$, and x is a variable.

There are only two shapes of the graph of $f(x) = ax^2 + bx + c$, $a \neq 0$. The value of coefficient a determines the shape of the graph, where the curved of the graph of a quadratic is called as a parabola. For a positive values of a , $a > 0$ the shape of the is likes \cup shape, while the shape is likes \cap for negative values of a , $a < 0$ (Choo *et al.*, 2019; Kiong *et al.*, 2019).

Characteristics of Changes the Coefficients of Quadratic Functions

Table 1 shows the characteristics of shape and position of the graph function when the coefficients of the quadratic functions were changed.

Table 1. Characteristics of in shape and position of the graph of function

Changes in shape and position of the graph of function $f(x) = ax^2 + bx + c$	
Only the value of a changes	<ul style="list-style-type: none"> Change in value of a affects the shape and width of the graph, however, the y-intercept remains unchanged. When $a > 0$, the shape of the graph is \cup which passes through the minimum point and when $a < 0$, the shape of the graph is \cap which passes through the maximum point. For the graph $a > 0$, for example $a = 1$, when the value of a is larger than 1, the width of the graph decreases. Conversely, when the value of a is smaller than 1 and approaches to zero, the width of the graph increases. For the graph $a > 0$, for example $a = 1$, when the value of a is larger than 1, the width of the graph decreases. Conversely, when the value of a is smaller than 1 and approaches to zero, the width of the graph increases. For the graph $a < 0$, for example $a = -1$, when the value of a is smaller than -1, the width of the graph decreases. Conversely, when the value of a increase from -1 and approaches zero, the width of the graph increases.
Only the value of b changes	<ul style="list-style-type: none"> Change in value of b only affects the position of vertex with respect to the y-axis, however the shape of the graph and the y-intercept are unchanged. When $b = 0$, the vertex is on the y-axis. For the graph $a > 0$, when $b > 0$, the vertex is on the left side of the y-axis and when $b < 0$, the vertex is on the right side of the y-axis. For the graph $a < 0$, when $b > 0$, the vertex is on the right side of the y-axis and when $b < 0$, the vertex is on the left of the y-axis.
Only the value of c changes	<ul style="list-style-type: none"> Change in value of c only affects the position of graph either vertically upwards or vertically downwards. The shape of the graph is unchanged.

RESULTS AND DISCUSSION

Effects of Changing the Values of Coefficient a on Graphs of Quadratic Functions

Figure 1 show the effects of changing the values of coefficient a and $a > 0$, on graphs of quadratic functions. The results clearly show that changing in value of coefficient a on quadratic functions affects the shape and width of the graph. However, the y -intercept is not changed. Based on the results, the values of a , $0.2 \leq a \leq 10$. Increasing the values of a will cause the graph to narrow at the y -axis or the width of the graph decreases. The graphs were plotted by using GeoGebra software to determine the effects of changing the values of coefficient a on graphs of quadratic functions.

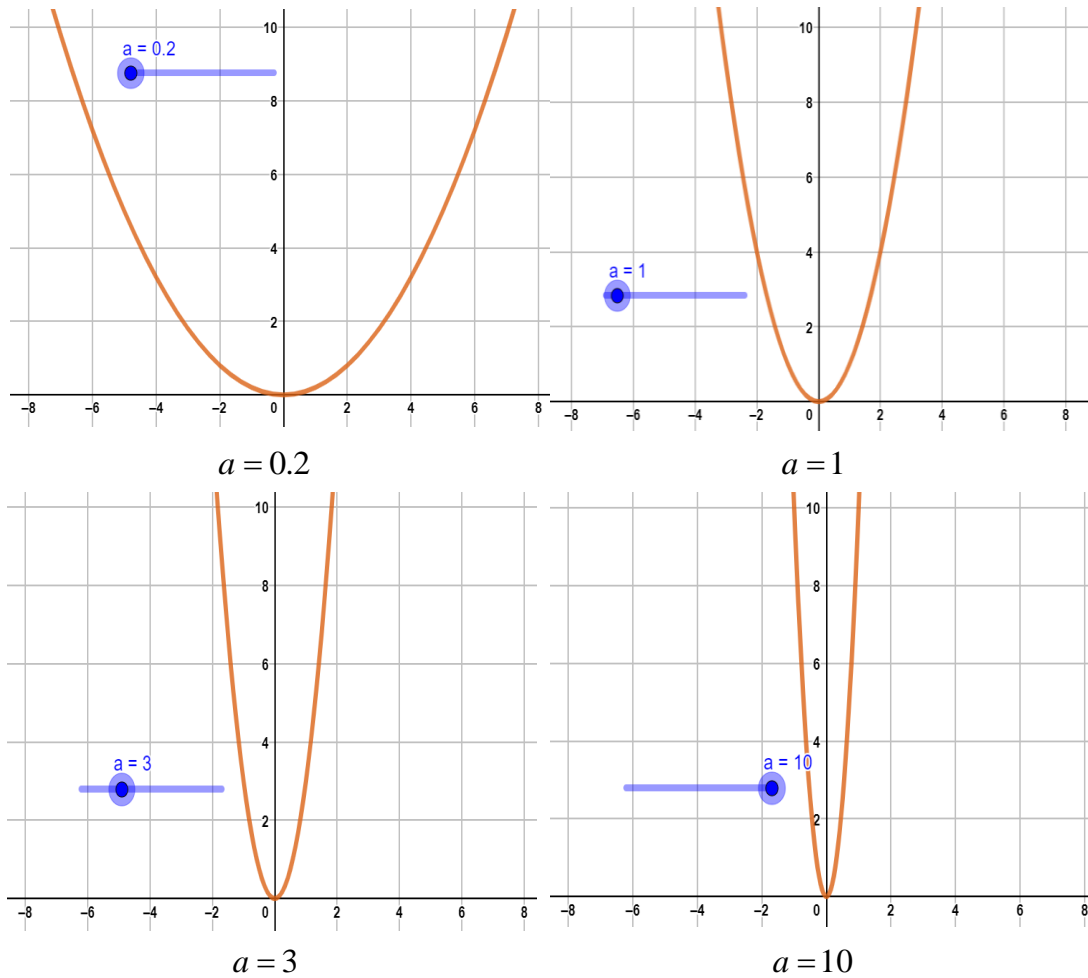


Figure 1. GeoGebra Graph: Effects of changing the values of coefficient a and $a > 0$, on graphs of quadratic functions

Effects of Changing the Values of Coefficient b on Graphs of Quadratic Functions

Figure 2 show the effects of changing the values of coefficient b , on graphs of quadratic functions. The results clearly show that changing the values of coefficient b , on graphs of quadratic functions were affected the position of the axis of symmetry. The position of the vertex on y -axis is only affected by changing the value of coefficient b , but the shape of the graph and the y -intercept remain unchanged.

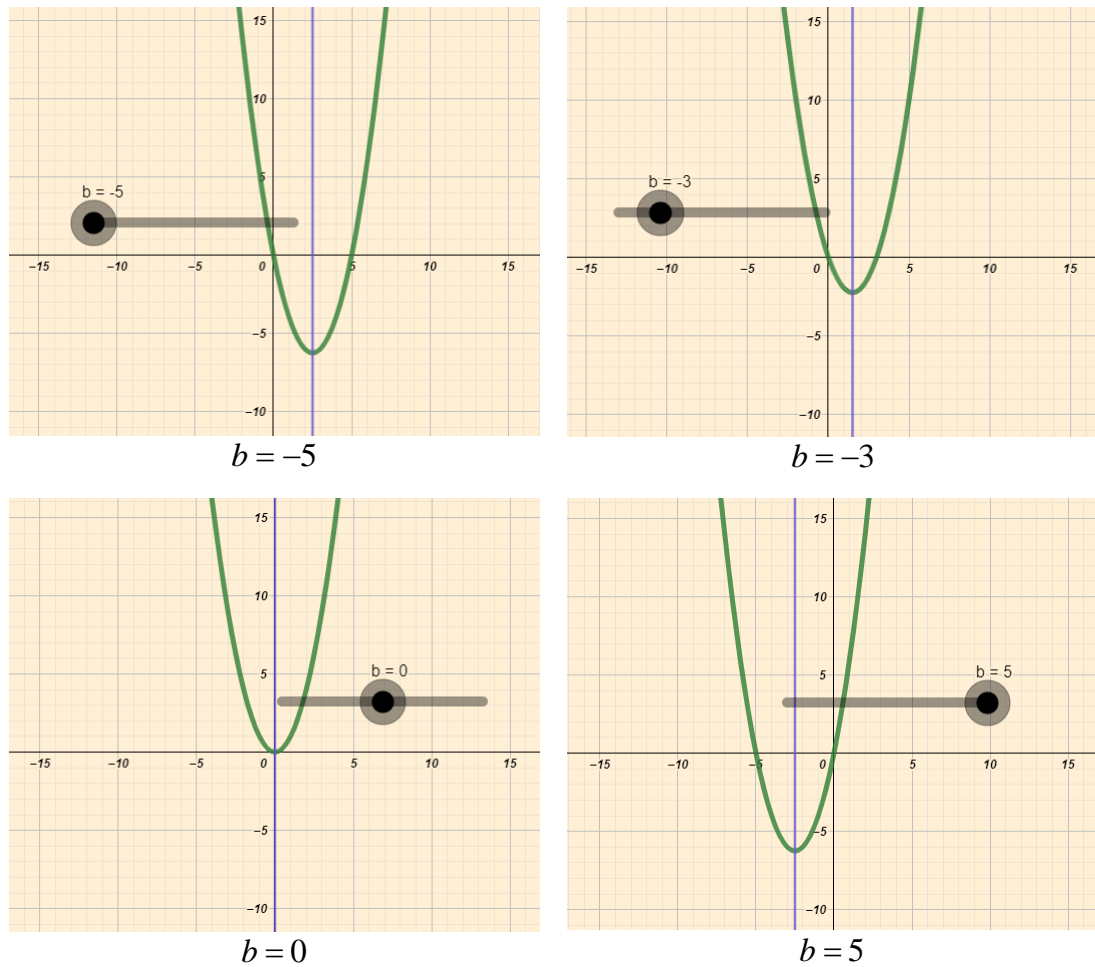


Figure 2. GeoGebra Graph: Effects of changing the values of coefficient b on graphs of quadratic functions

Effects of Changing the Values of Coefficient c on Graphs of Quadratic Functions

The effects of changing the values of coefficient c , on graphs of quadratic functions were illustrated in Figure 3. The results clearly show that changing the values of c determine the position of the y -intercept. The shape of the graph is unaffected by changing the value of coefficient c , which only affects the location of the graph vertically upwards or downwards.

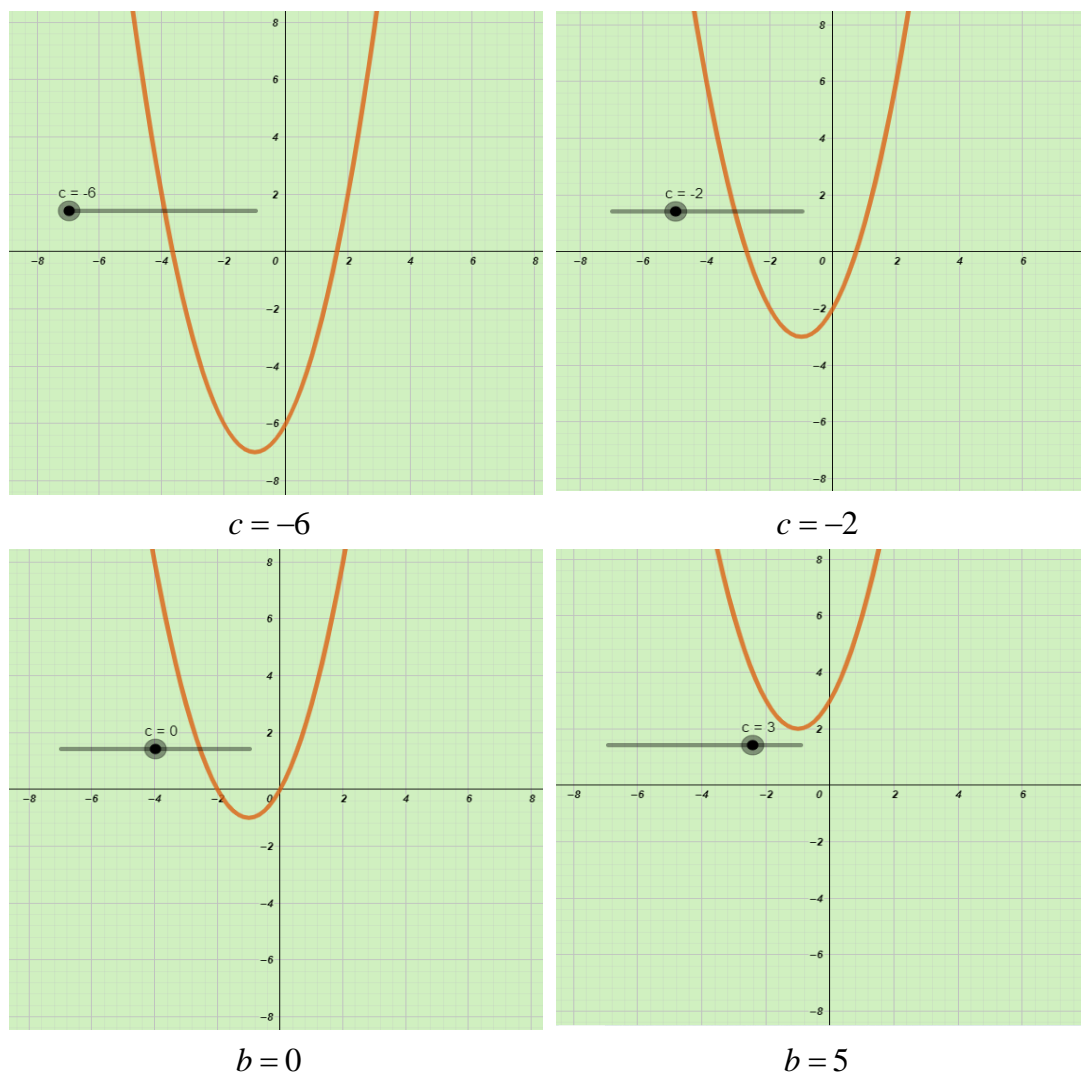


Figure 3. GeoGebra Graph: Effects of changing the values of coefficient c on graphs of quadratic functions

CONCLUSION

GeoGebra is an effective tool/software for teaching quadratic functions and has a significant effect on students' achievement in quadratic functions. Students agreed that this software is useful for learning mathematics, interpreting mathematical concepts, increasing confidence, creative thinking, making learning more interesting, and visualizing mathematical content. Students can construct a graph, modify and observe the effects of changing graph shape. The main objectives of this research was to analyse the application of GeoGebra on mathematics achievement in relation to the quadratic functions among gifted and talented Muslims student's at Kolej GENIUS Insan, Universiti Sains Islam Malaysia. The effects of changing the coefficients values on the graphs of quadratic functions was identified. The results show that changing in value of coefficient a on quadratic functions affects the shape and width of the graph, but, not the y -intercept. The position of the vertex on y -axis is only affected by changing the value of coefficient b , but the shape of the graph and the y -intercept remain unchanged. The shape of the graph is unaffected by changing the value of coefficient c , which only affects the location of the graph vertically upwards or downwards. The results of the research showed that this software is extremely valuable

and useful to improving students' achievement and conceptual understanding. As a result, lecturers must utilize this technology while teaching students on construct a graph of quadratic functions in their classes. Furthermore, it is suggested that curriculum developers and textbook writers include such kind of activities which are based on mathematics software in the curriculum.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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