




# Training of HOTS integration in elementary school level mathematics teaching as an effort to strengthen state defense awareness

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ARTICLE INFO	ABSTRACT
<p><b>Article history</b>            Received: 2024-03-29            Revised: 2024-07-03            Accepted: 2024-08-03            Published: 2024-10-08</p> <p><b>Keywords</b>            Elementary school            HOTS            Mathematics teaching            State defense awareness</p>	<p><i>Strengthening state defense awareness could be supported by the existence of educators from remote and border areas who have adequate performance of high-order thinking skills (HOTS). Currently, HOTS has not been consistently introduced in mathematics learning for teachers in remote areas. This study is a part of the teachers' development program concerned with delivering effective methods in teaching mathematics at the elementary school level and gaining teachers' State Defense Awareness to provide educators' perspectives regarding HOTS implementation in mathematics learning in remote areas of Indonesia. Data was collected by giving questionnaires to the teachers as pre-tests and post-tests. The results showed that the teachers of some remote areas recognized the advantages as well as the difficulties of HOTS integration in learning activities. Teachers' understanding of applying HOTS in mathematics teaching could be slightly increased through comprehensive training regarding HOTS. It was also found that teachers from remote and border areas are still required to be more encouraged to implement and develop HOTS in mathematics learning through training in education research activities.</i></p>
<p><b>Kata Kunci</b>            Bela negara            HOTS            Pengajaran matematika            Sekolah Dasar</p>	<p><b>Pelatihan integrasi HOTS di dalam pengajaran matematika tingkat sekolah dasar sebagai upaya penguatan kesadaran bela negara.</b> Penguatan Kesadaran Bela Negara dapat didukung dengan keberadaan tenaga pendidik dari daerah terpencil dan perbatasan yang memiliki keterampilan berpikir tingkat tinggi (HOTS) yang memadai. Saat ini pengenalan HOTS dalam pembelajaran matematika bagi guru di daerah terpencil belum dilakukan secara konsisten. Penelitian ini merupakan bagian dari program pengembangan tenaga pendidik yang bertujuan untuk memberikan metode yang efektif dan inovatif dalam pengajaran matematika di tingkat sekolah dasar dan meningkatkan kesadaran bela negara bagi tenaga pendidik untuk memberikan pandangan mengenai penerapan HOTS dalam pembelajaran matematika di daerah terpencil di Indonesia. Pengumpulan data dilakukan dengan pengisian kuosioner oleh guru dalam bentuk pre-test dan post-test. Hasil pengisian kuosioner menunjukkan bahwa guru-guru di beberapa daerah terpencil menyadari kelebihan dan kekurangan integrasi HOTS dalam kegiatan pembelajaran. Pemahaman guru mengenai penerapan HOTS dalam pembelajaran matematika dapat ditingkatkan melalui pelatihan komprehensif mengenai HOTS. Hasil pengisian kuosioner juga menunjukkan bahwa tenaga pendidik di daerah terpencil dan perbatasan masih perlu untuk distimulasi untuk lebih terpacu dalam menerapkan dan mengembangkan HOTS dalam pembelajaran matematika melalui pelatihan kegiatan penelitian pendidikan yang terstruktur dan konsisten.</p> <p>Copyright © 2024, Stiawan, et al            This is an open access article under the CC-BY-SA license</p> 

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## INTRODUCTION

The State Defense Awareness concept has been consistently emphasized by The Ministry of Defense of The Republic of Indonesia to strengthen the national defense aspect of the country. This study focuses on SDG 4 (Quality education), which aims to guarantee inclusive and equitable quality education and promote lifelong learning opportunities for all. Furthermore, SDG 4 (Quality education) aligns with SDG 11 (Sustainable Cities and Communities), which advocates for inclusive, safe, resilient, sustainable cities and human settlements that can enforce State Defense Awareness (Suwaryo et al., 2024). State Defense Awareness is an essential concept that shall be thoroughly introduced and steadily implemented by all Indonesian citizens, both the citizens who live in the country and those citizens who are located abroad (Pariyatman et al., 2023). Indonesian people living in some border and remote areas are considered to have vital roles in the State Defense Awareness aspect (Yohanes et al., 2023). Some non-military threats might appear in the border area of Indonesia related to the utilization of foreign money, limited access to infrastructure, social inequalities, etc. that further could influence those people's national identity (Aditya Dewantara et al., 2021). Delivering and gaining State Defense Awareness toward those people living in border areas is considered an appropriate method to grow proper harmonization of the society. For example, people with different backgrounds of ethnicity, religions, and citizenship in the particular border area (Central Sebatik District, North Kalimantan Province) were able to perform their routine activities peacefully (Wahyudi et al., 2020).

That pedagogy perspective is considered could protect society in the post-truth era (Fauzia Hakim et al., 2022), and consistent implementation of Pancasila and Citizenship education is considered the proper methods to shield our society from radicalism and terrorism exposure (Prayitno et al., 2021). As a consequence, any educators who live in remote areas should have a proper understanding of both knowledge rather than solely focusing on the development of either pedagogical or technical aspects of a particular subject (Indriani et al., 2023; Lord et al., 2024). Considering many secondary school institutions in Indonesia, the studies mentioned above in the Indonesian context embody relatively few studies. Moreover, the studies that have been undertaken have some differences from the present studies, either in terms of the method or focus of the study (R. Fitriani et al., 2023). Strengthening national defense awareness in terms of human resources can also be supported by the existence of educators from remote and border areas with adequate performance of high-order thinking skills (HOTS) since they are dedicated to teaching surrounding people to have the capability to sort any information that some could be categorized as national threats. As rapid advances in technology have made critical thinking an important educational goal in the 21<sup>st</sup> century, the role of teachers has shifted from merely transmitting information to preparing students for effective information to preparing students for effective information processing, critical judgment, and creative thinking (Petek & Bedir, 2018). In this context, cultivating a culture of HOTS, such as analysis, interpretation, inference, induction, deduction, and evaluation among teachers in remote and border areas can have far-reaching implications for state defense awareness.

Moreover, Indonesian teachers living in remote areas should also have essential roles in supporting State Defense Awareness since they will regularly meet and teach the students from subsequent generations. There were three categories of critical thinkers of mathematics teachers, unfortunately, the majority of those were categorized as non-critical thinkers (As'ari et al., 2017). Moreover, currently, most young generation of Indonesian citizens are considered to have not already ensured that the State Defense Awareness Program is essential to building the strong character of national citizens (Adianto et al., 2019). Hence, the Republic of Indonesia Defense University, as a university focused on the defense aspect of Indonesia, generated a development program for elementary school teachers living in rural areas of some geographical regions of Indonesia. This teacher development program was established not only to enrich the technical knowledge of the teachers but also to strengthen their State Defense Awareness so that in further period they can also deliver the concept of State Defense Awareness toward the beginning phase of students i.e., elementary school level. The quality of teachers has a direct impact on the overall education system, as it is a key factor in improving the quality of education (Wahyudin, 2020).

The linearity aspect of the educational system concerned with defense scope could strengthen the national defense system toward any challenge related to the Industrial Revolution and the 5th generation of war (T. Fitriani & Pertahanan, 2021). As a consequence, the Indonesian government thought to prepare the human resources readiness regarding educational linearity from the beginning stage of youth, for example by integrating subjects related to science, technology, engineering, and mathematics (STEM) in the elementary school level with its prospective aspects to defend our country. Strengthening national defense through youth education is considered feasible to implement if their elementary school teachers also have been properly introduced and consistently exposed, subsequently, to the same idea. Furthermore, state defence awareness can be utilized as a vehicle for the inculcation of the noble values of the Indonesian nation, including the principles of Pancasila, nationalism, and patriotism (Aulia & Darmawan, 2021). Additionally, students will be instructed in the application of mathematical and scientific principles for defense purposes, whether military or non-military, with topics being selected in their relevance to the student's age group.

In the aspect of the development of Indonesian human resources as well as national defense purposes, considerably it is required to be also supported by the existence of educators from remote and border areas with an adequate performance of high order thinking skills (HOTS) since they are dedicated to teaching surrounded people to have the capability to sort any information that some could be categorized as national threats (Brenya, 2024). The HOTS implementation encompasses a range of cognitive processes, including analysis, evaluation, and creation, which are predicted upon more fundamental skills such as comprehension and application. By encouraging students to explore multiple approaches, consider alternative perspectives, and justify their reasoning, teachers can nurture the kind of flexible, innovative thinking essential for success in both academic and real-world settings (Primasanti et al., 2020). Importantly, the benefits of HOTS in mathematics may extend beyond the subject itself, potentially enhancing students' awareness and understanding of broader societal issues, such as state defense. The abilities to reason mathematically and solve problems can provide a foundation for grappling with complex, multifaceted problems, which is highly relevant to state defense (Liu & Maas, 2021).

HOTS implementation ought to properly integrated into mathematic learning in elementary school for many reasons. HOTS in the mathematical thinking process is not particularly limited to numeracy skills but also it is reflected in how the students apply mathematics in daily life to solve problems and communicate mathematics in circumstances (Dinni, 2018). This aspect is emerging to be developed to gain broad ability of elementary students since a particular observation showed that the ability of elementary school students to connect mathematics in solving mathematics problems is still low (Kiswanto Kenedi et al., 2019). Through enough HOTS exposure, it is expected that students will have academic self-concept. By high academic self-concept, students could answer mathematical test problems and vice versa (Fadillah & Saputro, 2017). Despite its benefits, HOTS integration in mathematics learning in elementary-level schools would be challenging, especially for the aspect of teacher readiness, although two other challenges should be continuously handled, i.e., teaching and learning aspects, and student aspects (Tyas et al., 2019). In a particular study regarding the level of critical thinking of prospective mathematics teachers, it was found that the majority of the studied subjects were not critical thinker yet (As'ari et al., 2017). In the other case, there was a survey displayed that only limited teachers were familiar with mathematical literacy problems (Jupri & Rosjanuardi, 2020).

The community service program also delivered decision-making topics as a HOTS component through how to design lesson plans by applying four stages of decision-making (Sadijah et al., 2021). This study reported perspectives regarding HOTS integration in mathematics teaching in elementary schools located in remote and border areas of Indonesia that were obtained from teachers who participated in our designated teachers' development program. Hopefully, this community service could contribute to tackling global problems related to education quality (SdGs number 4) since many teachers still lack the required qualifications to teach due to limitations of accessibility and adaptability to new pedagogical concepts and methods (UN United Nations, 2023).

## METHOD

The study was conducted on 41 teachers of local elementary schools. They originated from several remote and border areas of Java, Kalimantan, and Papua regions that were selected by the Republic of Indonesia Defense University (RIDU) to be intensively developed regarding innovation of mathematics education and proper methods of mathematics teaching as well as comprehensively exposed with Indonesian national defense concept within a certain period. In that teacher development program, effective methods of teaching mathematics for elementary school level and current innovation, as well as popular approaches to education research, were delivered by mathematics experts of RIDU and lecturers in science of RIDU with backgrounds in pedagogical and education science topics, respectively. In the same program, the national defense concept was thoroughly delivered by academics and practitioners that focused on strengthening strengthen Indonesian national defense, i.e., The Indonesian National Armed Forces as the military forces of the Republic of Indonesia that consists of the Army, Navy, and Air Force.

Descriptive analysis by using pre-test and post-test results within one group of participants was performed in this study. Before starting the session between the trainers and the participants, pre-tests were filled out by the teachers. Meanwhile, the post-tests were correctly filled by those participants after the development program had been finished. Note that all statements within the post-test were identic with displayed statements in the pre-test. As a test instrument, statements that appeared on both the pre-test and the post-test were carefully designed to obtain actual participants' perspectives regarding HOTS implementation in certain levels of elementary school and to display their capabilities and interest in conducting research in education as teacher. Some statements represented their genuine perspective and opinions regarding HOTS implementation as the targeted idea. Then, the answers were scored by using the Likert scale, i.e., from strongly agree to strongly disagree were scored within the range from 5 to 1, respectively. The statements were categorized as related representative purposes. Meanwhile, those scores were calculated and proceeded into scores as percentages, subsequently. Afterward, the data were analyzed according to the trend displayed in the graphs. The

successful level of the training was extracted from the increasing level of teachers' understanding and positive perception regarding HOTS implementation.

## RESULTS AND DISCUSSION

The training was conducted in three main sessions, i.e., a presentation regarding HOTS from the instructors, an exercise in designing learning materials, and a simulation, subsequently. Figure 1 and Figure 2 display the participants' activities in integrating HOTS aspects into learning materials and interactive practice sessions, respectively.



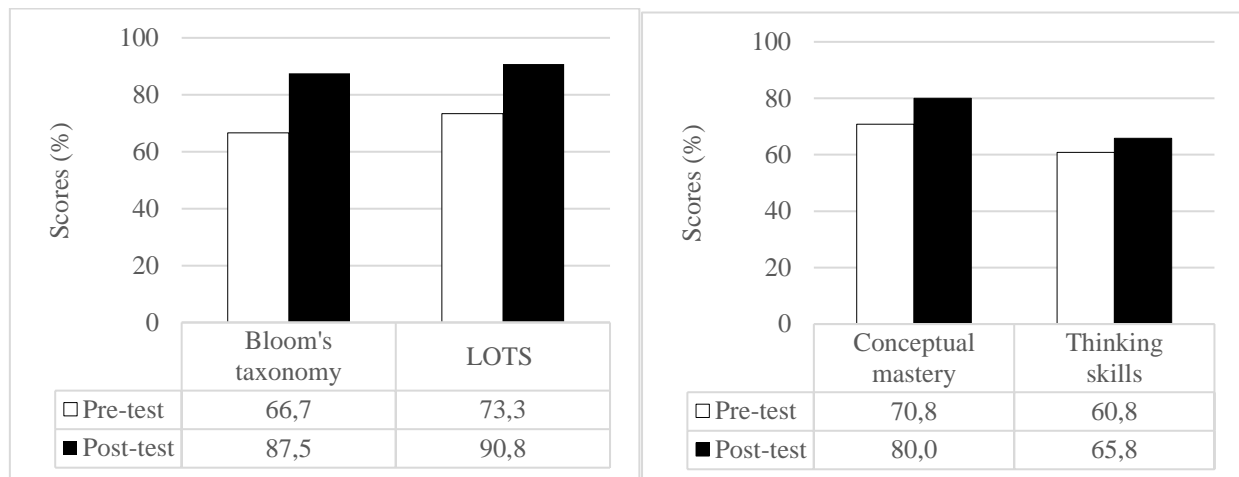
Figure 1. Three participants from border areas of Papua were designing lesson plans integrated with HOTS indicators



Figure 2. Interactive simulation session of integrating HOTS in mathematics teaching

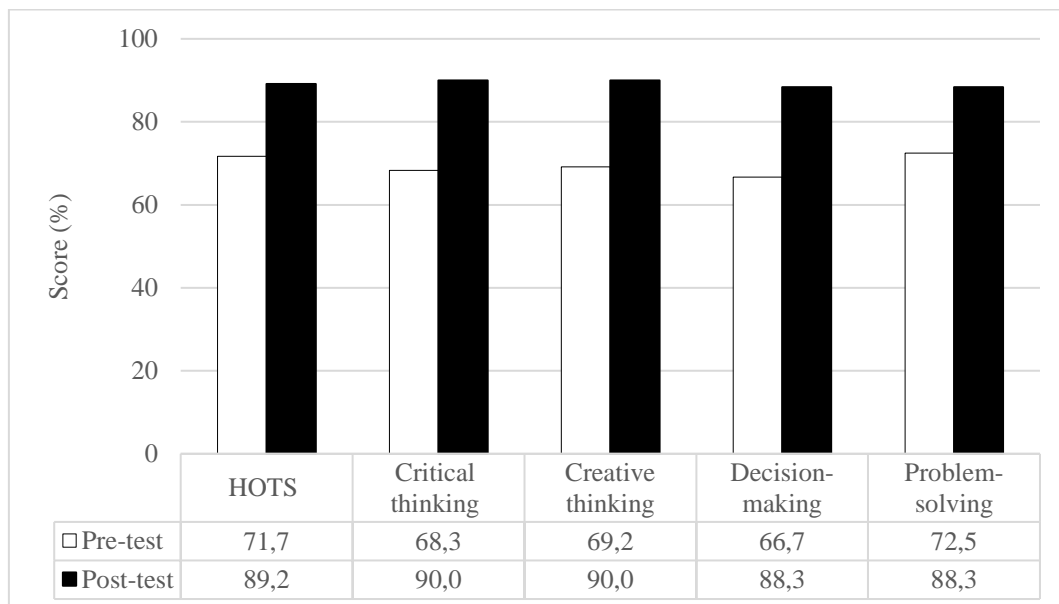
The data were proceeded and thoroughly analyzed then the results were discussed to provide findings regarding teachers' perspectives on HOTS implementation and development in mathematics teaching. The teachers as the participants of the development program were gradually asked to obtain their basic understanding regarding Bloom's taxonomy, LOTS, and broad aspects of HOTS, subsequently. As initial information, their understanding level of Bloom's

taxonomy and LOTS as well as their major goals of teaching were recorded. Figure 3. shows that most teachers have adequate knowledge of Bloom’s taxonomy and LOTS. Observation during the development program.



**Figure 3.** Teachers’ basic understanding regarding Bloom’s taxonomy and LOTS basic understanding (left) and teachers’ preferences regarding learning goals (right)

Figure 3. shows that most teachers have adequate knowledge of Bloom’s taxonomy and LOTS. Observation during the development program (e.g., in the simulation of writing lesson plan and microteaching session) also indicated that they were concerned about C1–C3 during the development of lesson plan in mathematics topics and its related assessment as well. Furthermore, it also can be roughly seen that the teachers put conceptual mastery as the main goal of the learning rather than students’ thinking skills. This finding is slightly consistent with a particular study that displayed that some mathematics teachers did not have enough expectations regarding students’ thinking processes in their written tasks (As’ari et al, 2019). Afterward, the teachers’ perspectives related to their basic understanding of HOTS were recorded and displayed in Figure 4.



**Figure 4.** Teachers’ basic understanding related to HOTS aspects

Figure 4 shows that the teachers from remote areas also have a sufficient level of HOTS basic understanding. After being trained through the development program, almost all indicators of HOTS's basic understanding have been improved. To obtain further information on teachers’ perspectives related to technical experiences related to HOTS, their viewpoints have been recorded and depicted in Figure 5.

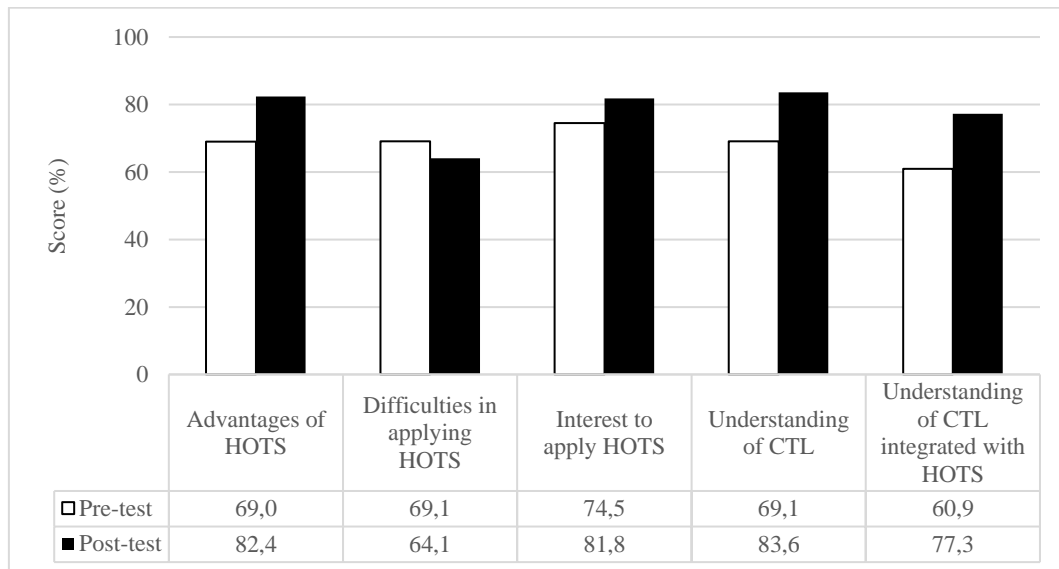


Figure 5. Teachers' perspectives on five aspects regarding HOTS

It can be seen from Figure 5 that our designed development program was able to increase their understanding regarding the technical aspect of HOTS (Ali & Zaini, 2023) and its combination with contextual learning (CTL) as an approach that is considered slightly relevant to be performed in some mathematics topics, such as geometry, currency, etc. In addition, CTL was shown to improve students' ability regarding mathematical representations (Surya et al., 2013). In CTL, teachers should proactively stimulate students to interpret context so that they will be able to find the main point of a mathematical idea and declare clear arguments that connect the context to the idea, subsequently (Widjaja, 2013). Meanwhile, there was an aspect that did not significantly increase after the teachers were introduced to HOTS implementation in mathematics learning, i.e., their perspective regarding difficulties toward HOTS implementation (Nikolic et al., 2023), means that the development program was still unable to suggestively stimulate them to immediately apply HOTS in their mathematics learning (Eisenhart & Weis, 2022).

As supporting information, our works also provide some aspects of participants' motivation and perspective related to learning materials development and preferences of learning circumstances. Figure 6 displays teachers' motivation to perform some activities related to developing learning materials.

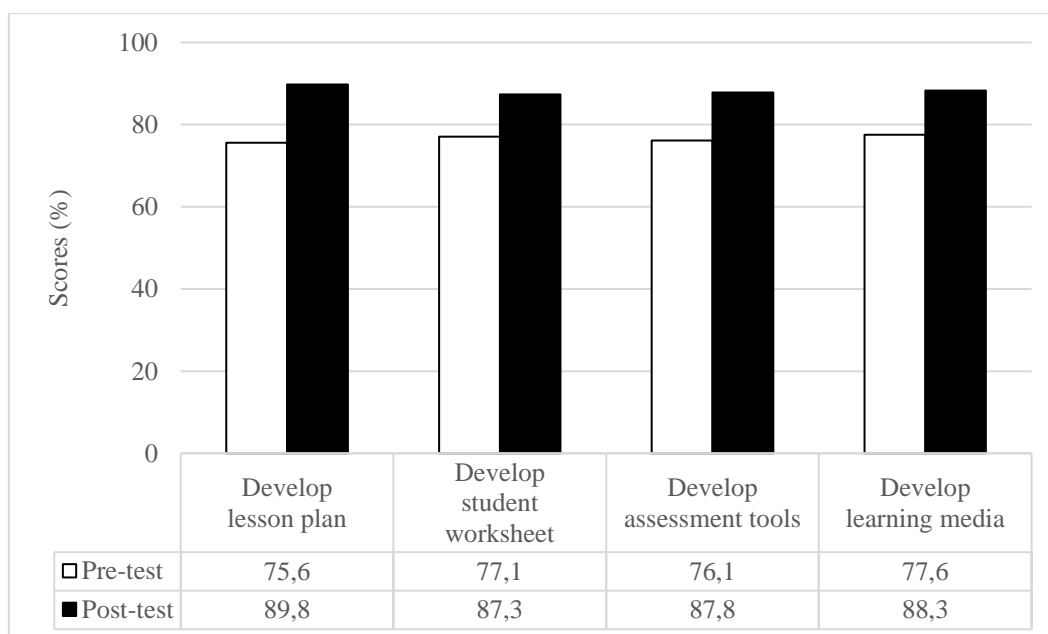


Figure 6. Teachers' motivation for lesson materials development

According to Figure 6, pre-test results indicated that teachers have been routinely conducting lesson material development in their professional daily tasks. After being involved in the development program, all indicators were improved. They were easily motivated to enrich and broaden many aspects of learning materials since they already had

enough basic skills and interests to complete their daily administrative tasks (Muthmainnah, 2023; Reis & Renzulli, 2023). Meanwhile, information related to those preferences regarding circumstances in classroom activities and assessment development is shown in Figure 7.

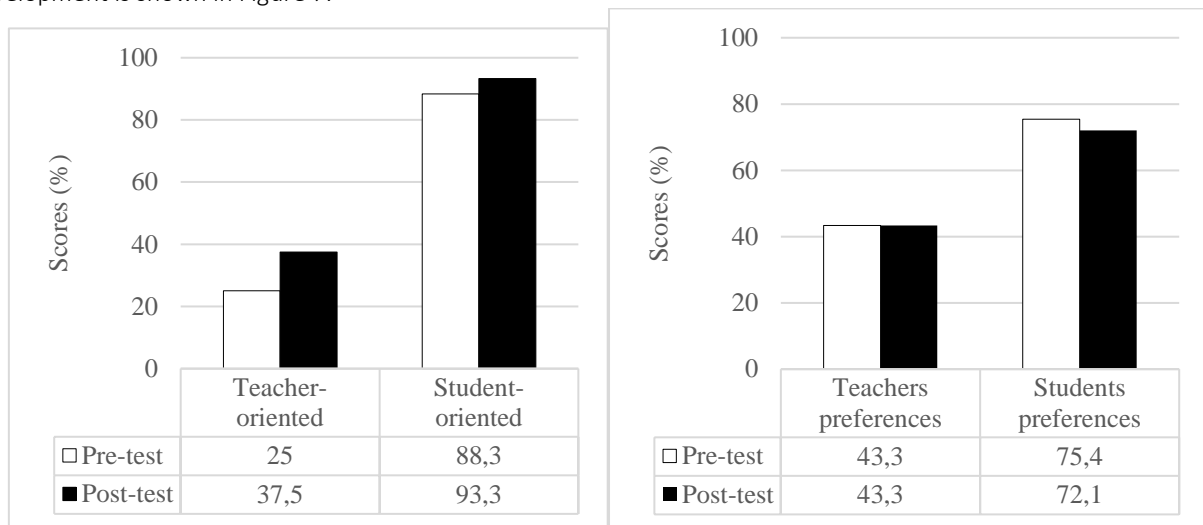


Figure 7. Teachers' learning type preferences (top) and their perspectives regarding closed-typed multiple-choice questions (bottom)

From Figure 7, it can be seen that almost all participants prefer student-oriented learning rather than teacher-oriented learning. According to direct interviews during the development program, the reason that a-fourth of participants still selected teacher-oriented learning was probably caused by several challenges of applying student-centered learning that were still appearing during real circumstances. For example, sometimes several teachers still found their students obtained exam marks with their HOTS-integrated assessment tools were not as good as the exam marks from other conventional types of simpler assessment tools. Whereas, if the teachers have been well-trained to correctly integrate students' HOTS in learning without diminishing students' conceptual mastery, the integration could be applied not only to lesson plans but also to existing learning media, such as through a particular mind map that was able to increase junior high school students' creative thinking skill in geometry topics (Zuraida et al., 2015) or through virtual interactive simulations' feature that can accommodate students' spatial perspective in three-dimensional view (Stiawan et al., 2014, 2022). This finding indicated that there are still some elementary school teachers who require proper and comprehensive training in HOTS implementation that is flexibly adapted to dynamic curriculum changes (Haniah et al., 2020; Rachmawati et al., 2023). Although consistent HOTS implementation is still considered challenging in several regions of remote areas, it is still required for elementary school teachers as essential component of educational practitioners to enhance students' critical thinking skills. As a basic component of HOTS, through the consistent introduction of HOTS-based questions (Sidiq et al., 2021) at least in discussion sessions of classroom activities then gradually applied into subsequent steps, i.e., into students' assignments and, finally, into their exam, if the students have been adequately introduced and appropriately exposed to HOTS learning in mathematics topics.

## CONCLUSION

Both advantages and difficulties of HOTS integration in elementary schools' mathematics teaching have been well-recognized by some teachers living in remote and border areas of Indonesia. Although the teachers supposed that it is still challenging to fully adopt HOTS in some topics in mathematics, the observation results during the designed teachers' development program indicated that they surely agreed that HOTS in the scope of mathematics subject is an essential and beneficial skill that should be mastered by their students as well as the teachers as well to strengthen State Defense Awareness. The implementation of HOTS which encompasses critical thinking, problem-solving, analysis, evaluation, and creativity are essential for addressing the complex and dynamic challenges that State Defense Challenges.

Our work suggests that teachers' understanding of applying HOTS in elementary mathematics learning could be slightly increased through the designed training of HOTS implementation delivered by HOTS experts and experienced practitioners who have successfully implemented HOTS in their routine tasks. Meanwhile, it was still found that teachers from remote and border areas are still required to be more encouraged in implementing and developing HOTS in the scope of mathematics subject. The development of attitudes and behavior through the HOTS integration in education is a multifaceted process that requires thoughtful facilitation by teachers. Teachers play a pivotal role in fostering the development of HOTS in their students by creating engaging learning environments, guiding and mentoring students, encouraging critical and creative thinking, modeling desired attitudes, and fostering a growth mindset.

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