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HOTS Test Development Based on Realistic Mathematics Learning For Grade V Elementary School

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Abstrak

Penelitian ini bertujuan untuk: menganalisis tingkat validitas tes HOTS berbasis pembelajaran matematika realistik pada topik bangun ruang; menganalisis tingkat praktikalitas tes HOTS berbasis pembelajaran matematika realistik yang dikembangkan; menganalisis keefektifan tes HOTS berbasis pembelajaran matematika realistik; dan mengetahui respon siswa terhadap tes HOTS berbasis pembelajaran matematika realistik yang dikembangkan. Jenis penelitian yang digunakan adalah penelitian pengembangan model Borg and Gall. Penelitian dilaksanakan di SDN 064987 Medan pada tahun Pelajaran 2021/2022 dengan subjek penelitian siswa kelas V berjumlah 30; Hasil penelitian diperoleh bahwa; kemampuan tes HOTS berbasis pembelajaran matematika realistik dalam meningkatkan kemampuan matematika siswa telah memenuhi kriteria valid; tes kemampuan HOTS berbasis pembelajaran matematika realistis dalam meningkatkan hasil belajar matematika siswa telah memenuhi kriteria praktis; tes kemampuan HOTS berbasis pembelajaran matematika realistis dalam meningkatkan hasil belajar matematika siswa telah memenuhi kriteria efektif; dan respon siswa terhadap tes kemampuan HOTS berbasis pembelajaran matematika realistis dalam meningkatkan hasil belajar matematika siswa telah memenuhi kriteria yang diperoleh rata-rata di atas 80% pada uji coba I dan uji coba II.

Kata Kunci: Pembelajaran Matematika Realistik, Tes HOTS

Abstract

This research aims to: analyze the validity level of the HOTS test based on realistic mathematics learning on the topic of spatial shapes; analyze the practicality level of the developed HOTS test based on realistic mathematics learning; analyze the effectiveness of the HOTS test based on realistic mathematics learning; and understand students' responses to the developed HOTS test based on realistic mathematics learning. The type of research used is the Borg and Gall model development research. The research was conducted at SDN 064987 Medan during the 2021/2022 academic year with 30 fifth-grade students as the research subjects; The research results indicate that the HOTS test based on realistic mathematics learning in improving students' mathematics skills has met the validity criteria; the HOTS test based on realistic mathematics learning in improving students' mathematics learning outcomes has met the practicality criteria; the HOTS test based on realistic mathematics learning in improving students' mathematics learning outcomes has met the effectiveness criteria; and students' responses to the HOTS test based on realistic mathematics learning in improving students' mathematics learning outcomes have met the criteria with an average above 80% in both the first and second trials.

Keywords: HOTS Test, Realistic Based Learning.

A. Introduction

In the field of education, assessment plays a very significant role thanks to its significance. Information on the learning outcomes that students have accomplished may be obtained via evaluation. This information on pupils must be collected via assessments that are carried out by instructors in order to determine the capabilities of the students. Information on the learning outcomes that students have accomplished may be obtained via evaluation. (Sabaruddin, 2019) Teachers are able to ascertain, with the use of this information, whether or not the learning goals that have been established have been accomplished.

The provision of feedback to students in order to ascertain the learning outcomes of the learning process that has been carried out is an essential function of learning evaluation designed for students (Devina, P., Suanto, E., 2021). Because this information is highly significant for planning further learning, having knowledge and comprehension of the learning outcomes of students will assist instructors in reflecting on their performance in order to improve it in the future. In addition to providing instructors and students with information on the extent to which a learning goal or skill has been achieved, feedback from learning evaluations performs a number of other purposes as well (Sudaryono., 2020).

Instructors are able to determine the efficacy of the learning program that has been implemented. In order for teachers to be able to carry out learning outcome assessments in an appropriate manner, they are required to fulfill a number of requirements. These requirements include the following: (a) teachers are required to master and comprehend a variety of laws and regulations that contain articles on learning outcome assessments; and (b) teachers are required to mastered the theory of learning evaluation (Masri, MF., 2018).

Due to the intricate nature of the evaluation process, it is essential for educators to possess sufficient knowledge and abilities. There are a lot of actions that take place during the preparation stage. One of these activities is the creation of a specification table that includes assessment procedures, assessment objectives, and the required number of instruments. When it comes to evaluating the consequences of learning, a teacher has the option of using two distinct kinds of testing: conventional exams and teacher-made tests. A test that has been subjected to a process of standardization, which ensures that the test is both valid and trustworthy, is what is meant by the term "standard test" (Hendrikson R Panjaitan, 2023).

(Winandyaz, 2021) defines a test as an instrument or tool that is used for the purpose of gathering information such as a person's knowledge or abilities. A test, on the other hand, is a set of questions or exercises, as well as other instruments, that are used to evaluate the skills, intellect, knowledge, abilities, or talents that are held by people or groups, as stated by (Arikunto, 2018). One may draw the conclusion that a test is an instrument or tool that is used to gather information in the form of knowledge and intelligence skills that are held by an individual or group. This conclusion can be reached based on the numerous viewpoints that have been expressed.

It has been determined, on the basis of the findings of field observations, specifically at SDN 064987 Medan Amplas, that teachers at the school conducted evaluations, particularly in mathematics lessons for grade V during the even semester, using measuring instruments that did not meet the criteria as good test tools. As a result, the teacher was unable to accurately measure the learners' capabilities.

Further, the tests that were used were not subjected to any preliminary testing, which resulted in the standards for validity and reliability not being satisfied. When considered through the lens of the new Bloom's taxonomy, the tests that were used were only found to fall within the levels C1 to C3 range. It is challenging for instructors to develop exam questions that are up to cognitive level C6 since students are expected to have cognitive abilities that are at least equivalent to level C6 in mathematics classes, particularly when it comes to the topic of spatial figures (Hajar, S., Bernard, H., & Djam'an, 2018).

In order for students to understand mathematics, they need to be connected to real-world situations. Things that are real are the things that pupils encounter on a daily basis in their surroundings. According to (Astuti, P. H.M., Margunayasa, I.G., & Suarjana, 2019), it is important to keep in mind that anything that is contextual in the setting of a student in one area may not necessarily be contextual for students in other areas. According to (Al-Khwarizmi, 2018), the implementation of a realistic mathematics learning strategy offers pupils a greater number of possibilities to actively engage in the learning process. A realistic approach to learning mathematics is used throughout the problem-solving phase and the presenting phase of the learning process, which reflects this approach in the learning phases.

During the period of problem-solving, students are given the opportunity to think actively according to their own thoughts and ideas in order to discover and comprehend a topic and to construct their own knowledge. After that, during the presentation phase, the outcomes of the students' work are shown. These findings demonstrate how the students solved challenges that were provided by the instructor utilizing the material that was already available. Consequently, students are able to articulate their viewpoints and levels of comprehension when it comes to the resolution of issues (Rustam.E., Sidabutar.D.R., 2017).

This allows students to offer explanations for their solutions and to respond to the inquiries of their peers. According to (Muliza, 2020), the realistic mathematics learning method offers students the chance to be more engaged in the process of addressing learning difficulties and to have a positive attitude toward mathematics. This is in agreement with what they have mentioned. Students will grow their own knowledge and be able to improve their skills to link their current information with the challenges that are provided to them.

This will result in students' abilities becoming more sophisticated. Students will construct their own knowledge by solving their own difficulties. The following are the five criteria that are associated with realistic mathematics education, as stated by (Zakaria, E & Muzakkir, 2017): (1) The learning process starts with recognized contextual difficulties, which are introduced via the use of contextual problems (the use of context): (2) Using vertical instruments (bridging by vertical instruments), the use of vertical instruments in the form of models, schemes, diagrams or symbols as a bridge between informal procedures and formal forms; (3) Student contribution, students actively construct their own problem-solving strategies with teacher guidance; (4) Interactive activities, students are given the opportunity to convey ideas, negotiate explicitly, collaborate, and evaluate between students, students towards devices, and constructive interactions between students and teachers; (5) Intertwining, in mathematics, structures and concepts are interrelated. The use of vertical instruments. These vertical instruments might take the shape of models, schemes, diagrams, or symbols. This is one of the features of actual mathematics learning. One way to see this is as the process of converting an issue into a mathematical form, which may take the form of symbolic representations, mathematical equations, or visuals.

On the other hand, according to the findings of study carried out by (Herawati, Sunarya & Muhtadi, 2020), it was discovered that instructors did not use a realistic mathematics learning strategy throughout the process of teaching mathematics. Instead, they simply utilized a lecture technique, question and answer, and assignment delivering. The learning results of students are still judged to be weak, despite the fact that this strategy is believed to be successful. The author is interested in performing research which is connected to the Bloom cognitive exam, realistic mathematics learning, and is named "development of HOTS tests based on realistic mathematics learning for grade V elementary schools." This interest is based on the description of the general backdrop.

B. Research Method

In this particular study, the sort of research that was used was development research. Twenty kids from the fifth grade at SDN 064987 Medan Amplas were chosen to participate in this research project. During this time, the HOTS exam, which was established in the field of mathematics education, was the focus of this research. SDN 064987 Medan Amplas, which can be found at Jalan SM. Raja KM. 5.5, Harjosari I Village, Medan Amplas District, Medan City, North Sumatra Province, was the location where this study was carried out. The investigation was carried out during the academic year 2021/2022, specific to the second semester of grade

V. For the sake of this investigation, the term "model developed" refers to the Research and Development (R&D) model established by Borg and Gall. The Model of Borg and Gall. The stages of the Borg and Gall method are:

Step 1 of research and information gathering involves collecting data to build Revised Bloom's Taxonomy cognitive tests. Pre-research activities gather field data and examine literature to help development research. Stage 2 planning. This stage involves setting research goals and product development skills. Material analysis should follow the primary school curriculum, including competence standards, fundamental competencies, learning indicators, learning goals, and test grids. Step 3: Product development. This step involves constructing a cognitive exam based on Revised Bloom's Taxonomy to create the product. This first design yields a cognitive test as the product's first draft. Experts will validate the product after the initial draft. Validation is done to get feedback on product enhancements and see whether the product is practical and fits requirements before testing. After validation, the first product change is made based on expert advice to create the second draft. Limited product testing on small groups are step 4. The purpose of the Revised Bloom's Taxonomy-based cognitive exam is to determine whether students grasp each question item and give them enough time to answer them. Fifth, first product revision. This stage involves a second product change based on a short trial. A third product draft will follow the modification. Step 6: field trial. The product's quality is assessed at this point. The quality of a cognitive exam is determined by its validity, reliability, discriminating power, and complexity. Step 7 final product edit. To determine whether the Revised Bloom's Taxonomy-based cognitive exam is practical, the final product is revised and assessed using development outcomes. It assesses pupils' comprehension.

C. Result and Discussion

The data analysis of the research results obtained in each development step is presented as follows:

Data Collection

Collecting a number of references that are associated with this study is the first stage in this process. These references are specifically regarding the research that was conducted on the creation of the Revised Bloom's Taxonomy cognition exam according to realistic mathematics learning. In addition to this, the researcher carried out a curriculum study in order to investigate the mathematical educational materials that were available at SD Negeri 064987 Medan. At this point, the researcher conducted an analysis of the curriculum concerning the subject matter of spatial figures. Cubes, blocks, prisms, pyramids, cylinders, cones, and spheres are the types of materials that are included in the spatial figures lessons that are taught in the fifth grade of primary school during the even semester. In light of the findings of the first observations, it is evident that the mathematical capabilities of the pupils are rather poor. According to the outcomes of the pupils' responses to the preliminary mathematical aptitude test that was administered, this is possible to see. According to the findings of the examination, only a small percentage of the pupils were able to attain the minimal category of mathematical skills that were anticipated of them.

Planning

At this point, the process of developing instructional materials is carried out in order to acquire a prototype, which is an example of instructional materials, for the material consisting of cubes and blocks. At this point in the process, activities include the compilation of exams, the selection of formats, the selection of media, and the early design of instructional materials.

Based on learning goals and student analysis, the Bloom's taxonomy cognitive exam grid is created. It has four descriptive questions and 60 minutes to finish. The key and scoring instructions for each question are in the assessment guide for test scoring. Test compilation will produce draft I of the instructional materials. SD Negeri 064987 mathematics instructors utilized a lesson plan that was not prepared by the teacher and did not apply a realistic mathematics-based learning paradigm. Thus, the researcher will create a four-meeting lesson plan. Core competencies, fundamental competencies, indicators, learning goals, teaching and learning activities (settings, techniques, methods, necessary materials), learning scenarios, and evaluations are in the lesson plan. Realistic mathematics-based learning models are used in the learning activity scenario. The study found that SD Negeri 064987 instructors did not supply student worksheets. The instructor merely displays a few instances of questions on the board and then explains them, making pupils less engaged in learning.

Initial Product Development

Product development is product realization. This stage checks HOTS mathematics test creation based on the idea. The researcher drafted HOTS test development using Bloom's theory. The researcher created a series of questions with question grids, answer keys, and scores, as well as a validation sheet for the validator to provide test ideas. After reviewing the validator's findings, the researcher changed the test and validated it at SD Negeri 064987. An undeveloped question and its developed version are shown below.

Figure 1. Student Worksheet Display

The quality of HOTS mathematics test can be measured from the validation, reliability, practicality and effectiveness of the test. The success of the test was received from the teacher's activity sheet, student activity sheet, participant reaction questionnaire and student practice result test. While the practicality of the test was measured by the practicality observation sheet assessed by the grade V teacher. The meaning of this image can be seen that the learning device through student worksheets based on HOTS tests is very supportive in the mathematics learning process.

Validation of learning devices includes content, format, language and illustrations. The results of expert validation of learning devices can be seen in the following table:

Table 1. Summary of Learning Validation Results by Experts

No	Objects to be Assessed	Total Validity Average Value	Validation Level
1	Lesson Implementation Plan (RPP)	4,4	
2	Student Worksheet (LKPD)	4,3	Valid
3	HOTS Test	4,4	

It can be seen in the table above that HOTS test-based learning devices, in the valid category, can be used as support in the learning process.

Limited Trial

The testing was done to deploy the exam, determine its quality, and assess students' HOTS math skills. Validator validation, first trials, and field trials comprise testing. Validation and testing findings are the revision standard. The questions were analyzed using the Person product moment correlation formula, namely by correlating the question item score with the total score. The results of the pretest and posttest HOTS Mathematics Test instrument trials are presented in table 2.

Table 2. HOTS Mathematics Pre-Test Items

Test Items	**rxy**	**r_{tabel} (α = 0,05 dan N = 30)**	**Interpretation**
1	0,79	0,36	Valid
2	0,51	0,36	Valid
3	0,82	0,36	Valid
4	0,75	0,36	Valid

Initial Product Revision

The created HOTS Test must be revised based on the formative assessment analysis from the experiment. Formative assessment data were compiled and evaluated to identify learning gaps. The adjustment was done in hopes that teaching materials based on the actual mathematics-based learning paradigm will enhance the exam and students' mathematical HOTS skills.

Description of Effectiveness in Trial

The HOTS mathematical ability test was conducted twice, namely before and after the implementation of learning activities for four meetings. The purpose of the posttest was to determine the completeness of HOTS mathematical abilities obtained by students after being given learning treatment using a realistic mathematics-based learning model on cube and block material. The description of students' HOTS mathematical results in trial II is shown in Table 3 below.

Table 3 Description of HOTS Mathematical Ability Results

Information	***HOTS Mathematical Ability Pretest***	***HOTS Mathematical Ability Posttest***
Highest Score	80	95
Lowest Score	50	70
Average	65,16	84,50

From Table 3, it shows that the average HOTS mathematical ability of students in the pretest results was 65 and in the posttest results was 84. If categorized based on the level of student mastery, then the level of mastery of HOTS mathematical abilities of students in the pretest and posttest results of trial II can be seen in Table 4 below.

Table 4. Level of Mastery of HOTS Mathematical Ability in Trial II

No	**Value Interval**	***Pretest***	***Posttest***

		Number of Students	Persentase	Number of Students	Persentase	Category Value
1	$0 \leq$ SKSM < 45	0	0%	8	26,67%	Very Good
2	$45 \leq$ SKSM < 65	8	26,67%	20	66,67%	Good
3	$65 \leq$ SKSM < 75	9	30,00%	2	6,67%	Enough
4	$75 \leq$ SKSM < 90	13	43,33%	0	0%	Poor
5	$90 \leq$ SKSM ≤ 100	0	0%	0	0%	Very Poor

From Table 4. it is obtained that in the pretest there were students who obtained the less category as many as 13 students (43%), the sufficient category as many as 9 students (30%), the good category as many as 8 students (25%) and there were no students who obtained the very good category (0%). However, in the posttest the results showed that there were no students who obtained the very less category and the less category, the sufficient category as many as 2 students (6%), the good category as many as 20 students (66%) and the very good category as many as 8 students (26%). The research constraints are:

1. The time needed in the test stage during testing is still lacking because the school only provides a research duration that suits the mathematics lesson.
2. The facilities and infrastructure available at the school are still quite limited, so researchers use private facilities and infrastructure to facilitate students.
3. There is no readiness of students in facing HOTS-based questions, so that during the testing process there are many students who are confused and do not know the purpose of the questions

Discussion

The HOTS Test based on practical mathematics for pupils satisfied traditional completion standards, according to trial test analysis. Because the mathematics study material and challenges were tailored to the students' learning environment. Students will learn cubes and cuboids better utilizing the HOTS Test based on practical mathematics. Trial II posttest: 93%. At least 85% of students who participated in the learning achieved a score of ≥ 75, meeting the requirements for classical student learning completion. With a 93% completion rate, the HOTS mathematical ability posttest attained classical completion. Thus, trial II's realistic mathematics-based challenges matched conventional student learning outcomes requirements. Student learning completion is due to scaffolding, an important idea from Vygotsky's theory (2015). Realistic learning approaches emphasize the need for continuous interaction between students, mentors (teachers), and learning devices so that each student benefits. In a realistic method, the instructor only answers the students' first questions by giving directions or ideas until they grasp the questions. With teacher scaffolding at the start of learning and while completing assignments, students will be more active in their learning tasks, which will improve learning and classical learning completion. Nieeven (2007) said that effectiveness is how students perceive the program and how well they accomplish the developer's goals. Based on research, learning theory, and student learning individually and traditionally, the learning gadget meets efficacy requirements and is beneficial for learning.

D. Conclusion

The following were found via study and debate on developing HOTS ability exams based on actual mathematical learning: The HOTS test based on realistic mathematics learning's ability to improve students' mathematical test abilities has met the valid criteria, including 1) the RPP validation validated by a team of experts with an average total of 4.4 with a valid category, 2) the validation of student activity sheets based on realistic mathematics 4.3 with a valid category, and 4) the validation of student The HOTS test based on realistic mathematics learning improves students' mathematical skills and meets the practical criteria: 1) The team of experts or validators says the test can be used with minor revisions. 2) teachers and students saying the HOTS test based on realistic mathematics that was developed can be used easily from the interview results, and (3) the implementation of the HOTS test has a good category, making it practical. The HOTS Test Ability, based on realistic mathematics, has been shown to be effective in improving students' mathematical skills. In trial II, 91.17% of students achieved KKM, meeting the criteria for completeness. HOTS Test Ability based on actual mathematics-based learning improved students' arithmetic ability on average over 80% in trial I and trial II (Helmawati, 2019).

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