HOTS AND E-LEARNING OF DIPLOMA AND UNDERGRADUATE: ILMIZI MODEL FOR ENVIRONMENTAL DISASTER MITIGATION EDUCATION DURING NEW NORMAL COVID-19

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Abstract: Innovation in learning is a necessity for environmental learning in 21st century especially during the new normal era of the Coronavirus Disease 2019 (COVID-19). One of important skills to address disaster mitigation issue is Higher Order Thinking Skills (HOTS) that can be trained using the Innovation Learning Model for Natural Science and Environmental Learning (ILMIZI) model regarding e-learning. This research aims to measure HOTS and descriptively analyse the e-learning and ILMIZI model. The research method is descriptive with survey as the data collection technique. The total sample size of this research were 176 students divided into 105 diploma students and 71 undergraduate students. The results show a very low HOTS score of students at the diploma (30.98) and undergraduate (32.02) level regarding disaster mitigation concepts. This study also considered the dominant use of Power Point file (41.38%), distractions in e-learning related to phone signals (44.83%), and the study discovered that majority of students feel more independent in learning (62.07%). The descriptive analysis indicates that the ILMIZI model is compatible for use in environmental learning concerning disaster mitigation. It is the finding of this research that student's HOTS scores are still low; the implementation of e-learning programmes faces some obstacles; and the ILMIZI model is suitable for environmental learning as a means of disaster mitigation.

Keywords: HOTS, ILMIZI, disaster mitigation.

Introduction

Education amid a pandemic requires an adjustment in various aspects. One of the aspects is the implementation of physical distancing policy during Coronavirus Disease 2019 (COVID-19) pandemic. The policy prevailed as efforts to keep a distance from each other is vital to prevent COVID-19 transmission (Bashyam & Feldman, 2020; Tian *et al*., 2020). This has triggered a shift in learning systems from face-to-face to online learning (e-learning). The use of long-distance learning systems via Internet will change its implementation (Golitsyna, 2017; Leeuw *et al*., 2016; Xia, 2017). In turn, this will result in several changes to the teaching materials and learning media used, evaluation of learning objectives and other aspects. Moreover, this affects environmental learning that requires various adjustments, especially for environmental disaster mitigation.

Disaster mitigation demands Higher Order Thinking Skills (HOTS) as a means of learning in the new normal era of COVID-19 (Rahmayanti, Ichsan, Azwar, Purwandari, *et al*., 2020) as it is a topic that involves skills to analyse problems, evaluate them, and create a solution (Onuma *et al*., 2017; Tsai *et al*., 2015). Issues such as environmental pollution require the use of mitigating processes. The mitigation process requires the use of HOTS since disaster mitigation is a complicated issue to resolve. Improving HOTS can be carried out by the use of better teaching materials, newer learning media and more innovative, holistic learning models among other things (Abidinsyah et al., 2019; Churcher et al., 2014; Hugerat & Kortam, 2014; Husamah et al., 2018). One of recommended learning models is known as the Innovation Learning Model for Natural Science

and Environmental Learning (ILMIZI) model (Ichsan, 2019). The syntax of ILMIZI involves

(1) Identifying the Problem

(2) Limiting the Problem

(3) Making a Mind Map

(4) Interpreting Results

(5) Analysing Results

(6) Interaction and Evaluation.

The model, however, has not been implemented further in several contexts related to disaster mitigation education efforts.

Numerous studies have been done on HOTS especially those relating to students' HOTS profiles at various levels of education. The results of these previous studies suggest that the students' HOTS score were low (Ichsan *et al*., 2019, 2020; Zohar & Agmon, 2018) Junior High School. In addition, HOTS test questions developed to measure students' skills in the context of environment related to COVID-19 indicated that the HOTS score in this area was also low (Ichsan & Rahmayanti, 2020) especially to solve environmental problems when COVID-19 pandemic. This was to develop a new level of thinking, namely Higher Order Thinking Skills of Environmental Problem (HOTSEP). Other studies concerned the development of a learning model to improve HOTS (Husamah *et al*., 2018; Rahmayanti, Ichsan, Azwar, Purwandari, *et al*., 2020). Additional, effort to develop HOTS started with media utilisation and has since moved to changes in education curriculum (Garcia, 2015; Miarsyah *et al*., 2019; Sigit *et al*., 2019; Teimourtash & Moghaddam, 2017; Vidergor, 2018). Studies on ILMIZI model have been previously conducted and the model is recommended to enhance students' HOTS (Ichsan, 2019). ILMIZI potentially improve HOTS because it has syntax to analyse and evaluate problems, in this case the problem of environmental pollution.

HOTS is a skill that must be improved using e-learning, especially now given the current COVID-19 pandemic situation. Especially for students at the diploma and undergraduate levels. This is because at this level students in the younger generation can create an impact in the community. Innovation and technology-based education is necessary during the COVID-19 pandemic for students at the diploma and undergraduate levels (Allo, 2020; Crawford *et al*., 2020). This is due to the difficulty of providing access to content in the classroom directly. This encourages the need of utilise technology as a medium of learning. Consequently, the development of teaching materials and learning media should be based on technology, especially in relation to mitigating the effects of the COVID-19 pandemic. It can be said that the research is urgently needed. This research paper aims to describe students' HOTS related to disaster mitigation to prevent environmental pollution, describe the ILMIZI and e-learning effort undertaken in support of environmental learning during the new normal of the COVID-19 pandemic.

Method

The method used to conduct the research was descriptive with data collection done by way of a survey. The total sample size of this research was 176 students, which consists of 105 diploma students and 71 undergraduate students selected by way of simple random sampling. The research period for this paper was from November 2020 to February 2021.

The research made use of HOTS test questions that consisted of three aspects and six indicators. The aspects were related to HOTS according to Anderson *et al* (2001) that consist of Analysis, Evaluation, and Creation. The indicators and instruments items were developed to measure HOTS especially in relation to knowledge of environmental disaster mitigation processes. The instrument indicator of the HOTS questions are listed in Table 1.

Table 1: Instrument indicators of HOTS in disaster mitigation

No.	Indicators	Item
1	Analyze the causes of flooding and recycle habits in the context of disaster mitigation	1,2
2	Analyze the impacts of lack of disaster mitigation efforts for river pollution	3,4
3	Evaluate disaster mitigation programs to support sustainable development in urban areas	5,6
4	Give criticism regarding the use of plastic that has impacts on disasters	7,8
5	Create innovative ideas so that environmental impact analysis can be used to solve environmental disaster mitigation issues	9,10
6	Create disaster mitigation-related innovative programs	11,12

Validity and Reliability of Instruments

The results of validity test using Pearson's product moment for the validity and reliability of instruments showed that there was an implied correlation and that the score for all items had significant meaning and that all items were valid. The reliability calculations derived using a split half (Spearman Brown) indicated a value of 0.83; which confirmed that the instrument was reliable for use.

As all instruments were valid and reliable, students' HOTS measurements can be conducted following a HOTS score interpretation using categories as outlined in this study. The students' HOTS score is divided into several categories, namely: "very high", "high", "moderate", "low", and "very low". This categorisation aims to facilitate the measurement of students' HOTS. The score categories are indicated in Table 2 below.

Table 2: Categories of students' HOTS score

Category	Interval of Students HOTS Score
Very high	$X > 81.28$
High	$70.64 < X \leq 81.28$
Moderate	$49.36 < X \leq 70.64$
Low	$38.72 < X \leq 49.36$
Very low	$X \leq 38.72$

Source: Categories and interval scores are adopted from Ichsan *et al*. (2019)

Regarding the identification of students' opinion on the utilisation of e-learning a follow-up survey was carried out that involved 87 other students. Various aspects asked were related to media, type of file, and duration of e-learning. In addition, the questions provided also concerned about type of connection, disturbances, and type of device used.

Besides the e-learning survey, further analysis was carried out about the ILMIZI learning model in relation to environmental learning for disaster mitigation. The analysis was related to learning activities when the ILMIZI model was applied.

Results and discussion

The research results signified that the students' HOTS score was still in the "very low" category. This was due to the lack of disaster mitigation learning at the diploma and undergraduate level. The lowest HOTS score was in the seventh item, which was carrying plastic bag as a food container (refer to Table 3).

The research results indicated that the students' HOTS score based on each indicator were varied. In the diploma level, the lowest score was obtained in the fourth indicator, which was give criticism on plastic utilisation.

At the undergraduate level, however, the lowest score was in the third indicator that related to evaluation of sustainable development programmes (see Table 4).

Table 3: Score of students' HOTS on disaster mitigation for each item

No.	Item	Diploma	Undergraduate
1	Floods that frequently occur in urban areas causes numerous social and economic disturbances in the communities; provide your analysis results in this matter	4.63	5.35
2	Accumulated garbage in urban areas can be processed as a form of disaster mitigation. Provide your analysis on the accumulated garbage	3.64	3.80
3	River siltation-related disasters are due to the large amount of garbage that inhibited water flow. Provide your analysis related to this matter	3.12	3.41
4	Provide an analysis related to environmental impact analysis functions in environmental disaster mitigation	3.35	3.08
5	Give an opinion related to sustainable development program that is difficult to implement in terms of disaster mitigation	2.70	2.65
6	What evaluation the students can do in disaster mitigation to support sustainable development programs?	2.98	2.80
7	Give criticism of people's behavior that refuse to perform disaster mitigation efforts as they still carry plastic bag as a food container!	2.55	2.61
8	Give criticism and suggestion related to the effectiveness of paid-plastic policy	2.85	3.03
9	Create a solution to overcome the issue of low community awareness in the environmental disaster mitigation	3.11	3.31
10	environmental impact analysis as a way of disaster mitigation is deemed less effective; provide an innovative idea so that environmental impact analysis could be effective	2.70	2.73
11	Provide an innovative solution so that environmental impact analysis and other regulations can be implemented for disaster mitigation	2.62	2.72
12	Create a simple program to increase students' awareness to flood mitigation	2.92	2.93
	Raw Score	37.17	38.42
	Average Score (interval 0-100)	30.98	32.02
	Category	Very Low	Very Low

The results suggest that the lowest score for diploma and undergraduate level was in the evaluation aspect of the HOTS programme. This can be interpreted as most students being unable to provide a proper evaluation or criticisms and suggestions on various environmental issues. The results of the HOTS score for each aspect are presented in Table 5.

Table 5: Students' HOTS score for eachaspect

No	Aspect	Diploma	Undergraduate
1	Analyze	3.69	3.91
2	Evaluate	2.77	2.77
3	Create	2.84	2.92

Table 4: Students' HOTS score for each indicator

No.	Indicators	Diploma	Undergraduate
1	Analyze the causes of flooding and recycle habits in the context of disaster mitigation	4.13	4.58
2	Analyze the impacts of lack of disaster mitigation efforts for river pollution	3.24	3.25
3	Evaluate disaster mitigation programs to support sustainable development in urban areas	2.84	2.73
4	Give criticism regarding the use of plastic that has impacts on disasters	2.70	2.82
5	Create innovative ideas so that environmental impact analysis can be used to solve environmental disaster mitigation issues	2.90	3.02
6	Create disaster mitigation-related innovative programs	2.77	2.82

The research results indicate that most of the students utilised Google Classroom for learning with most of them using PowerPoint to complete the assignments and work, with the average duration of each e-learning session, being between two and three hours a day (see Table 6).

The research results also indicated that most students utilized cellular data plan as their type of connection used for learning and only 34.48% used WiFi. This was due to the fact that WFi usage fees are relatively more expensive and require a subscription. The cellular data plan, on the contrary, is more practical and has various options. Students mostly experienced some disturbances due to the cellular signal. Type of device used by the majority of the students was android Smartphone (see Table 7).

Table 6: Media, type of file and e-learning duration

Option	Total	Percentage
Type of Media		
Website	6	6.90
WhatsApp	21	24.14
Google Classroom	48	55.17
Zoom Meeting	3	3.45
Other	9	10.34
Type of File		
PowerPoint (PPT)	36	41.38
Image (JPG/PNG)	3	3.45
Video	23	26.44
Word document	14	16.09
PDF document	11	12.64
E-Learning Duration		
1 hr/day	26	29.89
2-3 hrs/day	47	54.02
4-6 hrs/day	13	14.94
> 6 hrs/day	1	1.15

Table 7: Type of connection, disturbance, and type of device used

Option	Total	Percentage
Type of connection		
Wifi	30	34.48
Cellular data plan (data/unlimited)	57	65.52
Type of disturbance		
Running out of data	21	24.14
Disturbed cellular signal	39	44.83
Longer Smartphone loading	10	11.49
Disturbed Wifi	13	14.94
Other	4	4.60
Type of Device		
Android Smartphone	55	63.22
iPhone	8	9.20
Laptop	24	27.59

In terms of students learning independence, most students (62.07%) agreed that the application of e-learning made them more independent. Most of them also perceived that it was easy for them to understand the content using e-learning although some of them (33.33%) were still uncertain about how easy it was to understand the content presented on an e-learning platform (see Table 8).

Based on the research results the students' HOTS scores were "relatively low" in matters relating to disaster mitigation. The students' opinions regarding e-learning were varied and covered everything from the obstacles experienced during e-learning to the aspects of learning independence and ease of understanding the content conveyed by the lecturers. The research results generally

Table 8: Learning independence and easiness in e-learning

Opinion	Total	Percentage
Learning Independence in E-Learning		
Strongly agree	3	3.45
Agree	54	62.07
Uncertain	25	28.74
Disagree	4	4.60
Strongly Disagree	1	1.15
Easiness in Understanding Content		
Strongly agree	1	1.15
Agree	43	49.43
Uncertain	29	33.33
Disagree	11	12.64
Strongly Disagree	3	3.45

indicated that e-learning experiences must be improved and its implementation made to work more smoothly and without obstacles in order to improve its utility. In coping with the obstacles, one of learning models that was used was the ILMIZI model. An innovation of the ILMIZI model is an alternative option to overcome various environmental problems. The ILMIZI model implementation can be seen in Table 9.

The research results implied that the HOTS' score was still very low in terms of disaster mitigation. This was due to the lack of availability of HOTS-based teaching materials and learning media. As consequence, students have difficulties in performing an activity applied to improve the HOTS.

Innovation and development in HOTS-related teaching materials and learning media require further advancement (Garcia, 2015; Hugerat & Kortam, 2014; Husamah *et al*., 2018; Istiyono *et al*., 2020; Miarsyah *et al*., 2019; Rahmayanti, Ichsan, Azwar, Damayanti, *et al*., 2020; Ramadhan *et al*., 2019; Sigit *et al*., 2019; Suharini, Ariyadi, *et al*., 2020; Suharini, Kurniawan, *et al*., 2020). The goal is to have various alternatives for teachers and lecturers in utilizing the teaching materials.

These teaching materials and learning media variation will facilitate environmental learning and students will become more interested in learning. Students who are active in learning will be better due to discussion and interaction in the learning that brings good impact on the learning quality.

ILMIZI as an environmental learning model that has learning stages that support efforts to elevate interaction and discussion between students. Stages of ILMIZI that can be improve HOTS were in step 3, 5 and 6. Because students train to be create an innovative mind map, then they must analyze and evaluate the problem to be solved.

The discussion between students will talk about disaster mitigation that becomes the learning focus. The activity is observable in the learning stages from the first to the last stage. In addition, the last stage of the ILMIZI model is evaluation activity and e-learning require a variation in media and teaching materials. ILMIZI model in this context is suitable for disaster education because disaster can have many problems to be solved.

Table 9: Learning activities from ILMIZI model in disaster mitigation topic

No.	Learning Step	Learning activities	Duration
1	Identify Problem	Students were asked by lecturer to identify problems related to disaster aspects in Indonesia	10 minutes
2	Limitation Problem	Students limit the disaster mitigation problems	10 minutes
3	Make Mind Map	Students create a mind map related to efforts for disaster mitigation in urban areas	20 minutes
4	Interpret Result	Students interpret the results of the created mind map to make it easier to observe the flow and solutions of the disaster mitigation problem solving	15 minutes
5	Analyze Result	Students analyze the results of the created mind map	10 minutes
6	Interaction and Evaluate	Students interact with their friends. The interaction is a question and answer process. An interaction also occurs between students and lecturers regarding the discussed disaster mitigation topic. Next, an evaluation carries out on student skill in understanding the disaster content. The evaluation is conducted by providing an assessment to fellow friends and through test questions provided by the lecturers.	20 minutes

All disaster mitigation plans can be learned with ILMIZI model because all disasters need analysis to create a workable solution to solve problem. ILMIZI model can help teacher or lecturer to implement the HOTS-based learning.

The teaching materials and learning media developed can take the form of or as a supplement in education (Azrai *et al*., 2019; Ichsan *et al*., 2020; Komala *et al*., 2020; Rahmayanti, Ichsan, Oktaviani, Syani, *et al*., 2020; Sulistyawati *et al*., 2019; Suniah *et al*., 2018). This is in accordance with student needs to supplement in the form of additional content in various environment-related topics. The supplement is felicitous for the 21st century environmental learning as students can procure various additional knowledge during the new normal of COVID 19.

During the new normal, all learning activities are online. This requires the use of online-based teaching materials and media. Various teaching materials and learning media can be developed in the form of e-book with content adjusted to the student needs. For example, an e-book that is a supplement requires broader content than those in the textbooks (Lai, 2016; Purwanto *et al*., 2020). A supplement book will facilitate students to be more contextual with the current situation and condition (Kartikaningtyas *et al*., 2018; Paristiowati *et al*., 2019).

Therefore, the learning will be contextual and relevant to the current state. This situation will assist students to empower their skills in HOTS, especially those related to efforts in improving disaster mitigation education with specific topic in environmental pollution. Another topic such as climate change and global warming can be developed as a learning media innovation with the ILMIZI model.

Conclusion

The conclusion drawn by this research paper is that the HOTS score of diploma and undergraduate students is "relatively low". This was due to the lack of teaching materials and learning media employed as a learning supplement on disaster mitigation.

Moreover, e-learning application during the new normal of COVID-19 was still experiencing various obstacles. E-learning, however, has some advantages, such as it can share various files and make learning more independent. ILMIZI model was one of innovation can be implement for disaster education during pandemic.

This model has a syntax that can improve HOTS implementation. Suggestions proposed by this research include the need for teaching material or learning media development that functions as a supplement for disaster mitigation.

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