



Question Making Training with LOTS, MOTS, and HOTS Cognitive Levels for High School Teachers

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ABSTRACT

The current focus among educators is on assessments that promote higher-order thinking skills, enabling students to develop critical, analytical, and systematic thinking, especially in problem-solving, communication, and collaboration. Nonetheless, some teachers still struggle to create questions that effectively target these skills. This service initiative aims to educate 18 instructors from Muhammadiyah Mlati High School on crafting questions that address advanced cognitive abilities. Using a variety of methods, including lectures, interactive Q&A sessions, group discussions, and presentations, the results indicate that the training participants have successfully grasped the basic principles of designing questions for Higher Order Thinking Skills (HOTS) in education. After participating in four sessions, they have shown competence in categorizing and structuring questions that span Lower Order Thinking Skills (LOTS), Medium Order Thinking Skills (MOTS), and Higher Order Thinking Skills (HOTS).

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Introduction

Assessment is a crucial component in the learning process. The type of assessment used should align with the characteristics of the subject matter and the desired learning outcomes [1].

Teachers are required to apply appropriate assessments to support student learning success. Assessment is provided to reflect on learning deficiencies and to evaluate student achievement [2], [3]. Additionally, assessment is also used to evaluate the effectiveness of the curriculum, teaching materials, instructional strategies, and student learning progress, as well as to determine the achievement of learning targets [4]. This helps identify each teacher's professional competence.

Professional competence emphasizes the holistic mastery of learning materials, including assessment, while pedagogical competence focuses on applying pedagogical knowledge that aligns with students' characteristics and development. Social competence encourages students to live harmoniously with others and adapt to specific cultures, and personality competence emphasizes that teachers should be honest, responsible, and morally upright individuals. These four competencies are key to the quality of learning, leading to both academic excellence and character formation [5], [6].

21st-century educators demand students to master critical thinking and problem-solving skills. Teachers utilize their competencies to design challenging learning activities that prompt students to think critically, systematically, communicate, and collaborate, thus preparing them to face global competition [7], [8]. Critical thinking skills enable students to use complex thinking systems in interactions, make appropriate decisions, and solve problems in learning [9], [10].

Higher Order Thinking Skills (HOTS) are high-level thinking abilities that include analysis, evaluation, and creation (C4-C6 in Bloom's taxonomy) [11], [12]. Question development should consider the composition of LOTS (C1 and C2), MOST (C3), and HOTS (C4-C6). HOTS-oriented questions are more commonly used in the independent curriculum for various levels [13].

A needs analysis by Ref. [14] shows that this analysis is crucial to help teachers make informed decisions in developing teaching materials. Ref. [15] add that needs analysis helps teachers reflect on evaluation standards and understand student needs, as well as identify inhibiting factors and enhance learning motivation. Based on this data and needs, comprehensive and in-depth training is highly necessary to assist teachers in developing HOTS-oriented questions that meet the learning needs of teachers and students.

Literature Review

A. Training

Training is one of the crucial processes in human resource development aimed at enhancing the skills, knowledge, and competencies of individuals within an organization [16]. Training is frequently discussed in various contexts, including education, human resource management, and organizational development. Training is defined as a systematic process designed to develop or improve the knowledge, skills, and abilities of employees to achieve organizational goals

effectively and efficiently [17]. The primary objective of training is to improve individual and organizational performance, increase productivity, and meet evolving job requirements [18].

The literature identifies several types of training, including on-the-job training, which is conducted at the workplace while employees perform their tasks, off-the-job training, which takes place outside the work environment, such as seminars, workshops, or formal courses, technical training, which focuses on enhancing specific technical skills required for particular jobs, and managerial training, which is designed to develop leadership and management capabilities.

Training can be conducted through various methods and approaches, including classroom-based training that involves instructors delivering material directly in a classroom setting, technology-based training that uses technological tools and platforms such as e-learning and simulations, and integrated training that combines several training methods to achieve optimal results [19]. Evaluating training is a critical process to determine whether the training has achieved its objectives [20]. The success of training is influenced by several factors, including management support involving top management's engagement and support, participant motivation that affects training outcomes, and training design that determines its effectiveness.

B. HOTS

Higher Order Thinking Skills (HOTS) is a crucial concept in the field of education that emphasizes the ability to think critically, analytically, creatively, and evaluatively. This concept aims to prepare students to face complex challenges in real life, rather than merely memorizing facts and information. HOTS refers to cognitive abilities that involve higher-order thinking processes beyond memorizing or understanding basic information. According to Bloom's Taxonomy, HOTS includes analysis, evaluation, and creation. Ref. [21] revised this taxonomy by adding cognitive process dimensions, which include remembering, understanding, applying, analyzing, evaluating, and creating.

HOTS is considered important because it prepares students to think critically and creatively and solve complex problems. This ability is crucial in the continuously evolving era of information and technology. Ref. [22] emphasized that HOTS helps students develop a deeper and more applicable understanding of the material they study. The implementation of HOTS in teaching involves various methods, such as: (1) Problem-Based Learning, where students are encouraged to solve real, complex problems, thereby enhancing their critical and analytical thinking skill; (2) Project-Based Learning, where students engage in long-term projects requiring planning, research, and evaluation, allowing them to develop higher-order thinking skills; and (3) Classroom Discussions and Collaboration, which enable deep exchange of ideas and critical reflection.

Evaluating HOTS requires a different approach from evaluating basic skills. Traditional tests that only measure the ability to remember and understand are insufficient for assessing HOTS. Instead, evaluation tools that can measure analysis, evaluation, and creation skills are needed, such as essay tasks, research projects, and presentations [23]. The implementation of HOTS in education faces various challenges, including teachers' readiness, as many are not yet trained to teach and evaluate HOTS effectively; a crowded curriculum that often focuses on achieving specific standards without providing enough room for HOTS development; and an evaluation system that still heavily relies on multiple-choice tests and memorization, hindering the measurement of HOTS [24].

Material and Methods

The community service activity took place from January 10th to 12th, 2024, at SMA Muhammadiyah Mlati, located on Jl. Magelang Km 7, Sinduadi, Mlati, Sleman, DIY, with 18 teachers participating. The methods applied in this training activity included lectures, question-and-answer sessions, discussions, and presentations.

A. Lecture

The training started with a lecture by lecturers from the Mathematics Education Department, Mercubuana University. The focus of the lecture was to refresh teachers' knowledge regarding the classification of Bloom's taxonomy in learning assessment (C1-C6), with C1 and C2 as LOST, C3 as MOTS, and C4-C6 as HOTS. Lecturers were assisted by senior-level students who acted as hosts, moderators, note-takers, and activity documenters and supported the smooth running of the training.

B. Question and Answer

This method was applied after the lecture, providing an opportunity for teachers to ask questions and receive direct answers from lecturers regarding the preparation of questions according to Bloom's taxonomy classification (LOTS, MOTS, and HOTS).

C. Discussion

This method encouraged training participants to provide suggestions, advice, and opinions related to the training material. Teachers shared their real-life experiences in preparing questions according to the subjects they taught and the challenges they encountered. Lecturers accepted all inputs and assisted in preparing HOTS-oriented questions.

D. Presentation

This method focused on demonstrating and explaining how to perform a task through examples or experiments presented. Lecturers explained the essence of HOTS and provided examples of question construction in daily learning interactions. Teachers understood the

material, followed the examples provided by the training team, then presented their work in front of the training team, and concluded with a joint evaluation.

Results

A. Workshop

The workshop commenced with a brief introduction of the background of the four presenters. Moderating the workshop was a student who assisted the service team at Muhammadiyah Mlati High School. The service activity revolved around the theme "HOTS in Classroom," presented by four competent speakers with relevant topics.

The first speaker, a mathematics teacher with a doctoral background, presented the topic "development of HOTS-oriented questions". He systematically explained the material, covering the essence of HOTS in learning assessment, the reasons and definitions of HOTS, Bloom's taxonomy classification (HOTS, MOTS, and LOTS), and the role of HOTS in enhancing students' critical thinking skills. The material emphasized the importance of high-level thinking abilities in assessment, oriented towards achieving critical, creative, innovative thinking, as well as the ability to solve complex problems accurately and correctly.

The second speaker, a doctoral teacher in mathematics, addressed the topic "innovation and creativity in learning". He emphasized the importance of time allocation and the role of students in learning. According to him, teachers should provide sufficient time for students to innovate and create, with the teacher acting as a facilitator and stimulator. Proper appreciation of students' creativity is also crucial. Innovation, as the basis of creativity, can be realized when teachers provide adequate time allocation and excellent support.

The third speaker, a master's degree holder in mathematics teaching, presented the material "HOTS in portfolio assessment and project-based assessment in learning". He encouraged teachers to apply the concept of HOTS in various types of assessments. Teachers must be able to differentiate between portfolio assessment, authentic assessment, performance assessment, and project-based assessment from daily task-based assessments. Assessment of student homework differs from project-based assessment. Teachers were also encouraged to work extra in collecting, assessing, and commenting on student portfolios, which help assess the shortcomings and learning progress of each student and their ability levels at the LOTS, MOTS, or HOTS levels.

The fourth speaker, a master's degree holder in mathematics teaching, presented the topic "teacher strategies in enhancing learning motivation." He emphasized the importance of motivation in students' learning success. Motivation is considered a significant moderating variable contributing to achieving students' learning targets. This aligns with Ref. [25] view that motivation plays a crucial role in accelerating students' learning achievements. Motivation is the

main driving force for students to achieve maximum learning outcomes, and the higher the motivation they possess, the greater their determination to reach their learning targets.

B. Preparation and Presentation of Activity Results

The outreach activity for the development of HOTS-based questions was conducted both individually and in groups according to each subject area. After grasping the essence of HOTS in the assessment system explained by the speakers, participants were divided into subject clusters. The speakers took turns accompanying each group in internal discussions, utilizing an approach and language grounded in the local culture.

Culture-based discussions made participants feel happy and enthusiastic about sharing the challenges they faced in crafting HOTS questions. The sociocultural approach encouraged participants to be actively engaged throughout the activity. This approach also influenced the psychology of participants to express opinions openly and honestly.

Every participant actively participated in crafting questions, and the results were collectively reviewed within the groups, and then presented in front of the speakers and other subject groups. Other groups actively posed questions and provided relevant feedback on the questions prepared by the presenting group. The presenting groups responded carefully to questions and feedback. During the inter-group discussion process, the speakers listened to and recorded input and questions from the discussion participants.

The students were also active in this discussion session. They joined the teacher discussion groups, and when groups encountered deadlocks regarding questions and feedback, they provided the speakers with the opportunity to respond. The mentoring proceeded smoothly and effectively, marked by the numerous questions from participants and responses from other groups, concluding with input from the speakers for each group.

The training participants agreed that the HOTS-based question preparation training should become a regular workshop to support their success in crafting HOTS questions and refreshing their knowledge of learning innovations. They also sought understanding and willingness from the speakers to accompany them in the subsequent stages of HOTS question preparation. Below are excerpts from a selection of participant Q&A sessions with the speakers during the training activity.

After attending the workshop, the training participants succeeded in identifying several challenges they faced. Thus, this training has proven to be very useful, in line with the views of Ref. [26], [27] and [28], who states that HOTS question training influences the performance of high school teachers. Teachers become more motivated to carry out their duties, and better understand the educational process, direction and evaluation of student learning achievements. Apart from that, this training also increases teachers' competence, proficiency, and skills in carrying out their profession, as stated by Ref. [20] and [21].

Table 1. Excerpts from Participant Q&A Session

Question	Answer
Questioner 1: How can the Merdeka Belajar concept be integrated with an assessment system oriented towards HOTS?	The concept of Independent Learning and Independent Schools promoted by Minister Nadiem Makarim deserves our appreciation. What he means by Merdeka Belajar is giving students as much time as possible to be creative in the learning process. Give them the confidence to exploit the potential that exists within them. Design student-centered learning activities, such as task-based, problem-based, project-based, cooperative, contextual-based learning, and implement performance-based assessments. By giving students more time, they will be more likely to innovate and create according to their understanding. As teachers, we must continue to direct students' learning progress by providing substantial input on the results of their work. Merdeka Belajar are about students who become independent, innovative, and creative learners while still following rules that are by learning objectives.
Questioner 2: What concrete forms and HOTS-oriented project-based assessment techniques can I apply?	Project-based assessment emphasizes three key aspects. First, time management, where students are directed to manage their time well to complete projects according to the teacher's guidelines. Second, is relevance, which requires that the project be appropriate to the subject matter being taught, student knowledge, and learning objectives. Third, originality, which emphasizes that the project submitted must be the student's original work. Teachers can compare students' academic progress in class with their project work. The last two aspects, relevance, and originality, can be related to HOTS, where relevance relates to analysis (C4), and originality relates to creation (C6), as students are encouraged to produce their own authentic work.
Questioner 3: Are questions requiring HOTS mandatory on assessments, and are HOTS concepts relevant to students at lower grade levels? I ask for feedback and explanation.	Learning activities that emphasize higher-order thinking skills are an important step in improving the quality of graduates. Questions that focus on HOTS provide opportunities for students to develop analytical, evaluative, and creative abilities. The government, through the Ministry of Education and Culture, requires all teachers in every formal teaching institution to design learning and assessment based on HOTS in order to improve the quality of teaching in Indonesia. Teachers who usually use LOTS and MOST based questions are asked to immediately adapt to HOTS demands in order to improve the quality of learning for students.

C. Evaluation

Evaluation serves as the final step of this training activity. It is conducted through a questionnaire aimed at reflecting on the shortcomings, weaknesses, and strengths of the training implementation. Evaluation plays a crucial role in the sustainability of training activities, as emphasized by Ref. [31], stating that evaluation is an integral part of training and aims to assess achievements based on established standards. Ref. [32] also assert that evaluation is vital to determine the effectiveness of the conducted training.

The joint evaluation, results at the end of the activity indicate that this training has encouraged teachers to understand the construction of HOTS-oriented questions according to their respective subjects. The training participants expressed satisfaction with the materials presented by the speakers. They state that before this activity, they only constructed questions based on the mandatory textbooks for each subject. This training has broadened their insights into question

construction according to Bloom's taxonomy, covering questions oriented towards LOST, MOST, and HOTS.

The role of Higher Education Institutions in assisting schools in need of problem-solving regarding the construction of HOTS-oriented questions has proceeded as planned. Several technical suggestions and recommendations were obtained during this training. Overall, the results of the evaluation phase show a positive response to the beneficial nature of HOTS question construction training in enhancing teacher competencies. The principal of Muhammadiyah Mlati High School expressed a positive impression of this training. According to him, this training is very beneficial for teachers, especially regarding the construction of HOTS-oriented questions. The school appreciates and hopes for strategic and mutually beneficial cooperation between the Department of Mathematics Education, Mercubuana University, and the school. The hope is that this activity can be carried out continuously to enhance the competence of teachers.

Conclusion

After conducting the training on developing Higher Order Thinking Skills (HOTS) oriented questions, it can be concluded that the participants have understood how to formulate questions aligned with HOTS. They can apply the concepts taught during the training in crafting questions that challenge students' analytical, evaluative, and creative skills. Additionally, the participants have grasped the classification of question development based on HOTS, MOTS, and LOTS. They can now differentiate between questions that require low, medium, and high-order thinking skills, and are capable of formulating questions accordingly. The participants also received a refresher on the concept of Independent Learning and Free Schools. They understand the importance of fostering students' learning spirit through a more liberal and creative approach to teaching. This training provided new insights into how the concept of Independent Learning can be integrated into question development and more effective and enjoyable teaching strategies for students. Overall, this training not only enhanced technical skills in question formulation but also equipped teachers with a broader understanding of the importance of innovation and creativity in supporting student-centered learning.

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