HOTS-AEP-COVID-19: Students Knowledge and Digital Worksheet of ILMIZI Environmental Learning Model

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Abstract

Environmental learning when Corona Virus Disease (COVID-19) requires innovation to improve students' abilities in e-learning. One of the capabilities required Higher Order Thinking Skills that can be measured using Higher Order Thinking Skills Assessment based on Environmental Problem of Corona Virus Disease (HOTS-AEP-COVID-19). Besides, it is necessary to develop a digital worksheet based on the ILMIZI model. The purpose of this study was to describe the ability of students using HOTS-AEP-COVID-19 and developed a digital worksheet based on the ILMIZI model. The method used research and development. The study was conducted in March 2020, the samples involved from Bekasi City and Bandung City, West Java, Indonesia. The results showed that students HOTS score in terms of COVID-19 was still in the very low category with scores for all students (21.87), male students (21.00), female students (22.43). Also, the results of the development of ILMIZI-based digital worksheets showed very valid results which meant that it could be used when e-learning. This study concludes that Students HOTS in the context of COVID-19 are still relatively low and need to be improved using ILMIZI-based digital worksheets.

Keywords: HOTS-AEP-COVID-19, digital worksheet, ILMIZI model

1. Introduction

The emergence of the Corona Virus Diseases (COVID-19) outbreak caused many changes in various activities in the world [1-5]. That is because physical distancing policies implemented in various countries to reduce the impact of the spread of COVID-19 that occurred in various countries. Teaching and learning activities in schools have also changed into learning activities at home. COVID-19 makes changes in various aspects of student life, so knowledge about COVID-19 becomes an important aspect to learn. High-level knowledge is needed so students can anticipate the impact of the spread of COVID-19. High-level knowledge is also called Higher Order Thinking Skills (HOTS), which are very much needed in 21st-century learning [6-11].

Previous research has carried out the development of Higher Order Thinking Skills Assessment Based on Environmental Problem (HOTS-AEP) for students and university students [6]. This instrument has a function to measure student knowledge based on various environmental problems that have occurred. Previous studies have shown that measurements using HOTS-AEP students, in general, are still in the low category [6]. That becomes an important thing to be improved. The existence of an outbreak of COVID-19 makes measuring Students HOTS using HOTS-AEP into a novelty and an urgent research. HOTS-AEP instruments can be modified to Higher Order Thinking Skills

Assessment based on Environmental Problem of Corona Virus Diseases (HOTS-AEP-COVID-19). This was to overcome the impact of the spread of COVID-19.

In addition to requiring knowledge about COVID-19, it measured using HOTS-AEP-COVID-19, students also need to be given various exercises and group work when implementing e-learning. That is so students can understand various environmental concepts related to COVID-19. One effort that can be done so that students have guidance in conducting learning activities, especially to use student worksheets [12–16]. Previous research has developed a worksheet in multimedia form [17,18]. However, the worksheets developed did not focus on the prevention of COVID-19. Also, the use of e-learning systems during the COVID-19 pandemic requires a learning model that can be used following the needs of students to support the improving HOTS. One model that can be used is the ILMIZI model that has previously been developed and implemented [19]. This model has 6 stages of learning (syntax) namely Identify problem, Limitation problem, Make mind map, Interpret result, Analyze Result, Interaction and evaluate [20].

The development of digital worksheets based on the ILMIZI model became a novelty in supporting efforts to increase students' HOTS related to COVID-19 in e-learning. This research became a novelty because measurements were made using HOTS-AEP-COVID-19 which was then continued by developing a digital worksheet based on the ILMIZI model. It became an urgent to developed worksheet for support e-learning, realize learning at home during COVID-19. The purpose of this study was to describe the ability of students using HOTS-AEP-COVID-19 and developed a digital worksheet based on the ILMIZI model.

2. Method

This research conducted in March 2020 and used a research and development method that adapted from Borg and Gall model which modified [21]. This study has stages starting from (1) collecting data in the form of descriptive analysis using HOTS-AEP-COVID-19 (2) worksheet planning development (3) developing digital worksheet products based on the ILMIZI Model (4) Validation to users (teacher). The first stage was to measure HOTS using HOTS-AEP-COVID-19 which consists of six items and has three indicators. HOTS-AEP-COVID-19 was a modification of the HOTS-AEP instrument that was developed previously (6). This HOTS-AEP-COVID-19 instrument was given to 148 randomly selected Junior High School Students from Bekasi City and Bandung City, West Java Province, Indonesia. The sample was divided into 59 male students and 89 female students. Data collected using online media in the form of Google form. More complete information about the HOTS-AEP-COVID-19 instrument indicators can be seen in Table 1.

Table 1. HOTS-AEP-COVID-19 instruments

Aspect	Indicator	Item
Analyze (C4)	Analyzing environmental problems causing the spread of COVID-19	1,2
Evaluate (C5)	Evaluate community behavior for protecting the environment in the context of prevention COVID-19	3,4
Create (C6)	Creating problem solutions of environmental problems to prevent COVID-19	5,6

Source: Indicators adapted from Ichsan et al. [6]

The HOTS-AEP-COVID instrument tested for validity and reliability. The results showed that the 6 items used are valid and have a reliability value of 0.76 which can be interpreted that the HOTS-AEP-COVID-19 instrument can be used in this study. The measurement results of HOTS-AEP-COVID-19 will be interpreted into the HOTS category in Table 2.

Table 2. Category scores measured by HOTS-AEP-COVID-19

Category	Interval Score
Very High	$X > 81{,}28$
High	$70{,}64 < X \le 81{,}28$
Moderate	$49{,}36 < X \le 70{,}64$
Low	$38{,}72 < X \le 49{,}36$
Very Low	$X \le 38{,}72$

Source: Adapted from Ichsan et al. [6]

Meanwhile, the worksheets developed in this study were digital-based student worksheets and were developed following the ILMIZI model consisting of 6 stages of learning from Identify problems, Limitation problems, Make mind maps, Interpretation results, Analyze Results, Interaction and evaluate [20]. In this research, digital worksheet has not been implemented yet. This is because this research focuses on developing products. The validation was done to the science teacher. The validation instrument used was a questionnaire filled out by the teacher as an assessment sheet. The indicators of the validation instrument can be seen in Table 3.

Table 3. Indicators of validation instruments

Aspect	Indicators	Item
Layout and Suitability with Curriculum	Font size and layout	1,2,3
	Completeness of worksheets and compatibility with Curriculum	4,5,6,7,8,9
Language	Language suitability	10,11,12
	Sentence structure and usage	13,14,15,1617

Source: Indicators adapted from Ichsan et al. [22]

After validation, data interpretation will be performed. The score used in the instrument starts from 1 to 4. Then it will be interpreted in the form of a validity category with very valid, valid, less valid, invalid categories. The details can be seen in Table 4.

Table 4. Worksheet validation scores

Validation score interval	Validation Category
$3{,}25 < x \le 4{,}00$	Very Valid
$2{,}50 \le x \le 3{,}25$	Valid
$1{,}75 < x < 2{,}50$	Less Valid
$1{,}00 < x < 1{,}75$	Invalid

Source: Indicators adapted from Ratumanan & Laurens [23]

3. Result and Discussion

The results showed that students' HOTS scores measured using HOTS-AEP-COVID-19 showed a very low category. That indicates that the ability of students HOTS in terms prevention of COVID-19 related the environment still needs to be improved. The results of the study can be seen more details in Table 5. The lowest score were shown in item 2 which was related to analyzing environmental factors that contribute to the spread of COVID-19.

Table 5. HOTS score measured using HOTS-AEP-COVID-19 for each item

No	Item	All (n=148)	Male (n=59)	Female (n=89)
1	Based on the news about COVID-19, analyze what environmental factors are causing transmission of COVID-19?	2.11	2.07	2.13
2	In your opinion, what environmental issues contributed the most to the spread of COVID-19? Explain the results of your analysis	1.95	1.90	1.99
3	Community behavior that does not protect the environment, that has an impact on the spread of COVID-19, give your opinion and critique that behavior	2.22	2.17	2.26
4	What behavior should the community do to protect the environment from Covid-19? Give your critique and suggestions	2.12	1.97	2.22
5	Make an idea about efforts to reduce the impact of COVID-19 transmission that you can do in the environment around your home	1.98	1.90	2.03
6	Make a short paragraph (consisting of at least 5 sentences) about the relationship between the importance of protecting the environment and transmission of COVID-19	2.74	2.59	2.83
Raw Score		13.12	12.60	13.46
Average Score (Interval 0-100)		21.87	21.00	22.43
Category		Very Low	Very Low	Very Low

Note: Interval score for each item from 1 to 10

The results showed that the students HOTS score measured using HOTS-AEP-COVID-19 showed that the Analyze (C4) aspect was the lowest. This showed that the ability of students in analyzing various environmental issues related to COVID-19 was still weak and needs to be improved. The full score of students' HOTS based on each indicators can be seen in Table 6.

Table 6. HOTS score measured using HOTS-AEP-COVID-19 for each indicator

Aspect	Indicator	All (n=148)	Male (n=59)	Female (n=89)
Analyze (C4)	Analyzing environmental problems causing the spread of COVID-19	2.03	1.98	2.06
Evaluate (C5)	Evaluate community behavior for protecting the environment in the context of prevention COVID-19	2.17	2.07	2.24
Create (C6)	Creating problem solutions of environmental problems to prevent COVID-19	2.36	2.25	2.43

Note: Interval score for each indicator from 1 to 10

The product development research results showed that the HOTS score measured using HOTS-AEP-COVID-19 is still in the very low category. This was the basis for the development of a digital worksheet based on the ILMIZI model. The development of the HOTS worksheet is still needed. The design important for developing worksheets. The results of the development of the worksheet can be seen in Figure 1.

Environmental Students Worksheet about COVID-19 based on ILMIZI Model
(A digital version for e-learning)

Learning objectives
Students can analyze, evaluate, and create solutions for environmental problems specifically to realize the concept of a green school for preventing COVID-19

Activity instructions
(1) Create groups for discussion in e-learning
(2) Discuss after reading the story below

Green School is a concept where the school is based on the environment. Schools that adopt green schools usually do not allow students to bring plastic bags to school. Besides, learning in the classroom is based online so that it saves more paper. This green school concept is introduced for schools in urban areas. The existence of an outbreak of COVID-19 makes the use of paper drastically reduced. That's because all tests are based online, thus saving paper usage. Students who are in urban areas will usually find it more difficult to follow various rules that support environmentally friendly. Therefore the concept of green school is an innovation. The school was closed, during COVID-19. Then, after activities return to normal, students must be able to apply Green School according to COVID-19 prevention.

(3) Based on the explanation above, try to identify the environmental problems that exist around your school that inhibit the green schools during COVID-19 pandemic. **(Identify problem)**
(4) Limiting the problems that you have identified previously related to green school, only those related to COVID-19 **(Limitation)**
(5) Make a mind map of the problems you will solve related to green school and the impact of COVID-19 on the build a green school **(Make mind map)**
(6) Write a short paragraph about the mind map that you created **(Interpret result)**
(7) Analyze and write your solutions based on the mind map **(Analyze)**
(8) Upload the results of the discussion in online learning media and give comments **(Interaction and evaluate)**

Figure 1. Digital worksheet products based on the ILMIZI model that has been developed

The results of the development are then validated by the teacher as a user. The results of the validation were conducted for 7 teachers. The results showed that ILMIZI-based digital worksheet had a very valid category. This indicates that this digital worksheet can be used in the environmental learning at the elementary and junior high school levels. More details results of the validation can be seen in Table 7.

Table 7. Results of digital worksheet validation based on ILMIZI models for all indicators

No	Validators	Score
1	Teacher 1	3.76
2	Teacher 2	3.71
3	Teacher 3	3.41
4	Teacher 4	3.47
5	Teacher 5	4.00
6	Teacher 6	3.65
7	Teacher 7	3.76
Average Score		3.68
Category		Very valid

The validation results show that the highest average score is found in the Completeness of worksheets and compatibility with Curriculum indicator. This shows that this digital worksheet is compatible with the learning environment of the 21st century. More clearly can be seen in Table 8.

Table 8. Results of digital worksheet validation based on the ILMIZI for each indicator

Validity Indicator	Average Score
Font size and layout	3.71
Completeness of worksheets and compatibility with Curriculum	3.79
Language suitability	3.48
Sentence structure and usage	3.66

Besides developing a student worksheet, it is necessary to describe the implementation details of the use digital worksheet in the ILMIZI model. Based on this, the teacher activity and student activity must also modified to the e-learning system that was carried out, especially when the COVID-19 pandemic. More details about the syntax / learning stages, teacher activity, and student activity in the ILMIZI model for the use of digital worksheets can be seen in Table 9.

Table 9. ILMIZI Syntax (learning stages) for environmental learning during COVID-19

No	Syntax	Teacher Activity	Students activity
1	Identify problem	The teacher gives an initial explanation about the green school, then asks students to identify problems related to COVID-19. The problem was written on e-learning media (Google Classroom / Whatsapp group, etc.) After that, the teacher gives a ILMIZI-based digital worksheet to students	Students identify green school problems related to COVID-19 and write them in e-learning media (Google Classroom / Whatsapp group, etc.) Students also read and work according to the ILMIZI-based digital worksheet provided by the teacher
2	Limitation problem	The teacher asks students to limiting the problem and asks students to focus on discussing	Students limiting problems, especially for problems related to green school and COVID-19
3	Make mind map	The teacher asks students to make a mind map about various factors that support the green school during the COVID-19	Students create an individual mind map related to the limitation of the problem related to green school and COVID-19
4	Interpret result	The teacher asks students to interpret the results, by writing the results in their notes	Students write their interpretation of the mind map results that have been made in individually note
5	Analyze Result	The teacher asks students to write their arguments and analysis results from the results that have been interpreted	Students analyze to find the right solution for the problem after interpret the data that has been written
6	Interaction and evaluate	The teacher give instruction for students to upload their work to e-learning media, then the teacher clarify the wrong argumentation from students. After that give a test	Students upload a mind map and the results of their interpretation in e-learning media. Then students must ask and comment for discussion occurs

Note: All learning activities in Table 9 used e-learning due to physical distancing policy

Environmental learning during COVID-19 requires a variety of learning innovations. One of them is in the form of digital worksheets. This is in accordance with the learning needs during COVID-19 occurs. Learning during COVID-19 was using an e-learning system. This system used in order to reduce the number of physical meetings, according

to implementation of the physical distancing policy [24–26]. In addition, learning using e-learning must also implemented by an suitable model to improve students' HOTS in terms of COVID-19.

One model that has the potential to be used to increase HOTS in terms of COVID-19 was the ILMIZI model. This model was a learning model that can be used in physical meetings in class or using e-learning [20]. Learning with the ILMIZI model can still be carried out even though using e-learning, it can be seen in Table 9, where learning activities can be carried out through Google classroom, whatsapp group, or through other social media. Learning using social media was a learning innovation in the 21st century that is able to improve student competencies in various aspect [27–36].

One of the competencies that must be improved in 21st century learning was HOTS [37–46]. This study showed that Students HOTS in the context of COVID-19 are still very low. It showed that not all of the learning tools used HOTS-based. The measurement results using HOTS-AEP-COVID-19 was a description that learning about COVID-19 must be improved. In this study ILMIZI-based digital worksheets can be used by students in classroom learning for elementary and secondary schools. The digital worksheet also does not require students to go outside the house because the instructions and content on the worksheet only focus on analyzing, evaluating and creating a problem solution.

The digital worksheet is not only an innovation but also a form of development based on ILMIZI model. Previous research recommends the development of various ILMIZI-based learning tools. One of them is in the form of digital worksheets related to COVID-19. This is very contextual because 21st century learning had to discuss various contextual concepts. Students asked to be able to contribute to solving environmental problems around their environment related to COVID-19 prevention. Contextual environmental learning will be easier for students to understand, than environmental learning with topics that are not relevant [47–58].

Learning innovation in e-learning when COVID-19 is a thing that must be done. The teacher must also anticipate various obstacles that might occur during e-learning [59–69]. Example such as internet connections usually become one of the obstacles that are often experienced by students. In addition, obstacles regarding the difficulty of the learning topic for students also have to be solved. 21st century learning requires the ability of HOTS. However, the ability must also built from a correct basic understanding, so that in the use of e-learning, the teacher has a role to verify and clarify the wrong concepts from students argumentation. This is in accordance with Syntax from ILMIZI at stage 6, where the teacher evaluates and verifies the concept.

4. Conclusion

Based on the results of the study it was found that the students HOTS score measured using HOTS-AEP-COVID-19 showed that was still in the very low category. It showed that learning innovation needs to be done to improve students' HOTS. One of the innovations is in the form of digital worksheets based on the ILMIZI Model. Teacher's assessment as a user showed that the worksheets developed in the category are very valid so that they are suitable for use in learning using e-learning. Suggestions from this study are to further develop other learning tools based on ILMIZI to support environmental learning.

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