



Explore Teachers' Skills in Developing Lesson Plan and Assessment That Oriented on Higher Order Thinking Skills (HOTS)

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Abstract: In 2018, the Indonesian Ministry of Education issued a new policy related to the development of learning oriented towards a Higher Order Thinking Skill (HOTS) approach at the primary and secondary school levels. This learning development is expected to be able to improve the achievement of Indonesian students in international competitions such as PISA and TIMSS. This program was developed following the policy direction of the Ministry of Education and Culture which in 2018 has integrated Strengthening Character Education and learning oriented to 'HOTS'. Recently, the program is integrated into the MBKM program, where Universitas Pendidikan Indonesia (UPI) a university that produces educators decides to take a role in developing HOTS. This study aims to identify teacher skills in developing lesson plans and HOTS-oriented assessments. This is a case study research. A mixed-method design was used in this study as a way to analyse the teacher training process and the outcomes of the training. The sample of this research is science teacher at the sample school in Bandung. The results of the study show that the development skills of teachers' lesson plans are in the intermediate category, but not all lesson plans describe activities on 'intermediate' category. Therefore, further training and coaching is needed.

Keywords: HOTS; developing lesson plan; HOTS assessment; teacher training

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INTRODUCTION

Various international studies, such as TIMSS and PISA can be used as a reference to determine the HOTS achievement of students (Budiman & Jailani, 2014; Jailani & Retnawati, 2017; Apino & Retnawati 2017). TIMSS 2015, Indonesia's science skills area is at the bottom and students' skills are still in the 'know' and 'apply' domain or in lower order thinking skills. In the 'reasoning' domain, students' skills are still very low (Mullis, Martin, Foy, & Hooper, 2016). While the results of the 2008 PISA assessment, Indonesia obtained a science literacy score of 396 with an OECD average score of 487, where Indonesia is still ranked 10 below. Likewise, in the 2015 PISA survey, Indonesia only ranked 69 out of 77 countries with an average score of 403 in scientific literacy, while the average international score was 493 (OECD, 2018). This shows that the ability of Indonesia's HOTS is still low, so efforts are needed to improve it so that it can compete with other countries both by the government, educational staff education institutions, education units, educators and prospective educators.

One of Indonesia's current efforts to produce generations and prepare graduates. Higher education is resilient in the face of the era of disruption, namely the launch of the Merdeka (Independent) Learning Program – Merdeka (Independent) Campus (MBKM) by the Minister of Education and Culture in 2020. The MBKM policy is implemented in order to realize an autonomous and flexible learning process in higher education so that universities can design and implement carry out innovative learning processes so that students can achieve learning outcomes that include aspects of attitudes, knowledge, and skills optimally. This policy also aims to increase link and match with the business world and industry, as well as to prepare students for the world of work from the start (Director General of Higher Education, 2020). MBKM activities offer learning processes outside of on-campus study programs, including: internships or work practices, village projects, student exchanges, research, entrepreneurship, independent studies, humanitarian projects and teaching in schools.

This program is an opportunity as well as a challenge for the Indonesian University of Education. Not only for students but also for lecturers as well as the institution or college where the program is run. MBKM gives maximum freedom for UPI to develop, be creative, and carry out various innovations to produce prospective educator students who are able to answer the demands of the times. The key to the success of

universities in implementing MBKM policies is the existence of an adaptive curriculum that is able to adapt to the times, collaboration and cooperation between related parties are needed that can support the success of the student learning process. Currently, Universitas Pendidikan Indonesia is collaborating with the Center for Assessment and Learning (Pusmenjar) of the Ministry of Education and Culture and 7 education universities (ex-IKIP) in Indonesia jointly reconstructing and revitalizing educational programs to increase HOTS in the fields of language, science and mathematics in order to build centers of excellence university learning model as well as increasing the University Work Index (UWI).

One of consideration in developing this program is the demand that needed by the educator in schools. Teachers are dealing with the government policies in education. The government expects students to achieve various competencies by applying HOTS or Higher-Level Thinking Skills. These competencies are critical thinking, creative and innovative, communication skills, collaboration and confidence. The five things that the government said that became the target of the character of students are attached to Indonesia evaluation system in the national exam and are 21st century skills. In order to fulfil this demand, teachers should understand and skilful in developing learning activities that can build HOTS.

Krathwohl (2002) revealed indicators to measure higher order thinking skills include: a. analysing; 1) analysing incoming information and dividing or structuring information into smaller parts to identify patterns or relationships. 2) Be able to recognize and distinguish the causes and effects of a complex scenario. 3) Identify/formulate questions. b. Evaluating; 1) providing an assessment of solutions, ideas, and methodologies using suitable criteria or existing standards to ensure their effectiveness or value. 2) Creating hypotheses, criticizing and testing. 3) Accept or reject a statement based on predetermined criteria. c. Creating; 1) generalizing an idea or perspective on something. 2) Design a way to solve the problem. 3) Organizing elements or parts into a new structure that has never existed before.

Some researchers in Indonesia (Damaianti et al., 2020) figured out that Junior high school students in Indonesia do not have enough higher order thinking skills in understanding and dealing with reading procedure. Wartono (2018) tried to develop inquiry discovery can improve those skills of physics students. He compared two classes of students that used different learning model. It more likely reconstructs students' scientific knowledge of physics. Scientific processes that develop on inquiry discovery phases supported students' ability to analyse problems, creating hypothesis, design experiments, and analyse the data. That process leads students to use higher order thinking. It indicates that learning processes plan and design will give big impacts on students' higher order thinking skills. It could be assumed that teachers' ability in developing lesson plan is a crucial aspect on improving students' HOTS. Retnawati et al (2018) wrote that teachers' knowledge about HOTS, their ability to improve students' HOTS literacy, solve-HOTS based problems, and measure students' HOTS is still low. However they understand that HOTS literacy is important for students. Therefore, we designed professional development program in order to identify teachers HOTS literacy and ability in developing lesson plan and assessment that oriented on HOTS.

Learning activities in developing lesson plan is major factor to rise up HOTS. Researchers wrote that various instructions design in learning activities could impact differences in HOTS (Lo, C. O., & Feng, L. C., 2020). He chose twenty-five gifted students to got different instruction design and then tested using standardized HOTS instruments. He analyzed that stand-alone HOTS instruction and integrated HOTS unit gave different impact for gifted students in Taiwan. He concludes that HOTS instruction can promote students' thinking, even the different instruction design give different impacts. On the other hand, Mitani (2021) noticed that not all students received adequate education related to HOTS. She took form earlier study that there is inequality teachers' quality that arose achievements gaps on low socioeconomic status (SES), so that they cannot conduct students-center learning activities (Maas, et al, 2018: on Mitani 2021). She found that instructional practices such as same group work, asking students to work on complex problem were positively associated with the test score gap. Problem Based Learning (PBL) also promoted by Moallem (2019). He showed the effect of PBL into students' knowledge and HOTS. Furthermore, flipped classroom strategy can be used as catalyst in enhance HOTS. Priyadarshini (2018) used this strategy by giving lecture notes or video out of class, and then gave collaborative activities in class. The results showed signify improvement on students thinking skills. Therefore, teachers' knowledge and ability in developing active, collaborative, and problem solving activities is needed on lesson plan.

METHODS

This research is case study with a single-case design for selected sample. In order to confirm the validity of research processes, triangulating data is taken by observing, analysing and interviewing the sample. The qualitative method (Creswell, 2003) is taken to analyse teacher's performance in training class qualitatively.

Population and Samples

Junior high school teachers are the target population in this research. The sample was taken from selected schools. We decided to select schools from different accreditation value. It is ranged from A to C accredited schools in Bandung. Teachers came from three junior high schools in Bandung. Six teachers were invited from each school. However, in this case study, we took one school sample.

Research Procedure

Teacher training program conducted for six days. Teachers' performances (knowledge and skills) are the research variables. They are refer to what teacher know about HOTS, how is teacher profile in solving HOTS problems, and how they ability in developing lesson plan refer to their knowledge and profile. In the beginning of training, they were asked to solve HOTS problems. After finish solving problems, teachers were asked to discuss what is the hardest and the easiest points of the problems. After that the trainer explained what is HOTS, and how to develop lesson plan and assessment that oriented on HOTS. Finally teacher asked to develop lesson plan and the problem set and at the end of program they were asked to redo the problem set. In this paper, we are focused on teacher's skill in developing lesson plan and assessment.

Data Analysis

Teacher profile of HOTS literacy was collected using HOTS based problems from Assessment Center Indonesia (PUSMENJAR). It consists of linguistic and numerical problems that related to science, math, and linguistic content. The score were calculated automatically in web system. The differences of score were calculated mathematically (post-test score- pre-test score) to find out its profile. Rubric of HOTS lesson plan and assessment were developed as tools to categorized teacher's abilities. All the data analysed qualitatively based on some theoretic consideration from Krathwohl (2002), Brown, Richard, and Cameron (2001).

RESULT AND DISCUSSION

Learning that is oriented to higher order thinking skills or HOTS, emphasized the role of the teacher does not explain much, on the contrary, the teacher stimulates a lot of questions to encourage students' original thoughts, these questions include: 1) questions to focus attention or study to be deepened, 2) questions to encourage students to think about finding reasons or take an opinion position, 3) questions to clarify a concept with directions can formulate a definition clearly through comparing, connecting and looking for differences between existing concepts, 4) questions to encourage the emergence of creative ideas and alternative through imagination, 5) questions to encourage students to look for supporting data and facts as well as evidence to make a decision or position, 6) questions to encourage students to develop their minds further and more deeply, by trying to apply some information to various different cases and conditions, so it has more arguments, 7) questions to develop the ability to apply rules or theories which is more common in the case under study (Ariyana et al., 2018).

Questions that will be delivered to students should be well managed and planed. Lesson plan is the guideline for teacher to conduct the learning process. There is no strict lesson plan formats, however in a lesson plan it includes goals, objectives, activities, media, and assessment. Goals are a general changed that hope to be achieved by learner after joining the courses (Richard, 2001). Objectives are aims of learning that contains what teacher want the students to accomplished (Brown, 2001). It should be included 'ABCD' aspect; A=audience that refer to the students, B=behaviour that define performance to be learn, C=condition that demonstrate students performance, and D=degree that describe how well students must be able to demonstrate the performance (Richards, 2001). Activities are oriented to build students' HOTS that started with problems/phenomena to be identified, develop hypothesis, design the experiments, and create explanation. Media should be well prepared so that students will agree that media can help them to understand the lesson (Suwama, 2019). Assessment should be able to measure what is formulated in learning objectives (Cameron, 2001), in this research it should be oriented to HOTS assessment.

Table 1 describe the rubric to evaluate lesson plan developed based on those aspects and characteristics of learning that oriented to HOTS.

Table 1. Rubric of Lesson Plan Oriented to HOTS

Aspects	Characteristics and Category		
	Achievable for young learner to build their HOTS		
	Emerging	Intermediate	Advance
Goals	The verb that write in goals did not consist of HOTS keyword such as analysing (identify, analyse, recognize	Some of verb that write in goals consist of HOTS keyword such as analysing (identify, analyse, recognize	The verb that write in goals consist of HOTS keyword such as analysing (identify, analyse, recognize

	problems); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)	problems); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)	problems); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)
Showed ABCD aspects			
	Emerging	Intermediate	Advance
Objectives	Only aspect A, B, and wrote in the objectives. The 'B' did not show HOTS keyword	Not all aspect 'ABCD' wrote in objectives, but some of 'B' aspect show HOTS keyword	All 'ABCD' aspect wrote in objectives, and 'B' aspect show HOTS keywords
Building students' HOTS through questions			
	Emerging	Intermediate	Advance
Activities	the teacher stimulates a little of questions to encourage students' original thoughts, such as question to identify, analyse, clarify, create ideas and solution, and develop argumentation	the teacher stimulates some of questions to encourage students' original thoughts, such as question to identify, analyse, clarify, create ideas and solution, and develop argumentation	the teacher stimulates a lot of questions to encourage students' original thoughts, such as question to identify, analyse, clarify, create ideas and solution, and develop argumentation
Can help students to understand the concept			
	Emerging	Intermediate	Advance
Media	The media did not represent the concept	Media represent some part of concept	Media represent concept
Measure students' HOTS			
	Emerging	Intermediate	Advance
Assessment	The problems did not consider HOTS key word such as analysing (identify, analyse, recognize); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)	Some of problems consider HOTS key word such as analysing (identify, analyse, recognize); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)	The problems consider HOTS key word such as analysing (identify, analyse, recognize); evaluate (provide and create solution); and creating (generalize, design, organize ideas and solution)

In this case study, we observed science teacher who joined the teacher training activities. She has been teaching science for two years, her education background is biology education. It is her first time learns about HOTS. After getting explanation of HOTS, she feels it will be hard for students, because they do not use to build HOTS. She also said that school facilities did not supported yet. The principals explained that the school just opened for two years, after temporary closed because of managerial issues. Pandemic situation also pushed students to learn from home, and sometime it cannot run effectively because of technical issues of students such as Internet access. However, she believes that HOTS is important for students and she will practice to create learning activities that oriented to HOTS.

She created three lesson plans, it related to 'Plants structure and function' theme. The goals are:

- Analyze the structure and function of various plant tissues
- Analyzing the structure and function of roots, stems and leaves
- Analyze the structure and function of flowers, fruits and seeds
- Analyzing technologies inspired by plant structures

Based on verbs analyses from the rubrics, the goals only contain one HOTS keyword 'analyze' so that it included into 'intermediate' category.

The learning objectives is through a scientific approach and the Discovery Learning model as well as discussions, students analyze the structure and function of plant tissues and technologies inspired by plant structures, using media literacy, collaboration, critical thinking in solving problems and always being grateful for the grace created by God Almighty. Based on the rubrics it consist of aspect 'A' (students), aspect 'B' (analyze the structure and function of plant tissues and technologies inspired by plant structures, using media literacy, collaboration, critical thinking in solving problems), and aspect 'C' (always being grateful for the grace created by God Almighty), but there is no Aspect 'D'. Aspect 'B' consist of one HOTS keyword 'analyze', therefore it included into 'intermediate' category.

The learning activities were design in different context at each lesson plan. It is shown in [Table 2](#).

Table 2. Activities in lesson plan

Lesson Plan	Activities
	- Students are given a case study on coconut tree hatchlings Teacher ask question: <i>Predict, what will happen to the hatchling points after 20 years, if in the beginning the height of the hatchling points is 30 cm?</i> - Students are given another case study:
1	Lets' Analyse Mari menganalisis  Gambar 1 Gambar 2 Pada sebuah kasus, ada dua perlakuan yang berbeda pada proses menyiram tanaman, yaitu gambar 1 menyiram di bagian daun, dan gambar 2 menyiram di bagian tanah. Jaringan apa yang berperan dalam proses pengangkutan air dari tanah ke daun? Dan bagaimana perbedaan pertumbuhan yang terjadi pada kedua perlakuan tersebut? Teacher asks question to analyze what are the differences results from two different treatments to the plants, and create explanation about that. - Students discuss in group Teacher ask question to identify what is tissue type at those case study. - Students present the results and its explanation
2	Mari Mengamati!  Amati pohon di samping Apa yang menyebabkan pohon di samping bisa kokoh? Teacher asks students to identify what make plants grow strong. - Students discuss in group Teacher asks question to find out the function of plants roots - Students presents the explanation of plant roots function
3	- Students are given a picture display of roses Teacher ask question: "what parts are in the flower" - Students discuss in group Teacher asks question to find out the part of flowers - Students presents the explanation of parts on flowers

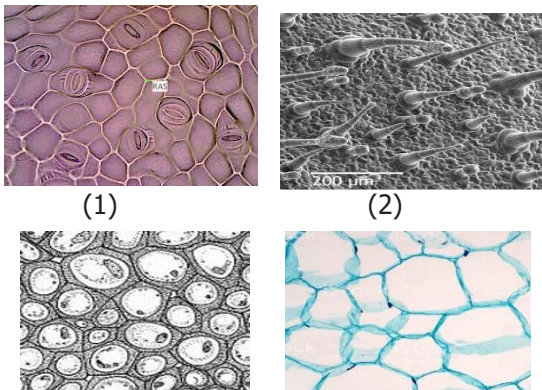
Based on the activities, it could be identified that lesson plan 1 has two activities that support HOTS; predict and analyze the case studies. It can be categorized into 'intermediate'. Lesson plan 2 and 3 delivered simpler activities for students, teacher showed pictures of phenomena and ask students to find out the faction of plant parts in the pictures. Questions that deliberated by teachers only trigger students to identify, so that not all questions on the activities can trigger students' HOTS. Therefore, it include to 'emerging' category.

Media in the lesson plan were categorized into 'emerging' category. Teacher use pictures as media, even though it can represent the concept, but the number is limited, it did not covers all concept of structure

and function of plants. Therefore, teacher should create innovative media using technology. Technology that used as media gives impacts to students' achievement. Lou et al (2019) developed technology-assisted guided learning (TAGL) to decrease the prior-knowledge achievement gap on students. She found that TAGL gave beneficial effect for students especially for those with low prior knowledge.

HOTS assessment is the hardest part for teacher to develop. She thought that HOTS assessment is a difficult problem set for students. It is misperception, because HOTS based problem doesn't mean a 'difficult questions'. The key component of HOTS assessment is using keyword of HOTS verb such as predict, analyze, identify, compare, create, design, evaluate, etc. Teacher need more practice in developing HOTS assessment, she said that she took some of question from website. It can be seen in Table 3 that not all questions have HOTS verbs.

Table 3. HOTS assessment identification

Question	HOTS verb Identification
Identify plants pictures as follow:  These plants are examples of several types of plants around us. Plants can be recognized or identified based on the characteristics of the main organs. Try to observe the examples of these plants based on the type of root, the structure of the stem, and the shape of the leaves.	Identify
Consider the simple experiment shown in the following picture  The color change in these plants to the color of the water in the glass is probably caused by the activity of the transport tissue. Is this statement true? explain your answer	Explain
Look at the picture of the following plant structure!  (1) (2) (3) (4) The part that serves as a support for the young part of the plant is shown by the figure numbered ...	None

The obstacles that faced by Indonesia teachers also perceived by teacher in Arab-Israel (Assaly, et al,

2021). They tend to teach students use low thinking skills than HOTS. They face some challenges such as students, systems, and social norms. Therefore, it need further training process. Teacher ability in developing lesson plan will impact to students' understanding. Some researchers are trying to find out how to develop teachers' abilities. For example, Rainio & Hofmann (2021) analyzed teacher professional conversation to understand how dialogue can expands teachers' conceptualization. She argued that teacher limited conceptualization of students influence students learning opportunity. She found that teacher reflective dialogue related to students challenged development could increase teacher conceptualization how the learning process has to be conducted. This strategy can be implemented in further teacher training and coaching programs to revise the learning activities.

On the other hand, assessing HOTS includes critical, logical, reflective, metacognitive, and creative thinking. Those can be activated when individuals encounter unfamiliar problems (Bhawani, 2012). Navel et al (2021) found that from 1998-2018, number of unfamiliar problem that inserted into assessment tools is increased. Complex knowledge was also more prevalent in second and third year modules. They also argue that more attention is needed to improve quality of assessment. In this paper, developing HOTS assessment is challenging for teacher. Teacher develops two type of assessment; identify and explain but they did not develop creative or evaluation type of assessment. It also happens to teachers in Malaysia (Suppiah, 2018). They use only three levels of HOTS, i.e. application, analysis, and evaluation. However, they develop little creative level assessment. She suggested that practical teacher must have wide knowledge through extensive reading in order to implement the various activities and type of assessment.

CONCLUSION

In this case study, teacher ability in developing lesson plan is included into 'intermediate' category. However, the activities element on lesson plan need to be build up to trigger students' higher order thinking skills (HOTS). Teacher need more practice on creating analysis, comparing, evaluating, and generalizing activities through representative media such as video, pictures, or real objects. Active learning that involve students HOTS can help students to solve HOTS assessment, so that they can answer PISA or TIMSS problems correctly.

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