



Experiences of Senior High School Mathematics Teachers With Higher Order Thinking Skills (HOTS) In Riau Islands Province-Indonesia

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Abstrak

Keterampilan Berpikir Tingkat Tinggi (HOTS) sangat penting bagi siswa, dan guru harus melatih dan menanganinya dengan benar. Penelitian ini bertujuan untuk menjelaskan persiapan dan pengalaman belajar guru matematika, mengevaluasi persepsi guru matematika tentang HOTS, menyelidiki upaya guru matematika untuk meningkatkan HOTS siswa SMA di Provinsi Kepulauan Riau, Indonesia dan untuk mengetahui kemampuan HOTS siswa. Seratus dua belas guru matematika SMA di Provinsi Kepulauan Riau menjadi sampel survei ini. Para ahli memvalidasi instrumen penelitian berupa angket yang diperbarui. Statistik deskriptif digunakan untuk mengevaluasi hasil (dalam persentase). Guru Matematika SMA Provinsi Kepulauan Riau melakukan perencanaan kelas dengan baik, tetapi tidak dilakukan secara konsisten. Beberapa guru tidak sepenuhnya merencanakan pembelajaran sesuai standar pendidikan yang direkomendasikan. Tantangan terberat guru dalam meningkatkan HOTS siswa selama proses pembelajaran matematika adalah menentukan stimulus menarik yang sesuai dengan sifat materi yang akan diajarkan. Pemahaman guru tentang HOTS cukup luas, dan mereka percaya bahwa HOTS harus diajarkan kepada siswa.

Kata kunci: HOTS; guru matematika; pengajaran; belajar; SMA

Abstract

Higher-order Thinking Skills (HOTS) are essential for students, and teachers must properly train and handle them. This study aims to explain mathematic teachers' learning preparation and experiences, evaluate mathematic teachers' perception of HOTS, investigate mathematic teachers' efforts to improve HOTS for senior high school students in Riau Islands Province, Indonesia and to find out students' HOTS ability. One hundred and twelve senior senior high school mathematic teachers in the Province of Riau Islands were the sample of this survey. Experts validated the research instrument, which is in the form of an updated questionnaire. A descriptive statistic was used to evaluate the results (in percentage). The Riau Islands Province senior senior high school mathematic teachers did a good job of planning the class, but it was not done consistently. Some teachers did not completely plan the lessons according to the educational standards that were recommended. Teachers' most difficult challenge in raising student HOTS during the mathematics learning process was deciding on an engaging stimulus that was suitable for the nature of the material to be taught. The teachers' understanding of HOTS is sufficiently broad, and they believe that HOTS should be taught to students.

Keywords: HOTS; mathematics; teaching; higher order thinking; senior high school

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I. Introduction

Efforts to increase educational quality are inextricably linked to the demands of the twenty-first century's challenging and demanding times. Because of the rapid pace of change in the twenty-first century, students must be able to make rational decisions, critically, and creatively in ability to come up with solutions to a variety of current and future societal problems (Skills, 2011). Learning and creativity skills, life and professional skills, and knowledge, media, and technological skills are the three core structures for 21st century skills (Scott, 2017). The scope of higher order thinking skills is a phrase used to refer these abilities. The need for these skills indicates that students' reasoning skills need to be enhanced (Tanudjaya & Doorman, 2020).

TIMSS (The Trends in International Mathematics and Science Study) conducted by the IEA (International Association for Evaluation of Educational Achievement) and PISA (International Student Assessment Program) conducted by the OECD (Organization for Economic Cooperation and Development) are international initiatives that test and evaluate student skills in the twenty-first century. PISA and TIMSS ask students to answer questions that require them to not only memorize but also to recognize and solve problems. PISA and TIMSS questions have contextual issues, such as requiring specialized problem-solving skills such as logic, argumentation, and imagination. When proposing, formulating, explaining, and solving mathematical problems in different contexts, students must analyze, reason, and convey ideas effectively, as measured by the PISA mathematical literacy assessment and the TIMSS cognitive processes assessment (Mullis & Martin, 2014; OECD, 2018).

PISA and TIMSS thinking skills are known as Higher Order Thinking Skills (HOTS). Higher order thinking skills (HOTS) are defined as a wider use of thinking to solve problems (Brookhart, 2010; Yustitia & Juniarso, 2018). HOTS is needed for an individual to be comfortable with change that necessarily involve

complex problem solving abilities (Masitoh & Aedi, 2020; Pratiwi, 2020; Zaiyar & Rusmar, 2020). HOTS is divided into three broad categories: transfer, critical thinking, and problem solving (Brookhart, 2010). Resnick (1987) further explain, HOTS as transfer is described as the ability to apply knowledge and skills acquired through learning in a new setting. HOTS is a transferable ability set that includes analytical, evaluative, and artistic abilities (Resnick, 1987; Tan, Aris, & Abu, 2006). Critical thinking, also known as HOTS, is characterized as the ability to make smart decisions and criticize things using rational and scientific reasoning (F. J. King, Goodson, & Rohani, 1998; Schraw & Robinson, 2011; Thomas & Thorne, 2009). The skills of expression, interpretation, and reasonable decision making are all part of HOTS as critical thinking (Bezanilla, Fernández-Nogueira, Poblete, & Galindo-Domínguez, 2019; Schraw & Robinson, 2011). The use of non-automatic strategies to identify and solve problems is known as HOTS problem solving (Haladyna, 1997; Resnick, 1987; Schraw & Robinson, 2011). Students are expected to solve their own problems and work more efficiently if they have this skill.

Furthermore, Heong et al. (2011) explains that higher-order thinking challenges can be addressed and mastered, and all students have the right to do so in order to solve problems. This demonstrates that higher order thinking skills are essential and sensible for students to solve problems in their learning experience, allowing them to improve their critical thinking processes, develop their intellect, and prevent thinking errors (Ghanizadeh, Al-Hoorie, & Jahedizadeh, 2020; Tan et al., 2006). Based on some of these viewpoints, HOTS can be described as more complex cognitive skills used to solve a variety of non-algorithmic issues, along with critical and creative thinking (F. J. King et al., 1998). HOTS includes students' abilities to interpret, synthesize, and assess, as if it is correlated with cognitive processes in Bloom's taxonomy, while if it is related to cognitive phases in Bloom's taxonomy revision, HOTS incorporates the ability to

analyze, evaluate, and construct (Anderson, Krathwohl, & Bloom, 2001).

Teachers play a critical role in building HOTS for students by organizing and executing activities that should be taken seriously and consistently (Abdullah et al., 2017; Apino & Retnawati, 2017; Hadi, Retnawati, Munadi, Apino, & Wulandari, 2018; Retnawati, Jailani, et al., 2018; Seman, Yusoff, & Embong, 2017; Tanujaya, 2016). Various research on the development and efficiency of learning processes in Indonesian schools have been conducted in an attempt to map and enhance the quality of Indonesian mathematic learning. Some research look at how well teachers can create and implement learning plans (Apino & Retnawati, 2017; Miri, David, & Uri, 2007; Retnawati, Jailani, et al., 2018; Tan et al., 2006). Several other studies have looked at teachers' ability to design or conduct evaluations, as well as the development of assessment questions (Budiman & Jailani, 2014; Kurniasi & Arsisari, 2020; Tanujaya, 2016; Widana, 2017; Witri, Febrian, & Rosmery Tambunan, 2019). Other research looking at general teacher competencies were also performed (Retnawati, Djidu, Kartianom, Apino, & Anazifa, 2018).

However, no previous research has attempted to uncover an analysis mathematics teacher empowerment of HOTS in Riau Islands Province. Therefore, this study was conducted to explore: 1) how senior senior high school teachers in Riau Islands Province prepare students for mathematic learning; 2) how mathematic teachers' interpretation of HOTS; 3) mathematic teachers' efforts in evaluating HOTS for senior high school students in the Riau Islands Province; and 4) the HOTS ability of senior senior high school students in learning mathematics in the Riau Islands Province through teachers' experience. The findings of this study are crucial for the growth of mathematic learning in Indonesia, as it represents the skills needed in the twenty-first century.

II. Method

This is a survey study that provides details about the facts and descriptions of senior high school mathematic teachers in Riau Islands Province, Indonesia, mathematic learning readiness, comprehension of High-order Thinking Skills, and teachers' efforts to build HOTS for students in Riau Islands Province's senior high schools. In Riau Islands Province, the entire population was positioned as a senior high school mathematic teachers. The sampling method is based on convenience or as desired. The respondents as the sample in this study were a total of one hundred and twelve senior high school mathematic teachers from Riau Islands Province.

A questionnaire has been verified by experts as the research instrument. The questionnaire has four main component, namely: 1) component of mathematic learning readiness (Abdullah et al., 2017; Ramdiah, Abidinsyah, Royani, & Husamah, 2019; Retnawati, Jailani, et al., 2018); 2) component of teacher's capability and obstacles of higher order thinking skills (Gradini, 2019; F. King, Goodson, & Faranak Rohani, 1998; Ramdiah et al., 2019; Widana, 2017); 3) component of evaluation students' higher order thinking skills abilities (Apino & Retnawati, 2017; Oktiningrum, Zulkardi, & Hartono, 2016; Ramdiah et al., 2019; Tanujaya, 2016); and 4) component of students' HOTS ability (Brookhart, 2010; Budiman & Jailani, 2014; Fatimah & Pahlevi, 2020; Prasetyani, Hartono, & Susanti, 2016; Pratiwi, 2020).

Questionnaires were evaluated by two assessment and education experts before being utilized as a data gathering tool. Furthermore, descriptive statistics with percentages were used to evaluate the results. This study aims to explain the information gleaned from questionnaires completed by senior high school mathematic teachers in Riau Islands Province.

III. Findings

Component of Mathematic Learning Readiness

The information on teachers' responses to the aspect of mathematic learning preparation in Riau Islands Province senior high schools is summarized in Table 1. Table 1 shows that mathematic teachers in Riau Islands Province Senior high school did a good job of preparing the students for their lessons. The majority of respondents, on the other hand, did not do any regular planning. It can be seen that respondents answer to certain questions with the word "sometimes" more often than others. This condition reduces teachers' ability to be creative in the classroom, especially in the preparation of learning documents and planning that adheres to educational standards.

Table 1.
Component of mathematic learning readiness

Question	Respon Percentage (%)		
	Always	Sometimes	Never
Do you provide learning outcome indicators for evaluation needs?	73.2	25.9	0.9
Do your learning and evaluation media support the expected learning outcomes?	50	50	0
Have you prepared a rubric for evaluating student learning outcomes?	51.8	45.5	2.7
Do you incorporate students' higher-order thinking skills development plans into your lesson plans?	41.1	58	0.9
Do you apply learning strategies in the teaching and learning process?	79.5	20.5	0
Is the learning in line with your plans?	44.6	54.5	0.9

The interconnected components of the relationship between students and teachers, as well as their interaction, play a large role in the success of education in Indonesia. Teachers play

a critical role in deciding the amount and quality of instruction they provide. As a result, teachers must carefully consider and prepare how to improve learning experiences for their students while also enhancing teaching quality and reflection. It goes on to say that this initiative would necessitate improvements in class structure, teaching methods, teaching and learning techniques, teacher attitudes and characteristics, and teacher attitudes and characteristics in managing the teaching and learning activities.

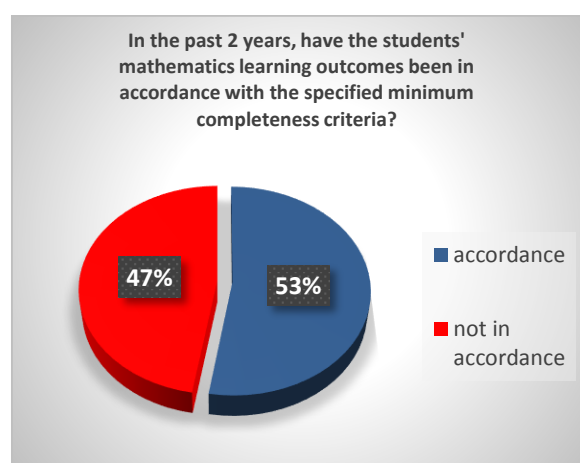


Figure 1. Students' mathematics learning outcomes with the specified minimum completeness criteria

From Figure 1 it can be concluded the students' mathematics learning outcomes during these two years meet the specified minimum completeness requirements. As the manager and facilitator of the teaching and learning process, the teacher creates and produces learning materials and helps students enhance their ability to listen and master learning objectives. Furthermore, the design aids teachers and designers in determining what students want. There is a method of gathering information, directing behavior, and presenting information about the learning outcomes performed by students in a formal learning environment. Teachers may also offer students more autonomy when leading them toward effective learning.

Component of Capability and Obstacles

The level of learning that seeks to empower this thinking ability will be influenced by the teacher's capability and obstacles of high-order thinking skills. Table 2 shows the level of awareness of higher order thinking skills among teachers in this sample. According to the findings of the table 2 study, 63.4 percent of mathematics teachers recognize the value of teaching students to improve their HOTS abilities. Table 2 also demonstrates the teacher's capability, with 53.6 percent of teachers unable to create and design special questions to assess students' HOTS.

Table 2.
Teacher's capability and obstacles

Questions	Responses (%)	
Are you able to develop and design specific questions to think about students' higher order thinking skills?	Capable	45.5
	Less capable	53.6
	Incapable	0.9
Are you training your students to develop their higher-order thinking skills?	Always	63.4
	Sometimes	35.7
	Never	0.9
What were the obstacles that were experienced when you developed the Higher-Order Thinking Abilities of your students?	Difficulty applying appropriate indicators related to higher order thinking skills	40.2
	Difficulty in choosing a cognitive level	31.3
	Difficulty in determining the right learning strategy	42
	Availability of questions related to higher-order thinking skills	32.1
	Difficulty in making questions that fit the criteria for higher-order thinking skills	51.8
	Difficulty selecting interesting and contextual stimuli	53.6

Based on Table 2, the most challenging challenge faced by teachers in rising student HOTS during the mathematics learning process was 53.6 percent of teachers having trouble selecting an engaging stimulation that was appropriate for the nature of the content to be taught. The teacher's second biggest challenge was coming up with questions that met the HOTS

requirements. This demonstrates that mathematics teachers in the Riau Islands Province need to develop their HOTS skills.

Component of Evaluation

The commitment of the teacher to enhance the learning process is critical to achieving the learning objectives. The empowerment of the expected thinking ability would be maximized by using the right learning practices and developing the right learning assessment process. Kurniasi & Arsisari (2020) further explain students' higher order thinking skills will only improve if they are exposed to practices that educate HOTS. This evaluation requires not only the provision of materials, but also the creation of an assessment method to assess HOTS. The effort made by teachers to improve students' HOTS while they were studying was also revealed in this report. Figure 2 depicts data on teachers' attempts to evaluate students in developing HOTS.

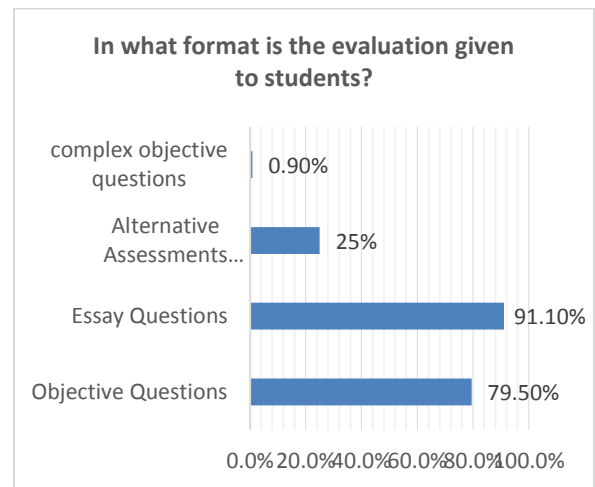


Figure 2. Format in HOTS evaluation

The responses of respondents showed that 91.1 percent of teachers use essay and objective question in evaluate students' HOTS. According to the study results of mathematic teachers' instrumen assessment in improving HOTS in Riau Islands Province, as shown in Figure 2, mathematic teachers have introduced successful evaluation programs but have not applied HOTS to their full potential. Not every good evaluation instrument will help students

develop HOTS, since empowering these thought skills necessitates the use of specific learning strategies and activities such as using alternative assessments (portfolios, project based scoring, journals etc).

Component of Students’ HOTS Ability

The HOTS ability of students in Riau Islands Province in solving math problems can be seen in Table 3. Based on the HOTS ability indicators, in Table 3 it can be seen that the students' HOTS abilities are still weak. The lowest HOTS ability indicator is 79.5% of students who are less capable of abstracting a problem that is in a math problem, this causes the given math problem to be difficult to solve mathematically.

Table 3.
Students’ HOTS ability

Question	Responses (%)		
	Able	Less able	Unable
Are students able to explain the problem in the questions?	33	64.3	2.7
Are students able to describe the problem in the questions?	36.6	61.6	1.8
Are students able to determine the right steps and solutions in solving problems?	33.9	64.3	1.8
Are students able to apply the formula correctly in solving problems?	44.6	53.6	1.8
Are students able to formulate / recommend a solution to the problem on the questions given?	33.9	63.4	2.7
Are students able to design / construct a solution in solving problems?	20.5	75.9	3.6
Are students able to represent the problem in the problem in mathematical form?	37.5	61.6	0.9
Are students able to build / create theories from the context of the problems of daily life given to the questions?	24.1	72.3	3.6
Are students able to abstract a problem that is in the question, so that the questions can be solved mathematically?	19.6	79.5	0.9
Are students able to correlate / connect a problem in everyday life into a mathematical concept?	37.5	60.7	1.8
If given a problem and its solution, are students able to criticize / prove that the solution is right or wrong?	36.6	61.6	1.8

Furthermore, if you pay close attention, you'll note that all of the HOTS indicators in Table 3 indicate that student HOTS ability is below 50%. Students' poor HOTS ability is due to a variety of reasons, including the fact that they're not being used to applying mathematical knowledge that they have practiced in their everyday lives, and are also unable to apply problem-solving skills when the problems are slightly different with what they've learned (Budiman & Jailani, 2014; Noprinda & Soleh, 2019). Indonesian students are used to solving math problems by memorizing formulas and applying previously taught procedures instead of using the higher-order thinking skills (Yenusi, Mumu, & Tanujaya, 2019). In this situation, students are considered to lack adequate HOTS capabilities. These results highlight the importance of young students continuing to improve HOTS skills as they face the twenty-first century.

IV. Conclusion

According to the findings of the study, students' HOTS ability in Riau Islands Province is still poor and senior high school mathematic teachers in Riau Islands Province have prepared learning well, but not frequently (constantly), and some have not prepared learning to the maximum extent possible in accordance with recommended education standards. Teachers already have a basic understanding of HOTS and recognize the importance of putting it into effect for their students. Since the HOTS factor appears to be overlooked, the teacher's efforts in improving HOTS have not been realized and are less defined in their teaching activities. More research is needed to determine the level of HOTS among Riau Islands Province students, as well as to examine various local government policies (education corporate headquarters) and various efforts to improve HOTS by upgrading learning quality.

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