



Development of E-Quiz Based on Liveworksheets for Biodiversity Topic to Train Higher Order Thinking Skills

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Abstract

The research objective was to develop a liveworksheets-based E-Quiz for biodiversity topic to train higher order thinking skills that are both theoretically and empirically valid, reliable, and practically. This study used a 4D model. Theoretical validation was evaluated used the question instruments, and E-Quiz. The limited trial was carried out by involving 20 10th grade students. The analysis of the empirical validity test used product-moment analysis; reliability test used Cronbach Alpha analysis. The practicality of E-Quiz media was measured used student response questionnaire. Practicality data were analyzed descriptively quantitatively. The result of theoretical validation analysis showed that questions developed were very valid with percentage of 99.84% and liveworkhseets-based E-Quiz was declared very valid with percentage 87.60%. The empirical validity test showed that in 1 questions set there were 9 questions declared valid. The reliability test showed that questions developed was declared reliable with high correlation coefficient of 0.717. The practicality test showed that liveworksheets-based E-Quiz was very practical category with percentage Of 99.17%. Thus, it can be concluded than the E-Quiz based on liveworksheets for biodiversity topic that can be used to train students' higher order thinking skills based on theoretical validity, empirical validity, reliability, and practicality.

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INTRODUCTION

The skills required in carrying out 21st century learning mastery include critical thinking skills, communication, problem solving learning, collaboration and creativity (Nuraini, 2017). All of these skills are included in higher order thinking skills. Higher thinking skills will make students have logical problem-solving skills which are a strategic value in real life (Saputri et al., 2019). Another goal of higher order thinking skills is to gain an in-depth understanding of long-term learning (Fahmi et al., 2019). It is appropriate that higher order thinking skills are trained and possessed by students at every level education.

Biology subject at the high school level material on biodiversity requires higher-level thinking skills. Biodiversity material is a learning material that discusses biodiversity in Indonesia including gene diversity, species diversity, and ecosystem diversity. The level of diversity is the basis of the material for biodiversity which has the nature of the sub-materials of basic skills in analyzing, so it can be said that the category of higher-order thinking skills is in the cognitive domain of C4 in the revised bloom taxonomy. In line with Dazrullisa et al., (2019), Bloom's revised taxonomy has six levels of thinking processes, which shows that analysis (C4) is included in higher-order thinking the same as C5 and C6.

In fact, several studies on efforts to train higher-order thinking have been carried out by teacher and schools (Fahmi et al., 2019). The government seeks to improve higher-order thinking skills with the implementation of the 2013 curriculum since the 2013-2014 teaching at the elementary, junior high, and high school levels (Agnafia, 2019). Improvement to achieve higher thinking skills is needed a high-level assessment instrument (Rahmi, 2021). The teacher seeks to adapt the material to the learning model to achieve the expected indicators (Susantini, 2021). The suitability is also carried out at the learning evaluation stage by developing questions. The preparation of questions used questions that have been standardized by the government or questions made by subject teacher (Septiana, 2016).

Efforts to train higher-order thinking skills have weaknesses such as students being less active, doing assignments in other subjects and creating forums outside of learning (Rubiyanto et al., 2016). Several other studies in training higher-order thinking skills developed learning models of Problem Based Learning (Ilham, 2019), Group Investigation (Rhomadhiyana, 2022), Discovery Learning (Fi'ilyah, 2019), Reading Mindmapping and Sharing (Ulhusna, 2019) and Guided Inquiry (Hudaya, 2020). However, the application of learning models to train higher-order thinking skills needs to be supported by higher-order thinking questions to test learning.

The purpose of evaluation according to Febriana (2021) is a reference for the continuation of the program being implemented. Based on Suryadi (2020) there are three learning evaluation functions: (1) instructional function (2) administrative functions and (3) guidance functions. In line with Rukajat (2018) and Nisa (2019), it is stated that the evaluation function is a tool for measuring students knowledge, reporting student learning outcomes to parents and program planning improvement (remedial teaching). However, in reality, teacher have difficulty developing questions test that match the characteristics of higher order thinking (Suryanda et al., 2020).

The development of evaluation tools in the form of essay type questions to minimize students being able to guess the answers as in multiple choice question type (Yuniar et al., 2015). The developed E-Quiz present higher order thinking skills questions with bloom cognitive levels of C4 (analyzing), C5 (evaluation) and C6 (creation). Questions to practice higher order thinking skills are presented such as analyzing current phenomena through question stimuli. E-Quiz are easy to develop according to learning needs and school conditions (Suyono and Hariyanto, 2015). According to Rasiman and Agnita (2014) E-Quiz makes it easier for students to understand the material because the operation is very easy and the animation has a positive value.

The advantage of E-Quiz is time efficiency at the correction stage. In line with Septianan et al., (2018) and Rhosyida et al., (2021) the advantages of E-Quiz are efficiency from the implementation stage to the self-correction stage. The development of E-Quiz utilizes a website called liveworksheet. Utilization of the use of technology can also be applied to encourage students to think at higher levels such as solving learning problems (Faizah et al., 2021). The application of learning technology rarely used liveworksheets but research results prove that liveworksheets are able to increase student motivation and performance (Tomala, 2021). In line with the study of Mispa et al., (2022) the use of liveworksheets has a good effect on

the expected indicators. According to Novikova (2020) the benefits of liveworksheets are unique features and animations that have a good impact on reader's emotions so that students are able to read actively and educatively.

Several studies have shown that liveworksheets can be applied to Protista material (Mispa et al., 2022), heat transfer material (Laudina, 2021), ecosystem material (Nadifatinisa and Sarim 2021), curved side space construction material (Putri et al., 2021), material form objects (Kholifatus et al., 2021), class 4th thematic subject (Wahyuni et al., 2021), material system linear equation of two variable (SPLDV: Sistem Persamaan Linear Dua Variabel) for 8th grade Junior High School (Yodiatmana, 2021), reasoning learning models (Asfar et al., 2021), science material for 5th grade Elementary School (Widiyanti and Nisa, 2021), fraction material (Putra and Agustina, 2021). 3rd grade thematic material for Elementary School (Rizki et al., 2021), civics materials (Widiyani and Pramudiani, 2021), class 5th thematic material (Andriyai et al., 2020), social arithmetic material (Sholehah et al., 2021), mathematics lessons (Khikmiyah, 2021; Haqiqi and Syarifa, 2021; Farman et al., 2021; and Roskaputri et al., 2021) and hydrostatic pressure material (Sihombing, 2022).

However, based on existing research, there is still no reference to indicate that liveworksheets have been development on biodiversity materials. Therefore, this research needs to be carried out by developing questions to practice higher-order thinking skills in the form of an E-Quiz based on liveworksheets for biodiversity topic. In accordance with the presented background, the research objective is to create an E-Quiz based on liveworksheets for biodiversity topic to train appropriate higher-order thinking skills based on theoretical validity, empirical validity, reliability, and practicality.

RESEARCH METHOD

This research was a 4D model development research, which consisted of 4 stages, namely the Define stage, Design stage, Develop stage, and Disseminate stage. The development of the E-Quiz goes through 4 stage, namely: (1) the define is carried out by analyzing the revised 2014 curriculum including Basic Competence (KD: Kompetensi Dasar) for the questions development of E-Quiz based on liveworksheets; presenting a grid of E-Quiz questions; and formulating a stimulus to train higher order thinking. (2) the design stage is carried out by formulating the material and structure of the E-Quiz questions. (3) the third stage, namely develop consists of developing instrument questions and E-Quiz media. (4) the disseminate stage is carried out by disseminating limited research results through uploaded articles.

The making of the question in the E-Quiz based on liveworksheets that was developed consisted of 50 questions and was organized into 5 questions set. The development of the E-Quiz is carried out based on the input stage from material experts and education experts, then the theoretical validity test, empirical validity, reliability test (Widana and Wayan, 2017) and practicality test are carried out. The development of the E-Quiz based on liveworksheets will be carried out from January to March 2022 at the Departement of Biology, Faculty of Mathematics and Science, State University of Surabaya; while the limited trial was carried out in March 2022 at Tarik Senior High School, Sidoarjo involved 20 students.

The validation of the questions and the E-Quiz based on liveworksheets developed were tested by material experts and education expert. The questions validation is based on the criteria for higher-order thinking questions and the rules for writing question. The question validation instrument was tested used the Guttman scale with a check mark (□) or cross (X); the validation criteria for the E-Quiz media developed include 18 aspects of assessment used a Likert scale with statement in the instrument there is a choice of scores form 1 to 5. The evaluation of the E-Quiz media instrument aims to assess the correctness of the concept, the construction of questions and product validity. The results of the theoretical validation obtained were analyzed used quantitative description methods applying the following formula:

$$\text{Validation} = \frac{f(\text{number of items checked } (\checkmark))}{N(\text{total of all items})} \times 100\%$$

The interpretation of score adapted from Riduwan (2018) is guideline for assess the theoretical validity based on the scores obtained with the categories presented in Table 1.

Table 1. The category interpretation score of the results of the theoretical validation of the E-Quiz based on liveworksheets.

Percentage (%)	Category
0 – 20	Invalid
21 – 40	Not Valid
41 – 60	Quite Valid
61 – 80	Valid
81 – 100	Very Valid

The results of the E-Quiz by students were analyzed to test empirical validity of the questions developed used product-moment analysis with the help of SPSS 23 software. The reliability test was carried out after the question were declared valid. The reliability test was carried out used Cronbach Alpha analysis. The reliability test was calculated and analyzed used the adapted formula (Bland and Altman, 1997). The values obtained based on the calculation are interpreted according to Table 2.

$$R_i = \frac{k}{(k-1)} \left\{ 1 - \frac{\sum S_i^2}{S_i^2} \right\}$$

Information: Ri = Cronbach alpha reliability coefficient
 k = number of question items
 $\sum S_i^2$ = the number of variance scores for each item
 S_i^2 = total variance

Table 2. The category of reliability test correlation coefficient of the E-Quiz based on liveworksheets.

Average Score	Corelation Category
0 – 20	Very High Reliable
21 – 40	High Reliable
41 – 60	Medium Reliable
61 – 80	Low Reliable
81 – 100	Very Low Reliable

Source: Kadir, 2015

Practicality questionnaires were distributed to 20 10th grade students of Tarik Senior High School, Sidoarjo who had carried out a trial used Google Form. The student response questionnaire total 12 questions based on aspect of complete learning, learning activities, and learning media used. The response questionnaire sheet was equipped with an introduction, instruction for filling out, identification, and suggestions. The assessment practicality of E-Quiz based on liveworksheet to train higher-level thinking skills used the Guttman scale with statement on the instrument there is a choice of “YES” or “NO”.

The response questionnaire score obtained is the total practicaliy empirical score divided by each maximum score that is expected to produce practical validation as in the following formula:

$$\text{Implementation} = \frac{\text{Implementation criteria}}{\text{Number of implementation criteria}} \times 100\%$$

After each criterion gets a practicality score, the total percentage of practicality for all criteria is averaged. The average result was a guideline for assess the practical validity of the developed E-Quiz media. The following categories of score interpretation obtained form the results of practicality.

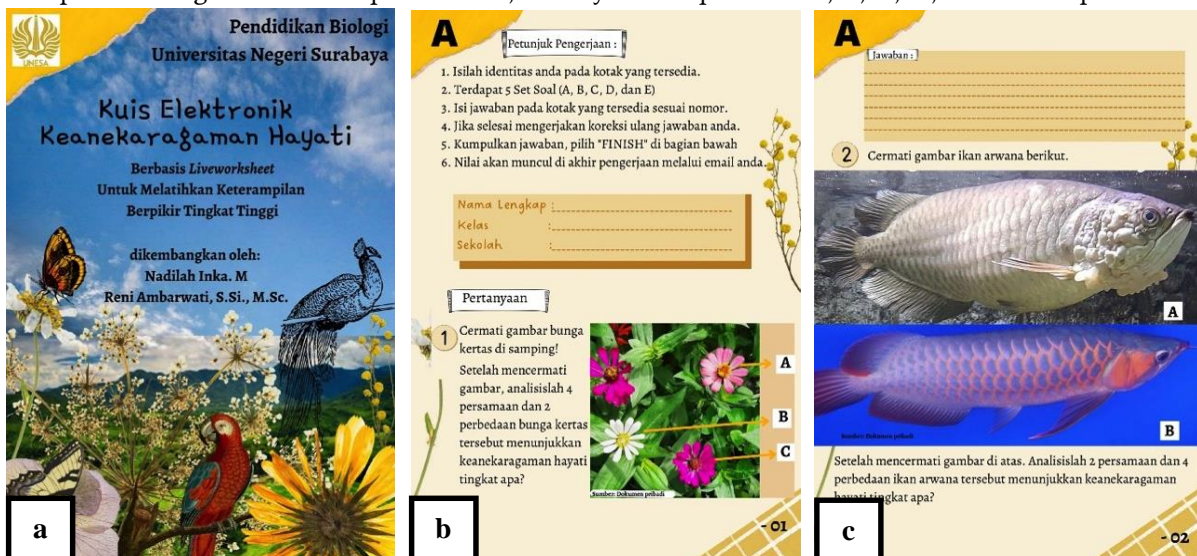
Table 3. The category score interpretation from the practicality of the E-Quiz based on liveworksheets.

Percentage	Category
0 – 20	Very Impractical
21 – 40	Impractical
41 – 60	Practical Enough
61 – 80	Practical
81 – 100	Very Practical

Source: Riduwan, 2018

RESULTS AND DISCUSSION

This research develop learning media in the form of the E-Quiz based on liveworksheets (<https://www.liveworksheets.com>) biodeversity topic to train higher-level thinking skills. The developed E-Quiz consists of 50 questions which include 6 indicators of biodiversity topic. The description of these indicators includes analysis of differences in biodiversity, analysis of different types of ecosystems based on characteristics, analysis of the distribution of biodiversity in Indonesia, analysis of causes of loss of biodiversity, analysis of biodiversity conservation efforts in Indonesia, and proposing ideas for biodiversity conservation efforts based on analysis of threat data loss of biodiversity in Indonesia. The questions developed were organized into 5 questions set, namely sets of questions A, B, C, D, and E. The profile of a



set of E-Quiz questions based on biodiversity topic to practice higher-level thinking skills is shown in Figure 1.

Figure 1 Profile of E-Quiz based on liveworksheets for biodiversity topic to train higher order thinking skills. a) cover; b) instructions for filling out, students identities, examples of displaying question number 1; c) an example of the display of question number 2.

The E-Quiz that has been done by students will be sent via email to the teacher automatically and students can see the score results. In line with the study Rhosyida et al., (2021) stated that the liveworksheet are very easy to operate with automatic assessment or called self-correction.

The theoretical validity test of the questions from the validation results of education experts and material experts obtained a very valid category. The validation results obtained from the average of 6 components of the characteristics of the questions including higher order thinking skills is 99.67%. aspects of assessment based on an average of 6 component of the rules of writing and language obtained a value of 100% with a very valid category. Thus, the assessment of the results of the validity of the two aspects is stated to be very valid at 99.84%. This is because the questions developed in the E-Quiz based on liveworksheets to practice higher-level thinking skills include questions on the cognitive dimensions of higher-order thinking C4, C5, and C6 ; questions can measure students' thinking skills higher order thinking skill ; questions developed according to the formulation of indicators ; school level and grade level ; and the illustration of the question instructions is clear and function Table 4.

Table 4. The results of the theoretical validity test of questions test of the E-Quiz based on liveworksheets.

Percentage	Category
0 – 20	Very Impractical
21 – 40	Impractical
41 – 60	Practical Enough
61 – 80	Practical
81 – 100	Very Practical

The results of the theoretical validity test of the E-Quiz questions that were developed based on the aspects of the assessment of the characteristics of higher order thinking get a very valid category (Table 4). This is because the questions presented in the E-Quiz based on liveworksheets discuss questions about the analysis of the latest biodiversity phenomena through the stimulus provided, thereby encouraging students to think at a higher level. In line with the study of Anggraini and Sriyati (2019), the qualification of higher-order thinking questions is the presentation of the question stimulus in the form of referenced sources such as photos, graphics, videos, tables, and news cases.

Although the theoretical validity of the developed of E-Quiz questions is stated to be very valid, it is necessary to improve the questions according to the device of material expert and education experts, so that the results were actually valid and really deserved limited tested. In line with Gumantan et al., (2020) the suggestions obtaines during the validation process are used as guidelines for product improvement in order to declare product in the true valid category before publication. Input from the validator to improve the questions and media of E-Quiz based on liveworksheets include language writing rules, accuracy of supporting images for the E-Quiz questions, media presentation and accuracy of the questions with answer keys.

The theoretical validity test in the form of the media presentation of the E-Quiz based on liveworksheets was also validated by education experts and material experts. The test was carried out with a validation sheet containing aspects of the valuation of media presentation of the E-Quiz based on liveworksheets that was developed. The E-Quiz based on liveworksheets validity test was conducted to assess the feasibility of presenting the E-Quiz media validation test is described in Table 5.

Table 5. The results of the theoretical validity media test of questions test of the E-Quiz based on liveworksheets.

No.	Category	Score		Average
		V1	V2	
1.	The E-Quiz has cover	5	4	4.5
2.	The E-Quiz is equipped with student identity	5	5	5
3.	The E-Quiz includes list of questions set, titles, instructions, page numbers, questions and answer columns in order	5	4	4.5
4.	E-Quiz has clear instructions for working	5	5	5
5.	The E-Quiz has feedback (score results) after working on it	4	-	2
6.	Original E-Quiz design display	4	5	4.5
7.	Attractive E-Quiz design display	4	5	4.5
8.	Ease of use of the E-Quiz based on liveworksheets	4	4	4
9.	E-Quiz can motivate users	4	5	4.5
10.	E-Quiz is easily accessible by handphone or PC	4	5	4.5
11.	The picture quality in the E-Quiz is clear and supports the questions	4	5	4.5
12.	The video quality in the E-Quiz is clear and supports the questions	4	4	4
13.	The suitability of font type and size of the letters	4	5	4.5
14.	The letters on the E-Quiz are legible	4	5	4.5
15.	Letters don't break when zoomed in	5	5	5
16.	Easy-to-understand question language	5	4	4.5
17.	The accuracy of the terms used	4	5	4.5
18.	Alignment of letters in question items	4	5	4.5
Overall rating aspect average			4.38	
Aspect score interpretation			87.60 %	
Category			Very Valid	

Description: V1: material expert, V2: education expert

The results of the theoretical validation test of media the E-Quiz based on liveworksheets that were developed were obtained from education experts and material experts of 87.60% including the very valid category (Table 5). This proves that the results of the media validation test in the form of an E-Quiz based on liveworksheets to train higher-order thinking skills are appropriate for use in the learning process. In the aspect of assessment number (Table 5) the education expert did not give a score, because in the validation process it was not clear how the final results of the trial participants got feedback after working on the developed E-Quiz. The display of the media E-Quiz based on liveworksheets has a aspect that is able to motivate users to get an average score of 4.5 from 2 experts (Table 5). This can be proven by the E-Quiz profile which was developed utilizing the latest technology and in it contains questions bu displaying photos, videos, graphs and maps Figure 2.



Figure 2 Profile of E-Quiz based on liveworksheets for biodiversity topic which display the stimulus question to train higher order thinking: a) sample question display with image and video stimulus and b) example of question display with graphic stimulus.

A limited trial recapitulation was obtained to analyze the empirical validity, reliability and practicality tests of the developed of E-Quiz media. The purpose of the analysis of the empirical validity of the E-Quiz questions is to find out whether it is valid or invalid after being tested on a limited trial (Rini and Budijastuti, 2022).

To test the empirical validity questions test of the E-Quiz based on liveworksheets to practice higher-order thinking skills contained 10 questions from 1 set of E-Quiz questions that were tested on students (Table 6). The study of the questions validity test of the E-Quiz developed is an essay questions, so can use the product-moment correlation (Mahendra, 2019). The questions validity test is categorized as valid if the r table is smaller than to the calculated r value (Oktanin and Suktino, 2015). The results of the calculation of the empirical validity test of the questions used SPSS 23 software, namely from 10 questions, 9 questions were declared valid and only 1 question was invalid.

Table 6. The empirical validity questions test of the E-Quiz based on liveworksheets.

Number of Questions	Category	r Table	Information
1	0.486		Valid
2	0.521		Valid
3	0.658		Valid
4	0.625		Valid
5	0.594		Valid
6	0.622	N = 20 = 0.444	Valid
7	0.486		Valid
8	0.266		Invalid
9	0.508		Valid
10	0.615		Valid

The question number 8 obtained r count of $0.266 \leq r$ table 0.444 so that it is classified as an invalid question (Table 6). This is because the question that have indicators of the causes of biodiversity loss in Indonesia have many variations of student answers that are not quite right. In line with the study Agustiana et al., (2018) the factors that influence that validity results are variations in respondents' answers that are not quite right. Therefore, questions that are declared invalid can be corected before being retested (Amalia and Widayati, 2012).

The selection of the type of essay questions directs studemys to express their opinions. In line with Rahmawati and Trimulyono (2022), the essay questions aim to develop students' reasoning to a higher level of thinking in expressing opinions. The questions are limited to only essay questions, there are no multiple choice questions, because multiple-choice questions have the opportunity to guess the answers more easily. This is evidenced by Yuniar et al., (2015) that the characteristics of multiple choice questions are easy to do, objective, high validity, students can speculate guess answers and cannot know students in the problem solving process.

After getting results of the empirical validity test, then the questions can be tested for reliability used Cronbach Alpha analysis with a one-time test. The purpose of the reliability test was to measure the questions which, when tested on the same material repeatedly, still showed consistent results (Rahayu and Djazari, 2016).

The results of the questions reliability test of E-Quiz based on liveworksheets to practice high-order thinking skills were declared reliable with a high correlation coefficient category of 0.717 (Table 7). The reliability test was obtained from 9 valid questions from 10 questions in a set of questions developed. This is because only questions that are declared valid are good instruments to indicate reliable questions. An instrument is said to be good determined based on validity and reliability (Yusup, 2018). Thus, the E-Quiz questios based on liveworksheets are declared reliable and the questions can be accounted for to train students' higher-order thinking.

Table 7. The practicaly test of questions test of the E-Quiz based on liveworksheets.

Number of Questions	Category	Information
9	0.717	Reliable

The practicality test of the liveworksheets-based E-Quiz to train higher-order thinking showed that students gave a positive response of 99.17%, thus the E-Quiz based on liveworksheets was very practical category (Table 8). However, in the aspect of assessment points 9 and 11 (Table 8) get 1 student who responded "NO". this is because students are accustomed to filling out evaluations of learning in schools in conventional ways and learning evaluation tools to practice higher-order thinking skills that are not supported by the use of existing technology. In line with (Dewi, 2018) learning in the classroom still used the traditional method in the form of a paper test.

Table 6. The empirical validity questions test of the E-Quiz based on liveworksheets

No.	Assessment Aspect	Responsive Response Percentage (%)	Category
A. Completeness of Learning Evaluation			
1	Students complete the E-Quiz with good grades	100	Very Practice
2	Students understand E-Quiz questions well	100	Very Practice
3	Students master the material from the E-Quiz questions given	100	Very Practice
4	E-Quiz based on liveworksheets are able to lead student to achieve learning goals	100	Very Practice
B. Learning Evaluation Activities			
5	E-Quiz based on liveworksheets provides an attractive learning experience	100	Very Practice
6	E-Quiz based on liveworksheets attracts students' attention	100	Very Practice
7	Positive student response to E-Quiz based on liveworksheets	100	Very Practice
8	Enthusiasm of students taking E-Quiz	100	Very Practice
C. Learning Evaluation Media Used			
9	E-Quiz based on liveworksheets is able to practice higher order thinking skills	96	Very Practice
10	E-Quiz media is appropriate and practical for learning evaluation	100	Very Practice
11.	E-Quiz based on liveworksheets does not burden students	100	Very Practice
12.	Liveworksheets-based media was first used by students	100	Very Practice
Average		99.17	Very Practice

The use of evaluation tools bu utilizing the latest technology, such as the E-Quiz based on liveworksheets needs to be familiarized with the learning process. In Tomala's research (2021) it is stated that in the application of technology in the world of learning it is still rare to use liveworksheets, but the results of the study prove that learning activities through liveworksheets can increase student motivation and performance. In general, students are very enthusiastic iin carrying out learning used E-Quiz based on liveworksheets. One respondent stated:

“E-Quiz based on liveworksheets was first used in learning”.

In addition, other respondents expressed their opinions about the learning experience used E-Quiz based on liveworksheets should often be done in the learning process such as the following respondents' opinions:

“It's better to do activities like this more often”.

The impressions from the respondents indicated that E-Quiz based-liveworksheets was good. So it can be stated that use of liveworksheets plays an important role in the current online learning period.

The good impact of using technology in education can be felt during the Covid-19 pandemic. One of them is the use of technology at the learning evaluation stage used E-Quiz based on liveworksheets which was developed according to this pandemic period. This is proven by Ramadani (2020) the use of liveworksheets can be used in the online learning process and is able to improve students' language skills. in line with the study of Hidalgo-Camacho et al., (2021) online learning used liveworksheets when learning has a positive effect on students' practice and pedagogy.

CONCLUSION

Based on the results of the limited trial implementation and the discussion carried out, it can be concluded that the E-Quiz based on liveworksheets for biodiversity topic to train higher-order thinking skills has succeeded in training students' higher-order thinking skills. This is supported by the E-Quiz based on liveworksheets obtained the results of the theoretical validation test of the questions developed which are declared to be very valid obtained 99.84% and the E-Quiz based on liveworksheets are stated to be very valid with a percentage value of 87.60%. Empirical validation of the developed questions shows that in 1 set of questions there are 9 valid questions, which are declared valid. The questions reliability test developed was declared reliable with a high correlation coefficient of 0.717. The results of the practicality test of the liveworksheets-based E-Quiz obtained a very practical category with a percentage value of 99.17%.

Suggestions can be made in further research by referring to the development of an E-Quiz based on liveworksheets used skills and other materials so that students are familiar with the application of evaluation tools that utilized the latest technology with the learning materials carried out

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