

Integration of Higher Order Thinking Skills in K12 Mathematics Subject through Group Activities

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Received: 31 July 2019

Revised: 7 August 2019

Accepted: 20 October 2019

Published Online: 3 November 2019

ABSTRACT

Mathematics is a subject that many students would have difficulties in learning it. Thus, integration of higher order thinking skills in the subject could play a role in helping the students in the learning process. Could the integration of higher order thinking skills be best fit in the learning process in consistent way or in periodical? This is because the hectic schedule of the students in Boarding School acts as a blockage in implementing this skill in the learning process. However, the skills should be implemented because of it serves many benefits to the students, especially in this new era of world. Thus, this paper will study on how to integrate higher order thinking skills in the learning process by using the group activities. The reason why must it be group activities is because this could give the chance to the students to communicate with each other in order to solve higher order thinking problems. This activity is also in parallel of the implementation of 21st century learning from the National Education Blueprints. The study has been progressing win assessing the implementation of higher order questions that should be answered individually among the students. Finally, research has shown that the integration of Higher Order Thinking Skill provide positive impact and further study should be carried out to assess the skill individually.

Keywords

Higher Order Thinking Skills, Mathematics, Students, Group Activities, Boarding School

Introduction

Higher Order Thinking Skills (HOTS) is of the main elements in 21st Century classroom learning. HOTS also helps students to think critically and creatively in order to solve problems and it could be teach directly to the students in the class. HOTS is also important for the students in order to build themselves and make them to be ready to face a more challenging world in the future (Malaysia Ministry of Education, 2011). HOTS act as the base to make sure that our education system is always relevant and always on the line with the education transformation (Cocurricular Development, 2009). Hence, Ministry of Education of Malaysia has come out with several guides and action along with the programs introduced to improve HOTS in students and teachers. Several programs that are currently running:

(i) Improve the Understanding on HOTS Items

Board of Examination, Ministry of Education of Malaysia is one of the organizations that responsible to build assessment and bank of questions that conjugating with HOTS. Teacher Training Division also play their roles in training the teachers to improve their professionalism in teaching.

(ii) 21st Century Skills Enhancement

Next generations should be equipped with 21st Century skills in various fields as to be ready for the future challenges. Among the skills that they have to be fully competent are higher order thinking skills (HOTS) and ethics in work management to face the future.

(iii) International Baccalaureate Programs

This program main objective is to develop now and next generations to be international minded. It emphasizes on social and group activities.

(iv) I-THINK Program

This program emphasizes on building the students to be more creative and innovative in their thinking. It uses several types of thinking tools such as *Thinking Maps*, *Thinking Hats*, *Q Matrix Chart* and *Habits of Mind*. List of programs that are being held aim for the development of the students itself in order to make them ready for the future and ensure that they are more than capable to be competent domestically and internationally.

Research Background

Teachers are the agents of changes that have a close engagement to the students except their parents. They spent most of the time with the teachers at school. Thus, teachers should be ready to be creative in planning their everyday lesson plan in order to equip the students with higher order thinking skills (HOTS). Teachers should be responsible for the changes that are currently happening and make it as a challenge for them to make the lesson effective as it could give a huge impact to the students (Tohaan, Taconis and Jochems, 2010). This issue is in conjunction with the programs that have been introduced by the ministry to instil 21st Century learning in the students. Curricular is also one of the important elements that can ensure the students to have higher order thinking (HOTS) characteristics (Abu Bakar, 2013). Study on pedagogy or teaching practice involving the HOTS should be done in order to make the ministry call comes true.

Other than creativity, teachers should also equip themselves with technology information to deliver HOTS content (Albion et al., 2010; Wee Tan, 2011). However, students should first, have a strong basic concept to answer HOTS question. This is because HOTS items require more detail answer, with explanations and description rather than straight-forward answers. The students are always escaping to answer questions that needed them to give detail explanation and description. Thus, one of the way to improve is to give more HOTS practice and exercises for them to make them used to answering such questions (Anuar, 2015). In addition, students always refer Mathematics subject as difficult and this study aim to observe the students' behaviour and achievement in solving the problems in groups. This also to give them the authority to think by themselves, discussing with the peers in order to solve problems and the usage of thinking tools such as i-Think mind maps and so on could trigger their cognitive to analyse and synthesize the problems that they have to solve in Mathematics subject.

This study was conducted to the students in Boarding School (SBP). The focus of the study is solely on Mathematics subject because of the subject requires different technique of teaching out of the conventional way (Coufal, 2014). This means that teaching Mathematics requires various way of delivering information to the students including to implement HOTS in teaching process either in group activities or individually (Burke, 2011).

Problem Statement

After analysing the background of the study shows that students should be provided with a difficult situation that requires the students to answer what can be assumed a high level when involving HOTS questions. It is because of the 21st Century learning needed the teaching and learning process to be done holistically. According to McKinsey (2017), researchers should study many aspects and not only on the level of the curriculum and pedagogy and preparing the students for the difficult situations in answering higher level of questions should be study upon to ensure students have the ability to think critically. This study is also to observe the impact of teaching and learning involving HOTS can be implemented in a consistent way.

Objectives

This study has three research objectives:

- i. To identify the impact on the students' achievement in groups for the higher order thinking (HOTS) questions under the topic of Pythagoras Theorem, K12.
- ii. To get reflection from the students on answering questions in group involving HOTS questions.
- iii. To identify whether the students have the ability to analyse information by using thinking tools.

Research Questions

The study objectives were created to answer these research questions:

- What will happen to the students' achievement in groups when given the higher order thinking (HOTS) questions under the topic of Pythagoras Theorem?
- What are the students' reflections when they were asked to answer questions in group involving the HOTS questions?
- Are the students able to analyse information by using thinking tools such as map circle and flow chart?

Methods

This study was conducted on 28 of K12 students (age 13) towards the higher order thinking (HOTS) question under the topic of Pythagoras Theorem. The questions were developed based on Bloom's taxonomy by an expert that has been experienced for more than ten years teaching Mathematics subject. This study used the quantitative approach to analyst the data for research question 1. The analysis for research question 1 applied descriptive and inferential statistics by using Statistical Package for Social Science (SPSS). Meanwhile content analyses were used to analyst data for research question 2 and 3.

The study started by applying several methods accordingly as given:

- Teaching and learning processes initiated with students are asked to write down the main points of Pythagoras Theorem by using map circle.
- Students are asked to sit in groups that have maximum three people. Students are asked to answer the questions given by discussing with their group mates to solve the problems.
- The students are asked to write their answers in the space given.
- Students will have interviews in groups and their reflections will be recorded.

Findings

The findings of the study were analysed by doing content analysis from each groups according to the research questions. To answer the first research question, the findings shows that the students are able to answer all the high level of questions correctly in groups. Students are also able to solve high level of Mathematics problem in a short time. The product students' works are shown in Figure 1.

Name: Al-Farooq Bin Mohammad Asri, Ezhad Eminnuddin Bin Kasim, Akmal Hamizad Bin Nazri Form: 2 P1-Khaeajiz-mi
Pythagoras' Theorem (HOTS QUESTIONS)

1. Find the distance in m between two balls.

~~$2.8\text{m} - 1\text{m}$~~
 ~~$= 1.8\text{m}$~~

~~$AB^2 = BC^2 + AC^2$~~
 ~~$= 1.8^2 + 2.4^2$~~
 ~~$= 3.24 + 5.76$~~
 ~~$= 9$~~
 ~~$AB = \sqrt{9}$~~
 ~~$= 3\text{m}$~~


2. Asri and Ramli were at stall X. Ramli ran 80m due to south from stall P. He ran 150m due east and reached stall Q. Asri took the shortest route to go from stall P to stall Q. What is the difference between the distance, in m covered by Ramli and Asri?

Asri and Ramli = x

~~$x^2 = 80^2 + 150^2$~~
 ~~$= 6400 + 22500$~~
 ~~$= 28900$~~
 ~~$x = \sqrt{28900}$~~
 ~~$= 170$~~

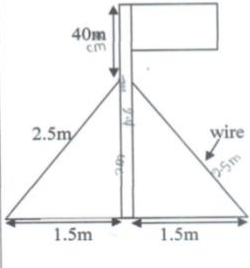
~~$= 80 + 150$~~
 ~~$= 230$~~
 ~~$= 230 - 170$~~
 ~~$= 60\text{m}$~~

3. A worker measures the length, width and diagonal of a quadrilateral-shaped window. The length, width and diagonal of the window are 1.6m, 1.2 m and 2.1 m respectively. Determine whether the window is exactly rectangular in shape.



$2.1^2 = 4.41 \text{ m}^2$
 $1.6^2 + 1.2^2 = 2.56 + 1.44$
 $= 4 \text{ m}^2$
 $\neq \text{No rectangular shape}$

4. The diagram shows a flag pole set up on the ground. The height of the pole above the ground is 2.4m. Two wires measuring 2.5m each are tied at a position of 40cm below the top of the flag pole. Another end of the wire is planted at a distance of 1.5m from the foot of the pole. Is the flag pole set up in an upright position?



$2.5^2 = 6.25 \text{ m}^2$
 $2^2 + 1.5^2 = 4 + 2.25$
 $= 6.25 \text{ m}^2$
 $= \text{Yes}$

Figure 1. The product of students' works in group

Based on the first research question also the study found out that the students can answer all the questions correctly, when they discuss the questions with more competent peers. Findings from the analysis also show that the student will be able to answer accurately. Based on the observation, students actively participant in the group discussion.

Then, to answer second research questions, the study found out, based on interviews and reflection analysis, that the students enjoy more group activities and discussion involving higher level of Mathematics problem. Majority of the students which is 84% of the students stated that group discussion helps them to understand better. 74% of the students also stated that communication and discussion that happens help them to share ideas and improve their understanding on a particular problem, especially the difficult one. This is because from the discussion, they are able to analyst and synthesize what the questions want, and answer the questions given correctly when it comes to high level questions.

For the third research questions which is to identify whether the students have the ability to analyse and synthesize information by using thinking tools, the study shows that the students are able to write down main points of Pythagoras Theorem accurately by using the thinking tools such as map circle. Map circle is a tool where it is being used before the start of the discussion where the students need to point out main point of a particular topic. This

mainly to see whether the students are able to list the correct points or not and also to make sure they are ready for the discussion. Findings shows that the students are also able to fill the flow map with the correct points as shown as in Figure 2.

Name: maha kristina dia wahyanudin Form: 1

Pythagoras' Theorem (CIRCLE MAP and FLOW MAP)

1. Fill in the blank. This includes terms and the characteristics of Pythagoras' Theorem.

2. How to prove the triangle of X is a right-angled triangle or not?. Write the steps in the flow map.

1. Find c^2 (hypotenute)

2. Find $a^2 + b^2$

3. if $c^2 = a^2 + b^2$

Conclusion: right angle triangle

Figure 2:The students work on Circle Map and Flow Map

Discussions

Discussion starts with the findings on the first research question which is to identify the impact on the students' achievement in groups for the Higher Order Thinking Skill (HOTS) questions under the topic of Pythagoras Theorem. From the activity that has been conducted that is group activity, the students are able to answer the questions correctly in a short time. This means that, group activity should be conducted frequently to the students to make sure that they get used to the sets of HOTS questions. This is because they enjoyed solving problems in group especially the difficult one based on the reflection collected.

For the second research question which is to get reflection from the students on answering questions in group involving HOTS questions, most of the students stated that they feel comfortable and less stress when they have to solve problems in group. They involved actively in the group discussion which lead them to be able to answer and solve the questions correctly and in a short time. The activity shows that it could make the teaching and learning session more effective.

Scope and limitation study

This study focuses on the effects of a ggroup work as it can be especially beneficial for large classes (Wright and Lawson, 2005). Wright and Lawson (2005) also found that group work helped students feel that the class was smaller and encouraged them to come to class more often. The felt more invested in Mathematics subject and in the class material, which promoted active learning in a large class environment. This study will not cover an individually task.

Conclusion

To conclude, the integration of higher order thinking skills in K12Mathematics subject through group activities is the based on building a concrete understanding and to make the lesson more effective for the students. This study shows that the integration made the students to have better understanding on a particular topic and helped them to answer and solve the problems from the questions given. The thinking tools also need to be use in every day lesson as it could help the students to think critically and creatively in order to analyse and synthesize the information in line with the study of Collins (2016). It also helps them to store the information in their mind in a long-term. However, the students' own initiative also needed to make sure that they learn holistically. The study also shows that the students are more comfortable and actively participated in the group discussion that lead them to be able to answer and solve the problem in the high level of questions given correctly in a short time. Hence, the findings also show that this integration provides positive impact and more of the same study should be carried out to asses it individually

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