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The Effectiveness of the Implementation of Three Dimensions Geometry KARA Module on Higher Order Thinking Skills (HOTS) and Motivation

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The development and use of the KARA module can help students fully understand learning three dimensions of geometry. This module applies the learning method of concrete experience, reflective observation, abstract conceptual, and active experimentation (KARA) to overcome abstract three-dimensional geometry and improve students' HOTS ability and motivation. This study aims to identify the KARA module's effectiveness on the students' higher-order thinking skills (HOTS) and mathematical learning motivation. The design of this study is a quasi-experimental study with pre and post-test forms involving 164 secondary school students in Pekanbaru, Indonesia. The data were collected using open HOTS questions and a mathematical learning motivation questionnaire. The inferential statistical analysis involves Two-Way ANOVA and MANOVA. The experimental study's findings showed a significant difference in mathematical HOTS based on the groups. There were significant differences and interactions between groups based on students' ability level for HOTS. The mean scores of students 'mathematical learning motivation indicate significant differences and effects of interaction on students' abilities. Furthermore, there were significant differences in mathematics learning motivation between groups and genders. There are implications from the research data regarding education needed, teaching, learning practices, school, and theoretical terms. This study contributes to the KARA module, teaching and learning practices, instruments evaluation for the KARA module, HOTS, and mathematical learning motivation instruments.

Keywords: mathematics learning motivation, HOTS, teacher professional development, teaching and learning, three dimensions geometry

INTRODUCTION

High-order thinking skills (HOTS) and motivation to learn mathematics need to be trained since students are in primary school. The fundamental solid skills and knowledge

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among primary and lower secondary school students are essential to the success of any policy at the upper secondary level. Based on previous studies, students' HOTS is low, especially in Three-Dimensional Geometry (Hamzah et al., 2022). HOTS are intellectual processes related to concept formation, analysis, application, syntax, and evaluating information gathered or produced through observation, experience, or reflection (Ball & Garton, 2005). Thus, HOTS combines cognitive processes and the ability to complete a task (Milvain, 2008). A person's HOTS can affect learning ability, speed, and effectiveness. Thus, HOTS is associated with the learning process because there is a close relationship between thinking skills and learning (Nouri et al., 2019). One of the problems experienced by students is the aspect of solving mathematical problems that use verse questions. Many students experience difficulty interpreting the meaning of the questions using mathematical symbols (Karnasih, 2015). Consistent with Hendriana's (2014) opinion, students 'mathematical strategy competency ability is still low.

Many students have poor mathematics learning motivation (Ismail, 2016). This poor motivation is also consistent with research suggesting that many high school students across the United States lack academic motivation (Snyder & Hoffman, 2002). Teachers pay less attention to appropriate mathematics learning strategies, so learning activities at school are boring for students. This situation causes a decrease in learning motivation among students. Students' mathematics learning outcomes are low (Ismail, 2016). In addition, students have a poor response to learning mathematics, reducing their learning motivation. Learning motivation is essential in mathematics learning activities because someone who does not have the motivation to learn mathematics will not be able to carry out learning activities well. Achieving a solid understanding of mathematics requires perseverance and strong effort (Kartowagiran & Manaf, 2021).

The use of modules can increase students 'learning motivation and enable students to learn more effectively and productively, and the feedback received by students is prompt, quick, and accurate (Ahmad, 2002). Winkel (2007) stated that there are six strengths of the module method in learning, namely (1) students have a greater interest in the learning unit, (2) students follow their abilities, (3) students are more active in learning, (4) students get information about learning progress, (5) teachers have more time to help students with learning difficulties and (6) teachers serve as mentors. The knowledge of mathematics teachers in Pekanbaru on integrating HOTS and motivation to learn mathematics in teaching and learning is still limited (Yuanita, 2021). In addition, the method of learning in the classroom is still conventional. These problems have become constraints for building HOTS and motivating students to learn mathematics. Until high-order mathematical thinking skills and students' motivation to learn mathematics are not well-built. Thus, studying the KARA module on the topic of Three-Dimensional Geometry can improve the HOTS and motivation to learn the mathematics of junior high school students in Indonesia, especially in Pekanbaru Riau.

Literature Review

KARA Module Approach on Three DimensionsGeometry

The KARA module is one of the learning approaches developed by David Kolb (1984). The phases of the KARA approach to Three-Dimensions Geometry, namely (1) concrete experience, (2) reflective observation, (3) abstract conceptual, and (4) active experimentation. Firstly, experience in concrete experience, intuition is strongly emphasized. Students must be open-minded, adaptable, intuitive, and actively involved in learning activities. Bradford (2019) suggests that students are exposed to actual objects, artifacts, behaviors, processes, and practices in this phase. Activities that involve students in the form of physical and emotional experiences can be considered activities that provide concrete experiences. The role of the teacher in this phase is as a facilitator. This phase is expected to result in a change in appreciation of the field studied. Secondly, in reflective observation, students need to look back at the experiences they went through in the concrete experience phase and process the information gained by discussing in groups and comparing and relating the experiences to each other. Concepts acquired are deductively proven, developed, and augmented with other related concepts and generalizations (Bradford, 2019). Students must be objective observers. Listening, observing, and being aware of change are particularly important for individuals involved in this learning style. Rogers (2002), in describing reflective student attitudes stated that some reflective students have a "wait and see" attitude, observing and listening to other people's discussions first in performing a task. They take time to think, hesitate, and lack confidence when asked. Appropriate activities for this phase include observation and discussion, such as structured group discussions, reflective written assignments, and linking old and new learning. The role of the teacher in this phase is to gradually add specifications and information about the concept based on the results of the group discussion with students. In this phase, students make observations before deciding by observing the environment from different perspectives, and students are required to look at various things to obtain meaning (Fathurrohman, 2017). This phase is expected to produce changes in the knowledge in the field studied.

Thirdly, abstract conceptualization. Students are exposed to information from authoritative sources such as reference books and teachers. Students predict cause and effect based on variables identified from the previous phase. Students strive to organize and organize information systematically and logically into concepts, theories, and ideas to solve problems and understand situations. Thinking is emphasized over intuition (Ndiung et al., 2021). Appropriate activities in this phase are lectures, instructions, textbooks, and printed materials. The role of the teacher in this phase is to give lectures related to the topic by relating the elements from the previous phase to the lesson's content. In this phase, students logically analyze existing ideas and act according to their understanding of a situation (Fathurrohman, 2017). This phase is expected to result in a change in understanding of the field studied. Fourthly, active. Students are directly involved with the environment in the last phase of active experimentation. The dominant style involved in active experimentation is the application of testing. The primary strategy is to find the right solution and get practical results. Bradford (2019) describes this phase as a stage of synthesis in the learning process. Students should be allowed to try out concepts or theories they have learned through problem-solving. Learning from phases I, II, and III tested its effectiveness through the ability to apply theory to new situations. Appropriate student activities in this phase are problem-solving activities, role-playing, and action plan design. The role of the teacher in this phase is to assess student achievement by asking questions. In this phase, students perform actions and make decisions by applying the obtained analysis to an event (Fathurrohman, 2017). This phase is expected to result in changes in skills and attitudes in the field studied. The four phases of Kolb's experiential learning consist of two dimensions of cognitive development: the concrete-abstract dimension as the receiving dimension and the active-reflective dimension as the processing dimension. Based on these two dimensions of cognitive development, Kolb also categorizes students or individuals into four groups: divergers, assimilators, convergers, and accommodators. Therefore, by implementing the four steps in the KARA module, it can be believed that it will train students to have HOTS and be more motivated to learn mathematics because students are directly involved in the learning process in class.

Higher Order Thinking Skills (HOTS)

The educational paradigm has shifted towards education associated with thinking skills and using opportunities in challenging situations (Nordin, 2013). In line with the current development in the 21st century, HOTS should not be considered an advantage but a necessity. HOTS can be linked to an individual's ability to use the information for various learning activities, such as obtaining or providing information, problem-solving, or decision-making (Mohd & Hassan, 2005). HOTS are defined as using the mind to generate thoughtful ideas, make decisions, and solve problems. HOTS are a process that involves the management of specific mental operations in a person's mind or cognitive system aimed at solving problems (Thomas & Harkness, 2019).

Motivation to Learn Mathematics

Motivation to learn is a psychological condition that motivates a person to do something. Learning motivation plays an essential role in the field of education, including in mathematics education (Sides & Cuevas, 2020). In learning activities, learning motivation is the overall driving force in students that creates, ensures continuity, and provides direction for learning programs so that goals can be achieved (Hediansah & Surjono, 2019). Teachers and students in mathematics learning need learning motivation to motivate themselves to achieve tremendous success in learning. Learning motivation can be defined as the ability or agreement invested in developing energy to achieve goals or even appreciation in mathematics learning. At the same time, the teacher must be a motivator to his students so that they succeed in their education and life. McClelland and Burnham (2008) explained that the types of learning motivation could be divided into four parts, namely instrumental motivation, student social motivation, performance motivation, and intrinsic motivation. Perseverance and strong effort emerge due to high motivation to learn. Gage and Berliner (1992) proposed ways to increase students' learning motivation in the T&L process, namely: (1) verbal praise, (2) exams and marks wisely, (3) arousing curiosity and desire for exploration, (4) doing things outside common, (5) stimulating student desire, (6) leveraging student knowledge, and (7) the use of simulations and games.

Secondary School Mathematics Curriculum

The curriculum in Indonesia emphasizes that teachers apply mathematics learning that involves students actively. Nevertheless, in reality, teachers still have many limitations to creating an active learning process. Some of the limitations experienced by teachers are the lack of time provided, and the lack of variety of learning approaches teachers use (Febriana et al., 2018). Most teachers deliver mathematics learning using the lecture method. Therefore, the KARA module approach to the Three-Dimensions Geometry topic is one of the alternative learning materials that are essential for teachers in Indonesia. This module applies the learning method of concrete experience, reflective observation, abstract conceptual, and active experimentation to help students actively participate in the learning process (Kolb, 1984). In addition, it grows students' cognitive abilities (knowing, understanding, applying, analyzing, synthesizing, and evaluating) in the learning process.

Three Dimensions Geometry

Three-Dimensional Geometry is one of the mathematics topics taught at the Secondary School (SMP) level in Indonesia. This topic is taught to grade 7 second-semester students. Three-Dimensional Geometry has length, width, height, and volume dimensions, such as cubes, cuboids, prisms, and pyramids (Siregar et al., 2020).

The Study

This study was conducted to determine the following:

a. Are there differences in mathematical high-order thinking skills (HOTS) between groups based on gender and groups based on student ability?
b. Is there an interaction between groups with gender and groups with students 'abilities in terms of high-order thinking skills (HOTS) of mathematics?
c. Are there differences in mathematics learning motivation between groups based on gender and between groups based on students' ability?
d. Is there an interaction between groups with gender and groups with students 'ability in terms of motivation to learn mathematics?

METHOD

Research Study Design

The evaluation of the effectiveness of the KARA module in this study was to use a quasi-experimental design by conducting pre-test and post-test. A quasi-experimental study was conducted with independent variables, namely teaching method (using the KARA module and conventional method), gender (male and female), and student ability (high, medium, and low). The dependent variables were the achievement score of the mathematics HOTS and the score of the student's mathematics learning motivation questionnaire. The design of this study has the advantage of providing information about the differences between groups. The research methods the effectiveness of the application of the three-dimensional geometry KARA module on the improvement of HOTS and mathematics learning motivation, as shown in Figure 1.

Participants

Two schools have been selected since it is the school has been established for more than 20 years; they an excellent school, and has permission from the school, according to the cost and period of the study as well as the convenience of the school's location, namely SMP Negeri 21 and SMP Negeri 23 Pekanbaru which are under the Ministry of Education. Both schools are in the Pekanbaru district. These two schools were also selected according to national accreditation, which is the one with an A. In this study, information was collected from respondents who consisted of students in the second form of SMP in the Pekanbaru district of the 2017/2018 session who were taken from classes that met the criteria that had been determined. The respondents who participated in this study were a total of 164 people consisting of 84 people from the treatment group and 80 from the control group. Then in this study, high-ability students are students who obtain academic achievements greater than or equal to 88, medium-ability students are students who obtain academic achievements between 77 to 88, and low-ability students are students who obtained a minor academic achievement of or equal to 77. The implementation of this research took 12 months. To confirm the results of the quantitative analysis, the researcher needs to conduct a qualitative analysis of HOTS and student motivation according to gender. The respondents were four students, two males, and two females from the treatment group.

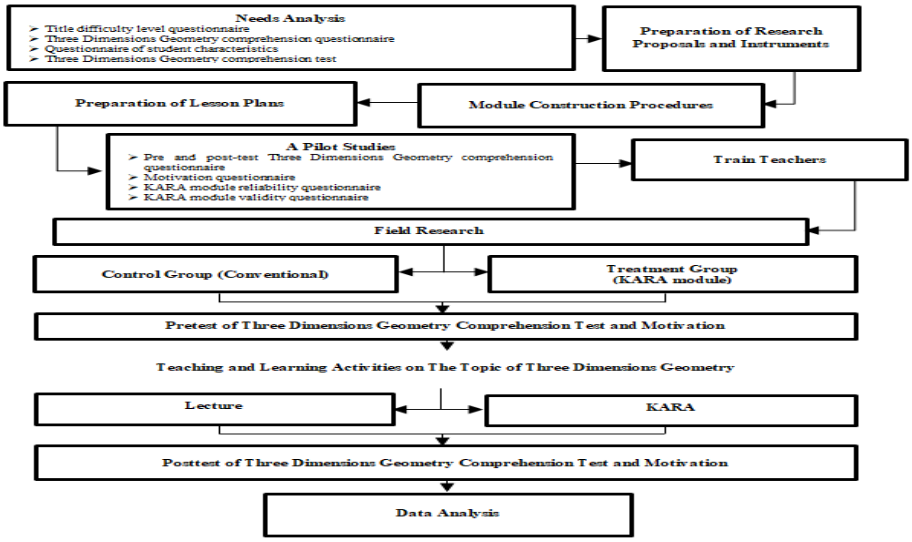

Figure 1
Research methods of the KARA module

Instruments

The instrument in this research consists of three components (1) the KARA module on the topic of Three-Dimensional Geometry, (2) the HOTS questionnaire, and the mathematics learning motivation questionnaire. These three instruments were made by researchers based on the steps developed by Kolb in 1984. Two lecturers validate the KARA module instrument with the criteria of sciences in mathematics education and module development and assessment in mathematics education. The KARA module device consists of (a) a learning implementation plan (RPP), (b) a teacher's book, (c) a student book, and (d) a student worksheet (LKS). The HOTS and motivation to learn mathematics questionnaire instruments were validated by three lecturers with criteria (1) sciences in the field of mathematics education and module development, (2) assessment, the field of mathematics education, and (3) mathematics and education. The cognitive domains of HOTS question constructs are applying (C3) (one question), analyzing (C4) (three questions), evaluating (C5) (three questions), and creating (C6) (one question). The motivation to learn mathematics questionnaire totals 30 items with four aspects of assessment. The four aspects are interest in learning mathematics (six questions), perception of the probability of success in learning mathematics (10 questions), satisfaction (six questions), and relevance in learning mathematics (eight questions).

The analysis of the reliability value of HOTS question items was used by Kuder Ricarhson (KR-20), which is 0.68. Overall, the HOTS test questions are valid, and the reliability of the HOTS test questions is moderate and usable. The validity and reliability of the mathematics learning motivation questionnaire was a pilot study involving 35 secondary school students (SMPN) 23 Pekanbaru. The results of the reliability of the mathematics learning motivation instrument using the Cronbach Alpha formula. Based on the Cronbach Alpha coefficient, namely interest (0.85); perception (0.85); satisfaction (0.84); and relevance (0.86), then the motivational instrument is included in the high-reliability category so that the item can be used without improvement refinement.

The Intervention

Students are required to perform learning activities guided by the tasks available in the module that contain high-level thinking skills. The study implementation for each group (experimental and control classes) was carried out for six weeks (28 meeting sessions). Students play an active role in the T&L process so that students are motivated to learn. During the intervention, the teacher acts as a facilitator. The KARA module process of learning involves four steps: (1) concrete experience, at this stage, students will be exposed to actual objects, artifacts, behaviors, processes, and practices; (2) reflective observation, students must review their experiences during specific experiential stages and process the information obtained through group discussions, comparing and linking experiences; (3) abstract conceptual, students strive to organize and organize information systematically and logically into concepts, theories, and ideas to solve problems and understand situations, and (4) active experimentation, students are directly related to the environment. The primary form of active experimentation is application testing. The main strategy is to find the right solution and get accurate results. Next, the control group carried out the T&L process using conventional methods (lecture learning). Conventional learning implementation techniques are more teacher-centered in the learning process; the teacher delivers the lesson, and the students listen, pay attention, and record what the teacher has explained. The learning process carried out in the class is that the teacher gives information related to the topic of geometry and gives time to the students to complete what is found in the textbook.

Before the research, the second group was given a pre-mathematics HOTS test and a pre-mathematics learning motivation questionnaire developed by the researcher. After the end of the teaching exposure, both groups were given a post-mathematics HOTS test and a post-mathematics learning motivation questionnaire. Pre-tests were used to look at equivalence between groups. Descriptive statistical analysis involving the skewness and Levene's test was carried out to determine the similarity between the compared groups. The skewness value of the HOTS test according to the treatment group is -0.02, with a standard error of skewness of 0.26 being -0.08. At the same time, the skewness value according to the control group is 0.11, with a standard error of skewness of 0.26 being 0.43. While the HOTS test by gender, the skewness value of male students is 0.07, with a standard error of 0.25 being 0.28. The skewness value of female students is 0.02 with a standard error of skewness of 0.27 0.08. Next, the HOTS test is based on the ability for the skewness value of students with high ability, which is 0.15, with a standard error of skewness of 0.40 is 0.38. The value of skewness of students with moderate ability is obtained at 0.00, with a standard error of skewness of 0.24 being 0.00. Lastly is the skewness value of students with low ability, which is 0.08, with a standard error of skewness of 0.38 is 0.21. Therefore, it can be concluded that the distribution of HOTS test scores of the Three-Dimensional Geometry topic from the study respondents involving group demographics, gender, and student ability is normal (Field, 2013). To see the assumption of homogeneity of the pre-test HOTS variance on the topic of Three-Dimensional Geometric involving group demographics, gender, and student ability, Levene's test should be conducted that the value of 0.39 > 0.05, it can be concluded that the assumption of homogeneity of the pre-HOTS test variance on the topic of Three-Dimensional Geometry based on the group is homogeneous (Pallant 2016).

The skewness value of the pre-test of mathematics learning motivation according to the treatment group is 0.18, with a standard error of skewness of 0.26 is 0.70. In comparison, the skewness value according to the control group is 0.03, with a standard error of 0.26 being 0.11. Regarding the motivation test by gender, the skewness value of male students was found to be -0.25 with a standard error of 0.25, which is -0.98. The value of skewness in terms of female students is 0.23, with a standard error of skewness of 0.27 being 0.85. Finally, the skewness value of the mathematics learning motivation test according to high ability is -0.59, with a standard error of skewness of 0.39, which is -1.49. The value of skewness obtained by students of medium ability is 0.26, with the standard error of 0.24 being 1.06. In contrast, the skewness value of low-ability students is -0.52, with a standard error of skewness of 0.40 being -1.30. In conclusion, the distribution of study respondents' pre-mathematics learning motivation test scores according to the group, gender and ability are normal (Field, 2013). Levene's test should be conducted with a value of 0.09 > 0.05; it can be concluded that the assumption of homogeneity of the variance of the pre-test of mathematics learning motivation between students in the treatment group and the control group is adhered to (Pallant, 2016).

Meanwhile, post-tests were analyzed to see differences between groups. The design of this study is divided into two forms of factorial design, namely (i) factorial design of group and gender and (ii) factorial design of group and ability. The effect of T&L on the treatment and control groups, students were also divided based on gender (male and female). Based on the daily achievement value, scores of both groups determined criteria from each student's ability. The effect of T&L given on the treatment group and the control group of students was divided into three groups based on students' ability, namely high, medium, and low ability, which were grouped for the treatment group and control group.

Analytic strategy

Inferential statistics were used to describe the differences between the variables. In this study, several tests were conducted to identify the differences between mathematics HOTS and students' mathematics learning motivation on Three-Dimensional Geometry based on the group, gender, and ability, namely: (1) data normality test to identify data in a normally distributed state by using skewness values HOTS or motivation to learn mathematics base on group and gender); (2) the homogeneity test of the data is to identify the similarity of the data variants by using Levene's test (HOTS or motivation to learn mathematics based on group and gender); (3) Two-Way ANOVA analysis was used to determine the differences and interaction effect of HOTS students 'abilities between groups and gender, and (4) MANOVA analysis was used to determine differences of sub motivation to learn mathematics based on the group. All analyses in this study involve statistical packages for social sciences (SPSS) software version 21.

FINDINGS

HOTS Test

The hypotheses related to the effect of using the KARA module method on the HOTS topic of Three-Dimensional Geometry from students and the effect of its interaction, it is necessary to conduct a Two-Way ANOVA analysis. Several tests of normality and homogeneity assumptions need to be conducted before a Two-Way ANOVA test can be implemented. The skewness values for the post-mathematical HOTS test are shown in Table 1.

Table 1
Post-HOTS test skewness values based on group and gender

Independent Variables	Demographic		Skewness		Z-Value
			Statistics	Standard Error	Skewness
HOTS	Group	Treatment	-0.62	0.26	-2.38
		Control	-0.51	0.26	-1.92
	Gender	Male	-0.35	0.25	-1.38
		Female	-0.94	0.27	-3.40

Post-mathematical HOTS test data are said to be expected when the result divides the skewness value and the skew standard error value between ± 1, ± 2, ± 3, and ± 4 (Field, 2013). The Levene test was performed to determine the homogeneity of the compared variances. The variance values for the dependent variables across all groups within the independent variables were the same (Tabachnick & Fidell, 2007); significant values above $p > 0.05$ indicate that the variance for all groups is the same (Pallant, 2016). The results of the Levene test analysis are in Table 2.

Table 2
Levene test post HOTS differences between groups based on gender

F	df1	df2	Sig.
0.90	3	160	0.43

The Two-Way ANOVA test analysis in Table 3 showed no significant interaction effect between the two independent variables of Group*Gender, F (1,160) = 0.03, p = 0.84 on the mean of HOTS test scores in the study. Next, to test the effect between subjects for mean post-HOTS test scores between groups and groups based on gender.

Table 3
Subject effect test for mean post-HOTS scores between groups based on gender

Independent Variables	Type IIISum of Squares	df	Mean Squared	F	Sig.	Partial EtaSquared
Group	1028.87	1	1029.87	4.81	0.03	0.02
Gender	317.07	1	317.07	1.48	0.22	0.00
Group*Gender	7.94	1	7.94	0.03	0.84	0.00
Standard Error	34167.73	160	213.54			
Total	761179.00	164				

The effect test between subjects in Table 3 showed a main group effect on the HOTS test of Three-Dimensional Geometry, F (1,160) = 4.81, p = 0.03. Thus, there was a significant difference in the mean of the Three-Dimensional Geometry topic HOTS test between the control and treatment groups. The inter-subject effect test in Table 3. showed that gender had no significant effect on the Three-Dimensional Geometry topic HOTS test, F (1,160) = 1.48, p = 0.22. Therefore, there was no significant difference in the mean of the HOTS test on the topic of Three-Dimensional Geometry between male and female students. Table 3 shows no significant interaction effect between the two independent variables of Group*Gender on the HOTS test, F (1,160) = 0.03, p = 0.84. Thus, there was no significant interaction between group and gender regarding high-order thinking skills (HOTS) in the mathematics of Three-Dimensional Geometry. Since there is no interaction between group and gender, the main effects of group and gender on high-order thinking skills can be interpreted separately. The findings of this study indicate that both T&L methods have a similar effect on mathematical HOTS in the topic of Three-Dimensional Geometry based on gender. The study also showed that gender factors did not influence students' mathematical HOTS in Three-Dimensional Geometry.

The Two-Way ANOVA test analysis in Table 4 shows a significant interaction effect between the two independent variables of Group*Ability, F (1,158) = 7.28, p = 0.001 on the mean test scores of HOTS in the study.

Table 4
Subject effect test for mean post-HOTS scores between groups based on the ability

Independent Variables	Type IIISum of Squares	df	Mean Squared	F	Sig.	Partial EtaSquared
Group	2924.86	1	2924.86	21.96	0.00	0.12
Ability	12479.91	2	6329.14	47.52	0.00	0.37
Group*Ability	1856.66	2	970.16	7.28	0.001	0.08
Standard Error	21000.43	158	133.17			
Total	761554.00	164				

The effect test between subjects in Table 4 showed a significant ability effect on the topic HOTS test of Three-Dimensional Geometry, F (1,158) = 47.52, p <0.001. Thus, there were significant differences in the mean of the Three-Dimensional Geometry topic HOTS test between the groups based on ability.

Table 4 shows an interaction effect between the two independent variables of Group*Significant capability on the HOTS test, F (1,158) = 7.28, p = 0.001. The effect of the difference is moderate, i.e., partial eta squared > 0.06. Thus, there was a significant interaction between the groups with the ability regarding the mathematical HOTS of the topic of Three-Dimensional Dimensional Geometry.

Next, the post hoc Bonferroni test was conducted. The justification for selecting the post hoc Bonferroni test is to look in more detail at the differences in students' mathematical HOTS based on students' abilities with unequal sample sizes (Aryadoust & Raquel, 2019). Analyst results of post hoc Bonferroni test as per Table 5.

Table 5
Post hoc Bonferroni test post-HOTS difference based on ability

(I) Level	(J) Level	Mean Difference (I-J)	Standard Error	Sig.
Height	Medium	12.64*	2.28	0.00
	Low	24.88*	2.77	0.00
Medium	Height	-12.64*	2.28	0.00
	Low	12.24*	2.30	0.00
Low	Height	-24.88*	2.77	0.00
	Medium	-12.24*	2.30	0.00

*significant mean difference at 0.05
a: Displacement for pair comparison = Bonferroni

A paired comparison for student HOTS after controlling for type I error using Bonferroni displacement is shown in Table 5. From the Table, it is found that there is a significant difference between HOTS high-ability students with a moderate ability which is p <0.001. In terms of mean, it showed that students with high ability had higher HOTS than students with the ability (mean difference = 12.64, p <0.001). There was a significant difference in HOTS between high- and low-ability students (mean difference = 24.88, p <0.001). Next, there was a significant difference in HOTS between moderate and low-ability students (mean difference = 12.24, p <0.001).

Motivation Test

Post-mathematics learning motivation test data are said to be expected when the result divides the skewness value and the skew standard error value between ± 1, ± 2, ± 3, and ± 4 (Gravetter & Wallnau, 2014). The skewness values for the mathematics learning motivation test based on group and gender are shown in Table 6. Thus, the distribution of the study respondents' post-mathematics learning motivation test scores based on group and gender is normal.

Table 6
Skewness values of mathematics learning motivation test based on group and gender

Independent Variables	Demographic		Skewness		Z-Value Skewness
			Statistics	Standard Error	
Mathematics Motivation	Group	Treatment	0.53	0.26	2.03
		Control	-0.57	0.26	-2.13
	Gender	Male	0.11	0.25	0.46
		Female	0.39	0.27	1.41

The Levene test was performed to determine the homogeneity of the compared variances. The variance values for the dependent variables across all groups in the independent variables were the same (Tabachnick & Fidell, 2007). Significant values above 0.05 indicate that the variance for all groups is the same (Pallant, 2016). Table 7. results of Levene test analysis between groups based on gender.

Table 7
Levene test of post-mathematics learning motivation differences based on gender

F	df1	df2	Sig.
1.21	3	160	0.30

Table 7. found that p> 0.05. It indicates that the assumption of homogeneity of variance has been adhered to (Pallant, 2016). This value means the variance-covariance of the dependent variable is homogeneous across the independent variable. Therefore, the Two-a-Way ANOVA test can examine the differences in students 'mathematics learning motivation between groups based on gender (Pallant, 2016).

The Two-Way ANOVA test analysis in Table 8 showed no significant interaction effect between the two independent variables of Group*Gender, F (1,160) = 0.08, p = 0.76 on the mean score of mathematics learning motivation in the study. Table 8. shows the inter-subject effect test for mean post-mathematics learning motivation test scores between groups based on gender.

The inter-subject effect test in Table 8 showed a significant group effect on students' mathematics learning motivation, F (1,160) = 37.27, p <0.001. Thus, there was a significant difference in the mean of students' mathematics learning motivation between the control and treatment groups. The inter-subject effect test in Table 8 showed that gender significantly affected students 'mathematics learning motivation, F (1,160) = 7.49, p = 0.007. Thus, male and female students have a significant difference in mean motivation to learn mathematics.

Table 8
Subject effect test for mean post-mathematics learning motivation score between groups based on gender

Independent Variables	Type IIISum of Squares	df	Mean Squared	F	Sig.	Partial EtaSquared
Group	3.46	1	3.46	37.27	0.00	0.18
Gender	0.69	1	0.69	7.49	0.007	0.04
Group*Gender	0.00	1	0.00	0.09	0.76	0.00
Standard Error	14.87	160	0.09			
Total	2132.04	164				

Table 8 shows no significant interaction effect between the two independent variables of Group*Gender on students 'mathematics learning motivation, F (1,160) = 0.08, p = 0.76. Thus, there was no significant interaction between group and gender regarding students 'mathematics learning motivation. Although the motivation to learn mathematics possessed by male and female students in the group using the KARA module and the group of students using the conventional method is not significantly different. This condition happens because male and female students think mathematics is complex to understand, so they are less motivated to learn. Nevertheless, there was an increase in the motivation of male and female students to learn mathematics in the group that used the KARA module. The Two-Way ANOVA test analysis Table 9. shows a significant interaction effect between the two independent variables Group*Ability, F (1,158) = 9.05, p <0.001 on the mean scores of students' mathematics learning motivation in the study. Table 9. shows the effect test between subjects for mean post-mathematics learning motivation test scores between groups based on ability.

Table 9
Subject effect test for mean post-mathematics learning motivation score between groups based on ability

Independent Variables	Type IIISum of Squares	df	Mean Squared	F	Sig.	Partial EtaSquared
Group	3.69	1	3.69	48.93	0.00	0.23
Ability	2.23	2	1.11	14.76	0.00	0.15
Group*Ability	1.36	2	0.68	9.05	0.00	0.10
Standard Error	11.94	158	0.07			
Total	2132.04	164				

The inter-subject effect test in Table 9 showed a significant effect of ability on students 'mathematics learning motivation, F (1,158) = 14.76, p <0.001. Thus, there were significant differences in mean motivation to learn mathematics between groups based on students' abilities. Table 9 shows an interaction effect between the two independent variables of Group*Significant ability on the mean score of mathematics learning motivation, F (1,158) = 9.05, p <0.001. Thus, there was a significant interaction between the group and students' ability regarding students' mathematics learning motivation. Next is to do the Post Hoc Bonferroni test (Table 10). The justification for test selection is to look at the differences in students' mathematics learning motivation based on students' abilities with unequal sample sizes (Aryadoust & Raquel, 2019).

Table 10
Post Hoc Bonferroni test post-mathematics learning motivation difference based on ability

(I) Level	(J) Level	Mean Difference (I-J)	Standard Error	Sig. [a]
Height	Medium	0.21*	0.05	0.00
	Low	0.30*	0.06	0.00
Medium	Height	-0.21*	0.05	0.00
	Low	0.08	0.05	0.30
Low	Height	-0.30*	0.06	0.00
	Medium	-0.08	0.05	0.30

*significant mean difference at 0.05
a: Displacement for pair comparison = Bonferroni

A paired comparison for mathematics learning motivation after controlling for type I error using the Bonferroni shift is shown in Table 10. The Table shows a significant difference between mathematics learning motivation based on ability. There was a significant difference in mathematics learning motivation between high-ability and medium-ability students (mean difference = 0.21, p <0.001). In terms of mean, high-ability students have a higher mean motivation to learn mathematics than low-ability students (mean difference = 0.30, p <0.001). Furthermore, there was no significant difference in mathematics learning motivation between moderate-ability and low-ability students (mean = 0.08, p> 0.05). Because the KARA module is built based on the experience and active involvement of all students, students with medium and low abilities still find it challenging to understand the topic of three-dimensional geometry, so they are less enthusiastic about learning mathematics. Examining differences in the interest sub-motivation, perception of success probability, satisfaction, and relevance specifically, MANOVA analysis was conducted. Results of MANOVA analysis to see the difference of each student sub-motivation based on group as Table 11.

Table 11
MANOVA tests the difference in sub-motivation of learning mathematics based on group

Sub Motivation	Group	Type III Sum of Squares	df	Mean Squared	F	Sig.	Partial Eta Squared
Interest	Treatment	3.74	1	3.74	16.22	0.00	0.09
	Control						
Success	Treatment	3.10	1	3.10	30.78	0.00	0.16
	Control						
Satisfaction	Treatment	5.20	1	5.20	22.96	0.00	0.12
	Control						
Relevance	Treatment	2.68	1	2.68	19.50	0.00	0.10
	Control						

From Table 11. it is found that there is a significant difference in student interest sub-motivation between groups, F (1,162) = 16.22, p < 0.001. The effect of interest sub-motivation differences was moderately partial eta squared > 0.06 (Cohen, 2013). For the perceived sub-motivation of the probability of success, there is a significant difference in the sub-motivation of the perception of the probability of students' success between groups, F (1,162) = 30.78, p < 0.001. The effect of the difference is significant, i.e., partial eta squared > 0.14. Next, there was a significant difference in student satisfaction sub-motivation between groups, F (1,162) = 22.96, p < 0.001. The effect of the difference is moderate, i.e., partial eta squared > 0.06. Finally, there was a significant difference in student-relevant sub-motivation between groups F (1,162) = 19.50, p < 0.001. The effect of the difference is moderate, i.e., partial eta squared > 0.06. It can be concluded that the four sub-motivations have significant differences between the treatment group and the control group.

To confirm the results of the quantitative analysis that the KARA module has a significant impact on the experimental group, researchers must conduct a qualitative analysis of HOTS and student motivation by gender. The respondents used were four people consisting of two males and two females.

Based on the results of interviews with four MRA and MDF respondents (male students), KDA and ZD (female students) showed that the four respondents were able to understand, identify, and explain the elements that were known and asked in questions number 1 and 2. Their ability could not be separated from the learning media suggested by the teacher before carrying out Geometry learning, as quoted from MRA:

> *Before the lesson begins, the things we need to prepare are: (1) Provide a modified box in the form of a cubic cube of various sizes; (2) Provide cutting blades; (3)*

> *Provide measuring tools (ruler); (4) Provides a framework for building a cube; (5) Provide a model of cube nets; (6) Providing other mathematics reference books; (7) Students are formed into several small groups (total 4-5 students) heterogeneously*.

Furthermore, MDF and ZD suggested that the KARA approach could encourage better interest and thinking skills because it implemented four stages in the learning process, as quoted from MDF and ZD:

> *The first stage; Concrete experience, means that students obtain information through direct experience; The second stage is conceptual abstract, where students understand concepts and principles. Ability to process information with reflective observation (third stage), namely observing or experimentally (fourth stage), active involvement of students in the activities carried out. Students process information either by reflection or intentionally doing something*.

Learning with the KARA approach can improve students' achievement in learning mathematics because of the direct active involvement of students, and the learning process is carried out collaboratively with other students, as quoted from KDA:

> *The learning process with the KARA approach creates more meaningful mathematics learning for students because (a) students are challenged and active in the learning process, (b) teachers train students to convey and develop their ideas, (c) appropriate and open tasks so that students are motivated to expand in building their knowledge, (d) cooperation between students that allows the exchange of ideas and (e) the situation in the classroom, namely students who respect the ideas of other students*.

Therefore, based on the results of interviews MRA, MDF, KDA, and ZD have an excellent ability to understand and solve a cube's surface area and volume. In addition, the four respondents are equally motivated to learn mathematics using the KARA approach.

DISCUSSION

HOTS and Learning Motivation between Groups

The success of teaching and learning methods using experiential learning approaches in mathematics HOTS and mathematics learning motivation for the topic of Three-Dimensional Geometry also occurred similarly for the study conducted by Elliott et al. (2001). Next, the Two-Way ANOVA test analysis showed significant differences in HOTS of mathematics and motivation to learn mathematics between groups of students based on ability. It indicates a significant interaction between the group with students' ability on HOTS of mathematics and students' motivation to learn mathematics. It indicates a relationship between the use of the KARA module and conventional methods with students with high, moderate, and low abilities in improving HOTS of mathematics and motivation to learn mathematics among junior high school students.

Students who use the KARA module have higher-order mathematical thinking skills and higher motivation to learn mathematics than the conventional T&L method. The improvement of HOTS of mathematics and motivation to learn mathematics occurs among students with high, medium, and low abilities. It indicates that using the KARA module impacts the improvement of HOTS of mathematics and motivation to learn mathematics among SMP. This study's findings align with previous studies' results stating that there are differences and relationships between HOTS and students' mathematics learning motivation based on ability (Finau et al., 2018).

This study's results align with Shih et al. (2019). They suggested that the active involvement of students in the T&L process can enhance and motivate students to possess the ability to think more creatively and think high level. Mathematical HOTS and motivation to learn mathematics are strengthened by teaching and learning using KARA modules emphasizing students' active involvement in solving mathematical questions. In addition, the KARA module is applied based on experience by allowing students to build their knowledge so that students with various abilities can accept and carry out the T&L process well. Furthermore, the T&L process with this module also implements small group-based learning. Each student can give their opinion and choose the best argument to be the alternative solution to the mathematical questions. Therefore, with these activities, students can solve various types of difficult mathematical questions, including mathematical HOTS (Wulandari & Gusteti, 2021).

The characteristics of question types in the HOTS category are (1) measuring high-order thinking skills, (2) contextually based problems, (3) using multiple questions such as multiple-choice questions, descriptive questions, short questions, and others (Rosyadi et al., 2022). While the questions used to measure HOTS (1) non-algorithmic, (2) have more than one solution, (3) complex questions, and (4) require effort to find non-linear structures (Ibili et al., 2019). At the same time, the benefit of the type of HOTS questions teachers give is to prepare students to welcome the 21st century and increase learning motivation among students (Ilhan Tutak & Celik, 2019).

Providing opportunities for students in the T&L process can positively impact better mathematical HOTS achievement outcomes (Retnawati, 2022). Based on the study results, it was also found that there is a difference in the mean score of motivation to learn mathematics based on gender. Previous studies found a high gap between female and male students on aspects of mathematics learning motivation (Parker, Van Zanden & Parker, 2018). However, these findings are contrary to most study findings stating that female students do not outperform males in aspects of mathematics learning motivation (Brandenberger et al., 2018; Daly et al., 2019). Male and female students argue that mathematics subjects are complex to understand, so they are less motivated to learn (Olarewaju & Suleiman, 2019).

One method that can cultivate aspects of the cognitive domain level (applying, analyzing, evaluating, and creating) of students' HOTS is a learning method using an experiential approach from Kolb (Suwarna et al., 2020). The first phase, the concrete experience phase, provides students with activities to engage students and provide awareness of the importance of the topic (Whitt et al., 2019). In addition, in this first phase, students are trained to have the skills to apply the knowledge they have learned (Rahmawatiningrum et al., 2019). The second phase is reflective observation (Pratama & Retnawati, 2018). Students are asked to relate existing knowledge to new learning in this phase. They were also asked to reflect on the emotional state and the learning involved in phase one (Rokhima et al., 2019).

Furthermore, the second phase trains students in assessment skills (Kurniawan & Utaminingsih, 2021). The third phase is the abstract conceptual phase, i.e., the presentation takes place in the form of lectures and textbook references. This phase encourages students to choose skills in analyzing the problem being solved (Purnomo et al., 2021). Finally, the fourth phase is the reflective observation phase, which consists of group project activities to solve less structured problems and require skills acquired from the previous phases (Aini et al., 2020). In this phase, students are trained to possess skills in creating various problem-solving concepts (Karimah et al., 2018). In this activity, they can express ideas, defend their ideas, debate for different examples, ask dissimilar questions, and be actively involved in the T&L process in the classroom (Ersoy et al., 2019).

Students learning mathematics very much need good motivation. The KARA module emphasizes group learning in problem-solving so that each student in the group gives each other support and a positive attitude to get the best solution results (Tasgin & Tunc, 2018). Using the KARA module positively impacts students' learning motivation because they can express ideas freely. The results of this study are in line with the results of previous studies that found that students have good motivation to learn in the T&L process by giving free opportunities to students; having good motivation in learning then also has an impact on students' ability to solve mathematical problems (Daly et al., 2019). Moreover, environmental (external) and internal conditions positively affect student motivation in the T&L process (Wilkie & Sullivan, 2018). It is related to the positive experiences and enjoyment experienced by students (Brandenberger et al., 2018).

The Interaction HOTS and Learning Motivation between Groups

The analysis conducted in this study found no interaction between groups and gender on the improvement of HOTS of mathematics and motivation to learn mathematics among students. This condition happens because male and female students think that mathematics subjects are complex to understand, think about, and solve, so they are less motivated to learn (Baten et al., 2019). It indicates no relationship between the T&L method using the KARA module and the conventional method based on the gender on the improvement of HOTS of mathematics and motivation to learn mathematics among junior high school students. Although HOTS of mathematics and motivation to learn mathematics possessed by male and female students in the group using the KARA module and the group of students using the conventional method did not differ significantly.

However, there was an increase in HOTS and motivation to learn the mathematics of male and female students in the group using the KARA module. It shows that teaching and learning using the KARA module improves HOTS and motivation to learn mathematics among male and female students.

This research is limited to a small number of respondents from junior high school students in Pekanbaru. In addition, the research only focuses on students' HOTS abilities and their motivation to learn mathematics. For further research, it is recommended to use a larger sample from various provinces in Indonesia. In addition, it is recommended to assess how the KARA module is viewed from the aspect of socioeconomic status, interests, and differences in students' urban and rural areas.

CONCLUSION

They used the three dimensions geometry KARA module; the learning process affects the improvement of the quality of teaching and learning of mathematics in several forms in two secondary schools in the district of Pekanbaru. In addition, it also affects the improvement of HOTS of mathematics and motivation to learn mathematics from students. However, this module impacts the improvement of HOTS of mathematics and motivation to learn mathematics from form two Secondary School students but is not significant by gender. However, learning with this module give impacts students' abilities. The study also found no significant interaction between group and gender in improving HOTS and motivation to learn mathematics. Meanwhile, there was a significant interaction between the groups, the ability to improve HOTS in mathematics and motivation to learn mathematics among SMP students.

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