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AI-Based HOTS Questions: Training for Elementary School Teachers in the Digital Era

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Abstract

The development of the digital era requires teachers to not only master conventional pedagogy, but also have the capability to manage and utilize Artificial Intelligence (AI) as part of learning and assessment innovation. However, some elementary school teachers have not fully followed these technological developments, so the preparation of Higher Order Thinking Skills (HOTS) questions tends to be done conventionally and has not optimized AI as a professional tool. This Community Service activity aims to provide training in creating AI-based HOTS questions for elementary school teachers to improve their pedagogical competence and digital literacy. The method used is Participatory Action Research (PAR), with stages of socialization, training, technology implementation, mentoring, and program sustainability by emphasizing the active participation of partners. The activity was carried out through collaboration between the proposing team and the target community, namely teachers of Setia Mulya 02 Bekasi Elementary School, so that the materials and practices provided are aligned with the school's needs. The results of the program implementation showed a significant increase in teacher understanding and skills, with more than 70% of participants being able to independently prepare AI-based HOTS questions. These findings confirm that the Community Service Program is relevant to the demands of learning in the digital era and significantly contributes to improving the quality of assessments that are contextual, technology-adaptive, and oriented toward developing students' higher-order thinking.

INTRODUCTION

The swift rise of digital technology is reshaping education at every level, including elementary schools. Teachers are now called to harness technology not just for teaching, but as a powerful ally in crafting assessments that spark students' higher-order thinking (Farag et al., 2022). Designing HOTS questions is more vital than ever, shifting the focus from rote learning to nurturing students' ability to analyze, evaluate, and develop original ideas or solutions on their own (Fikri et al., 2021; Utami et al., 2022).

The deep learning approach from the Ministry of Elementary and Secondary Education is closely linked to the use of HOTS-based assessments, especially when these are adjusted to meet students' needs and teachers' readiness (Prawiyogi & Rosalina, 2025). Deep learning focuses on learning that is meaningful, thoughtful, and applicable to real-life situations, so it needs assessments that go beyond just testing memory. These assessments should look at how well students can think, reason, and make decisions (Hendrianty et al., 2024). Using HOTS assessments makes sense as long as teachers understand the ideas, have strong teaching skills,

and have sufficient technology support (Shiwani et al., 2025). How well deep learning and HOTS assessments work together depends on whether teachers can create flexible and practical assessments that fit their classrooms and students.

Creating HOTS tests in elementary schools remains challenging (Saputra et al., 2025). Many teachers know the basics of HOTS but cannot always use them in tests that fit their students (Ilgun Dibek et al., 2025). These problems are made harder by the arrival of Artificial Intelligence (AI), which gives teachers new ways to make better and more creative assessments. But this has not been used much because teachers do not always understand how to use AI or have the needed technical skills (Al Farizi et al., 2024).

For teachers today, making HOTS questions is both a tough job and an exciting chance, especially now that AI can help. Teachers need to understand higher-level thinking and also make questions that connect to students' real lives (Munali et al., 2024). AI offers many ways to help, such as providing teachers with new ideas, offering different types of questions, and matching tests to learning goals more quickly and carefully. Using AI to make HOTS questions helps teachers become even more creative, thoughtful, and ready to adapt as they work with new technology in education.

Training elementary school teachers to use AI to create HOTS questions is very important, especially at state elementary school Setia Mulya 02 Tarumajaya, Bekasi Regency, because they do not yet fully understand how to use AI technology in teaching and testing students (Sirait et al., 2021). This problem is made worse by a lack of resources, which makes it hard for teachers to use new technology independently. This training is meant to help teachers get better at their jobs, not just by learning what makes a good HOTS question, but also by learning how to use AI as a helpful tool.

Teachers should be able to make questions that fit real-life situations, match the Independent Curriculum, and meet the needs of modern learning in today's digital world. This training is meant to give teachers not just knowledge, but also practical skills they can use in teaching and testing students at school. Teachers should be able to create and manage tests that encourage higher-level thinking and use technology well. This training is expected to guide other teacher training programs in keeping up with changes in educational technology, so learning remains useful and helps improve the quality of students' experiences during this digital transformation.

METHOD

The way this Community Service activity was carried out used a Participatory Action Research (PAR) approach, meaning partners are involved at every step (Lenette, 2022). This approach was chosen because it creates a fair partnership between the program team and the teachers at Setia Mulya 02 State Elementary School, Bekasi. Both groups work together to identify problems, develop solutions that meet their needs, and assess how well the activity is working. With PAR, teachers are not just recipients of the program; they are the main people involved in making changes and improving their skills (Cornish et al., 2023).

From the first findings, the main problems were that teachers did not know much about how to make questions that test higher-level thinking and did not use digital skills much, especially Artificial Intelligence (AI) tools, in checking student learning. The school also had problems, such as not having a digital system to manage question banks and not often reflecting on how good their tests are. To solve these problems, the PkM activity was planned in steps, including sharing information, training, using technology, giving guidance, checking progress, and planning for the program to continue.

Figure 1. Stages of the Participatory Action Research (PAR) Approach

Figure 1 shows the steps of activities based on the Participatory Action Research (PAR) design, focusing mainly on training and using new technology. At this stage, activities are set up to balance understanding ideas and learning practical skills (Fadli, 2021). Teachers learn how to make good questions that encourage higher-level thinking, then get hands-on training in using Artificial Intelligence (AI) to help create questions that fit the needs of elementary school students. The results of this training are real products: AI-based higher-level thinking questions, which are then added to a digital question bank that all teachers at the school can use and add to.

To make sure the program works well and lasts, this activity also includes mentoring, checking progress, and planning next steps. Teachers receive close support to help them solve various technical and teaching problems that arise during the process. Progress is checked by having teachers reflect and review each other's work to make the questions better. The program is kept going by appointing a teacher coordinator to oversee things, so the results do not stop at training but become part of teachers' regular work.

RESULTS AND DISCUSSION

The Community Service activity, which involved creating AI-based Higher Order Thinking Skills (HOTS) questions, was held in person from November 2025 to January 2026, using a learning method that let participants manage their own learning. This method encouraged teachers to take charge of their learning, try out technology, and develop their own questions in a lasting way. Eighteen teachers from State Elementary School Setia Mulya 02 took part in all parts of the activity, from understanding the ideas to practicing how to make AI-based HOTS questions.

Field observations and interviews with school leaders and teachers were used to find out what was needed for the activity. This step looked at how comfortable teachers were with technology, checked whether the school had the right tools and equipment, and identified the problems teachers faced when creating HOTS assessments. The results were used to create training materials, methods, and plans that fit the real situation in the school and met the teachers' needs in a practical way.

The activity started with an opening and introduction session to help everyone understand why making HOTS questions is important in today's digital world. At this point, participants learned that tests should not just check memory, but should also measure skills like analyzing, judging, and being creative. They were also shown how AI can be a helpful tool for making assessments that are more efficient, fit the situation, and can change as needed. Then, the idea of HOTS was explained step by step, including what makes a HOTS question, how it connects to higher levels of thinking in Bloom's Taxonomy, and the need to match learning goals, activities, and tests. This information was also connected to the Independent Curriculum,

especially in helping students take charge of their own learning and building the Pancasila Student Profile.

Participants were introduced to how to use AI in making HOTS questions and got hands-on practice. They were shown step by step how to use the AI platform to create questions that fit real situations, make multiple-choice questions based on HOTS, and check if the questions matched the learning goals. The activity continued with a workshop, where participants worked alone and in groups to make AI-based HOTS questions that fit elementary school subjects and grade levels. By the end, participants not only understood the ideas but also made assessment tools that could be used in their classrooms.

The final stage of the activity included time for reflection, discussion, and review. This was done to learn about participants' experiences, find out what they gained from the training, and make plans for using what they learned in their own schools. The reflections showed that the training helped teachers improve their knowledge and skills in making questions. Before, most teachers thought making questions took too much time, so they just changed questions from question banks. After the training, teachers learned that making HOTS questions can be faster and easier with AI. The training showed that using AI not only makes the process quicker but also makes the tests better and more varied, so teachers do not have to struggle to create tests that measure higher-order thinking skills.

Figure 2. Documentation of Community Service Activities at State Elementary School Setia Mulya 02 Bekasi

Figure 2 shows the lively atmosphere of the activity, with participants showing a lot of excitement. This was seen in how involved they were in each session, from discussions and hands-on activities to the Q&A session, which was handled in a helpful way. Their steady participation and willingness to learn showed they were eager to learn, which helped the whole activity go well and meet its goals.

The process of making AI-based HOTS questions for elementary school teachers started with a pre-test, which was used to see how much participants knew and understood about using AI and digital tools in teaching (Aini et al., 2025). This pre-test was important to get a clear picture of what participants knew at the start and to see any changes in understanding before and after the training. From the pre-test, 17 teachers and one school staff member took part in this activity, so there were 18 people in the first part of the training. Here are the results of the pre-test.

Table 1. Pre-test Results of AI-based HOTS Question Creation for Teachers

Indicator	Mean Score	Category
Understanding of HOTS Concepts	2.40	Moderate
Teachers' Digital Literacy	2.75	Moderate to Good
Knowledge of Artificial Intelligence	1.93	Low
AI-Based HOTS Question Development Skills	1.85	Low

The pre-test results were measured using a 5-point Likert scale, where 1 = very low and 5 = very high. The score categories were determined using interval criteria, namely 1.00–1.80 (very low), 1.81–2.60 (low to moderate), 2.61–3.40 (moderate), 3.41–4.20 (good), and 4.21–5.00 (very good). Based on Table 1, teachers' understanding of HOTS concepts obtained a mean score of 2.40, indicating a moderate category. Teachers' digital literacy reached 2.75, which falls within the moderate to good category. Meanwhile, knowledge of artificial intelligence (1.93) and AI-based HOTS question development skills (1.85) were still categorized as low, indicating that teachers had limited experience and understanding in integrating AI into HOTS-oriented assessment design.

The pre-test results in Table 1 indicate that participants already have a basic understanding of HOTS and digital literacy, but still have significant limitations in their understanding and skills in utilizing AI for HOTS question development. This reinforces the urgency of implementing training to improve elementary school teachers' competency in facing the demands of learning and assessment in the digital age. The following is a summary of the pre-test results in a diagram.

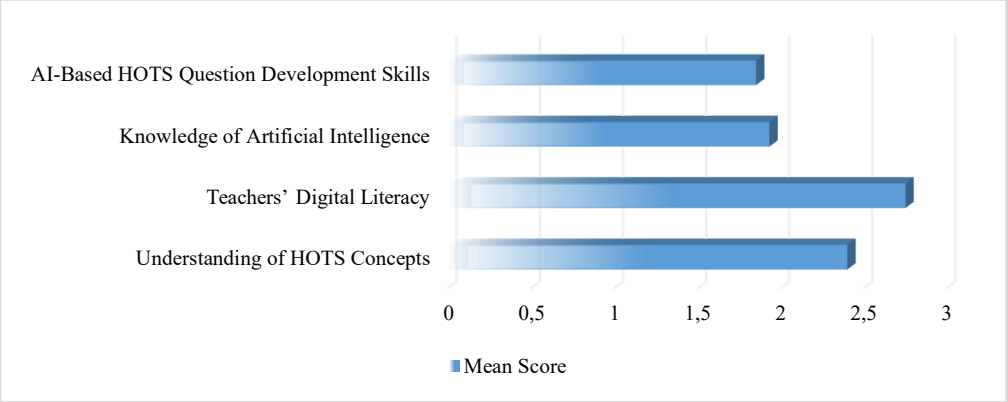

Figure 3. Pre-Test Results Diagram

Figure 3 shows the pre-test results of the AI-Based HOTS Question Creation Training for Elementary School Teachers in the Digital Era. The average score for understanding HOTS concepts was in the 'enough' category (2.40), while teachers' digital skills were in the 'fair to good' range (2.75). This means participants had a basic understanding of HOTS and how to use digital technology in teaching. However, their knowledge about AI (1.93) and their skills in making HOTS questions using AI (1.85) were still low. These results show that, although teachers are generally accustomed to using technology, their understanding and skills in using AI for HOTS question creation remain limited. This makes the training important and needed to help teachers meet the demands of teaching in the digital era.

The post-test results were used to compare participants' achievements after completing the Community Service (PkM) training on AI-Based HOTS Question Creation for Elementary School Teachers. The goal of this post-test is to assess how much teachers' understanding and skills have improved since their pre-test starting point. This helps to clearly see how effective the training was. The following table shows the post-test results, highlighting what participants achieved after finishing all the training sessions.

Table 2. Post-test Results for AI-Based HOTS Question Creation for Teachers

Indicator	Mean Score	Category
Understanding of HOTS Concepts	3.40	Good
Teachers' Digital Literacy	3.52	Very Good
Knowledge of Artificial Intelligence	3.10	Good
AI-Based HOTS Question Development Skills	3.15	Good

Table 2 shows the results after the AI-Based HOTS Question Creation Training for Elementary School Teachers, which reveal that participants improved compared to before the training. This progress was seen in all areas measured, such as understanding HOTS ideas, teachers' digital skills, knowledge about AI, and the ability to make AI-based HOTS questions. These results show that the training helped teachers better understand and use AI to create HOTS questions. To make these results clearer, the post-test scores are also shown in a diagram to better show the increase in scores and teachers' achievements.

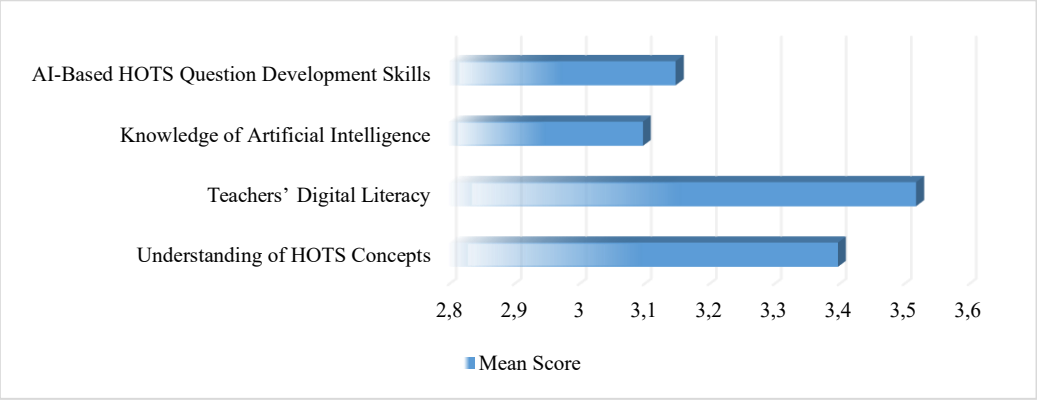

Figure 4. Post-Test Results Diagram

Figure 4 shows a big improvement in post-test results compared to pre-test results, meaning that the training helped participants better understand and create HOTS questions using Artificial Intelligence (AI). This progress was seen in all areas measured, with average scores going from good to excellent. The teacher digital literacy score was the highest at 3.52, which is excellent, showing that participants felt more confident and skilled in using digital technology for teaching. The scores for understanding HOTS concepts (3.40), knowledge of AI (3.10), and skills in making AI-based HOTS questions (3.15) were all in the good range. These results show that the training helped teachers improve both their understanding and practical skills in using AI for HOTS question development, which supports better learning assessments in today's digital world.

The Artificial Intelligence (AI)-Based HOTS Question Development Training for Teachers at Setia Mulya 02 Bekasi State Elementary School showed a clear difference between the test results before and after the training. These changes show that teachers improved their understanding and skills in making HOTS questions and using AI as a tool for teaching and assessment. Before the training, some participants were still in the moderate to low range, especially in knowing and using AI. After the training, most scores moved up to the good range

in almost all areas measured. This means the training had a positive effect and helped improve teacher skills, as shown by the comparison of the test results in Table 3.

Table 3. Comparison of Pre-Test and Post-Test Results

Indicator	Pre-test	Post-test	Improvement	Final Category
Understanding of HOTS Concepts	2.40	3.40	+1.00	Good
Teachers' Digital Literacy	2.75	3.52	+0.77	Very Good
Knowledge of Artificial Intelligence	1.93	3.10	+1.17	Good
AI-Based HOTS Question Development Skills	1.85	3.15	+1.30	Good

Table 3 shows a comparison of the test results before and after the AI-Based HOTS Question Creation Training for elementary school teachers. The data shows that all areas improved a lot after the training. Teachers' understanding of HOTS concepts went up from 2.40 to 3.40, which is considered good, and their digital skills went up from 2.75 to 3.52, which is very good. There were also big improvements in teachers' knowledge about AI, with scores going up by 1.17, and in their ability to make AI-based HOTS questions, with the biggest increase of 1.30. Both of these are in the good category. These results show that the training helped teachers not only understand the ideas better but also use AI more effectively to create HOTS questions in today's digital world.

The AI-based HOTS question-creation training greatly helped teachers better understand and improve their skills in creating learning assessments. Participants showed they could better understand Higher Order Thinking Skills (HOTS) and use Artificial Intelligence (AI) to create questions (Gembong et al., 2025). This was seen in the teachers' ability to make AI-based HOTS questions that matched learning goals, higher thinking levels, and the needs of elementary schools. After the training, more than 70% of participants could make questions that fit HOTS standards, showing the training improved both their understanding and their practical skills in making assessments. The program also resulted in a set of AI-based HOTS questions made by the participants, which are useful and suitable for use in schools (Irmayanti et al., 2025). This training goes beyond just theory and leads to real, useful results, showing that using AI in teacher training is a good way to help teachers grow and keep up with the changes in education today (Zuhri et al., 2024).

Higher Order Thinking Skills (HOTS) questions play a crucial role for teachers, particularly in the digital era, which demands students develop critical, analytical, and reflective thinking skills (Waffak et al., 2022). Current learning no longer emphasizes mastery of facts and memorization; instead, students must be encouraged to understand problems, analyze information, and make logical decisions (Indahwati et al., 2026). Developing HOTS questions in an elementary school context provides the initial foundation for developing students' mindsets, fostering reasoning skills from an early age (Sastrawati et al., 2025). Therefore, teachers need a strong understanding of the characteristics of HOTS questions so that the assessments they develop are truly aligned with learning objectives and students' cognitive development.

Fast changes in technology give teachers many chances to make better learning assessments (Kasman et al., 2025). Artificial Intelligence (AI) can be used as a helpful tool to make HOTS questions faster and still keep their quality (Fadila et al., 2025). Many elementary school teachers now use question banks, but these often do not match the real classroom, the students, or the learning goals (Fadli, 2024). With AI, teachers can change and create questions in more ways that fit their own classrooms, saving time. Still, teachers need to check and adjust the questions to make sure they match the lessons and what students need to learn in elementary school.

Research by Munali et al., (2024) show that using Higher Order Thinking Skills (HOTS) questions in elementary schools helps students develop important thinking skills, such as being critical, thoughtful, and able to view things from different angles from a young age. HOTS

questions are not just for checking what students have learned, but also for encouraging them to think deeply by having them examine problems, assess situations, and develop solutions to real-life issues. As technology in education advances, Indahwati et al., (2026) note that creating HOTS questions with Artificial Intelligence (AI) is becoming increasingly important today, as it helps teachers develop more useful, real-world, and time-saving ways to assess students while still following effective teaching practices. Using AI to make HOTS questions is seen as a helpful new idea that saves teachers time and makes learning tests better, which fits with what schools need today.

Making HOTS questions with AI aligns well with the deep learning approach, which focuses on meaningful learning that helps students really understand and lets them apply what they know in real life. In deep learning, tests are not just for checking what students remember but also for connecting how students think to broader learning goals (Ahmed et al., 2023; Al Ka'bi, 2023). HOTS questions help students think about what they know, connect ideas, and understand the bigger picture. So, using HOTS, AI, and deep learning together is an important way to create tests that match what schools need in today's digital world.

CONCLUSION

The training program that taught elementary school teachers how to use AI to make HOTS questions went well and helped teachers get better at their jobs, especially in understanding HOTS ideas and using AI to create learning tests. The results showed that teachers learned a lot, and over 70% of them could make AI-based HOTS questions on their own. This program fits what teachers need today and has helped make tests that are more connected to real life and help students think more deeply. It is recommended that similar programs continue with regular support, include more teachers, and focus on using AI responsibly and effectively, so the programs can keep making a difference and help improve elementary school education.

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