

## THE DEVELOPMENT OF HOTS ASSESSMENT INSTRUMENT USING QUIZZZ DURING COVID 19 PANDEMIC IN 11<sup>TH</sup> GRADE BIOLOGY SECOND SEMESTER

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### Abstract

High Order Thinking Skills (HOTS) require students to have the ability to argue, make decision and solve problem that exist in everyday life. The purpose of this research was describe validity, reliability, and response of students about practicality of Quizizz learning tool as HOTS assessment tool for 11<sup>th</sup> grade Biology second semester to measure high order thinking skills SMAN 1 Tarik students. This type of development research used the Analysis, Design, Development and Evaluation (ADDIE) model. Data collection methods included validated interviewed, gave tests and student response questionnaires. The validity of assessment was obtained from results of expert validation. Reliability was obtained from results of test items. Student responses of instrument were obtained from the results of the student response sheets. The trial was limited to 30 students of MIPA 6 12<sup>th</sup> grade in SMAN 1 Tarik. The results showed that the validation of the assessment instruments for multiple choice and essay question type that developed in this study were in highly valid category, the reliability of instrument was 0.62 for the multiple choice question type and 0.83 for essay item type. Quizizz as a tool of HOTS assessment instrument was practice. The results of student responses got 94% of percentage average. The conclusion of this research was assessment instrument of HOTS questions used Quizizz that developed was valid, reliable, and practice for students. This research could be applied in other schools to measure high order thinking skills of students.

**Keywords:** Assessment instrument, high order thinking skills (HOTS), *Quizizz*

### INTRODUCTION

Regulation of the Minister of Education and Culture Number 36 of 2018 about basic framework and structure of Senior High School curriculum contained in 2013 curriculum that the purpose of Biology learning is to prepare students become human resources who have life skills as individual that productive, critical, creative, innovative, effective and able to contribute to the life of society, nation and state (Depdiknas, 2020). Life skills is a person's ability to overcome challenges and demands for solving problems in everyday life. This problem certainly requires high order thinking skills to solve it (Mahanal, 2019).

Thinking ability as expected in education of Indonesia based on the objectives of the 2013 curriculum can be developed depends on high order thinking skills or (HOTS). HOTS is a high level thinking skill which require students to have the ability to argue, make decision, consider, and solve problem that exist in everyday life as well (Purwanto, 2019). HOTS is an ability to think that

occupies the highest cognitive level to Bloom's Taxonomy including C4 (analyze), C5 (evaluate) and C6 (create), which is there are two dimensions, namely knowledge and cognitive processes. This two dimensional linkage is needed by students to connect simple things to complex things (Anderson & Krathwol, 2015).

High order thinking skills of students can be trained by teachers by frequently answer on HOTS questions in daily, mid-semester and end-semester assessments (Lailly & Wisudawati, 2015). Students who answer HOTS question frequently, it can improve the ability to do HOTS questions, so that it is easier for students to do it with correct answers (Pangesti, 2016).

Giving HOTS questions as a good assessment instrument are able to measure valid learning outcomes, high reliability, relevant to the objectives to be achieved, does not contain multiple interpretation, specific, representative, and balanced (Istika, et al., 2019). HOTS questions must be given continuously during the final semester exams, even during national and international

standard exams to obtain maximum results (Putri, et al., 2018).

The benchmarks for the success of students during answer HOTS test questions can be seen, from the value of the National Examination (UN). Data from the Center for Education Assessment of the Ministry of Education and Culture in 2019 shows that 75% of the items contained in the 11<sup>th</sup> grade material for the second semester of Biology have not reach the standard value of 55.0 which is the minimum value of the UN results. The average score of achievement during the National Examination in 11<sup>th</sup> grade of subject matter for second semester is 50.1, so that the score is low categorize or less than the standard. Low grade achievement of students because students rarely trained to answer HOTS questions. Meanwhile, 80% of the material questions on the basic competency (KD) 3.8 - 3.14 material for 11<sup>th</sup> grade second semester at the UN lead to HOTS questions (Kemendikbud, 2020).

The results of the PISA (Program for International Student Assessment) questions also can be used as a benchmark for students in Indonesia to determine whether the students are able to answer international standard HOTS questions. PISA is an international level study that held by the Organization for Economic Cooperation and Development (OECD) which examines high level thinking skills of students in various countries in the world, including Indonesia. Indonesian students in 2018 were ranked 9<sup>th</sup> of the bottom, specifically 71<sup>st</sup> of the science performance category questions. Thus, it can be concluded that students in Indonesia have less skill when answer HOTS questions (Kemendikbud, 2019).

The low results of student National Examination and PISA assessments in Indonesia can be used as material for evaluating how to improve the quality of education. Efforts that can be made by training students to answer HOTS questions. In general, the questions that given are written test using paper and pencil instrument, which requires a lot of money, time, and correction errors so that judged less effective and efficient. For this reason, it is necessary to use technology to facilitate the assessment test use IT technology (Information Technologies).

Technology utilization for answer question assessment can utilize ICT (Information and Communication Technologies) media. One example of an ICT that provides online end of semester assessments is Quizizz (Yana, et al., 2019). Quizizz is an ICT application that students can answer HOTS questions use a smartphone, laptop, or computer. Quizizz is accessible for teachers and students by online and free for access. Utilize of ICT media have several advantages, include a correction feature, automatic duration, can insert interactive images

and paperless. Quizizz also can be used for daring assessment as an alternative to assessing students' abilities during the Covid 19 pandemic (Pratiwi, 2016).

Research of Putri (2017) on the development of HOTS question instruments was limited to the sensory system material for 11<sup>th</sup> grade Biology by describing the empirical validity of HOTS item based on CBT (Computer Based Test). The result was that the items tested in the study were well received by students and teachers at SMAN 12 Padang. The utilize of CBT was considered more effective because it had system for randomized question items and answer choices automatically, as well as direct feedback from the system. Further research was carried out by Noor (2020) regarding the development of an assessment instrument that was limited of 10<sup>th</sup> grade Biology. The research used the Quizizz application able to improve test assessment results because the display was very attractive and this application program was fun and could be answered at daring assessment.

The research conducted by researchers was supported by the results of teacher interviews at SMAN 1 Tarik, indicated that SMAN 1 Tarik teachers rarely gave HOTS questions during final semester assessments. The majority of the questions developed had a cognitive level of C3 (apply), whereas the basic competency that appear were C4 (analyze) and C5 (evaluate) with the dimensions of metacognitive knowledge. Biology teacher at SMAN 1 Tarik had not yet developed a final semester assessment test using Quizizz during online learning. Therefore, it is necessary to do this research with the title "Development of HOTS Question Assessment Instruments during Covid-19 Pandemic in 11<sup>th</sup> Grade Biology Second Semester Material Use Quizizz ". The purpose of this study was to describe the validity, reliability, and response of students about HOTS assessment questions for the 11<sup>th</sup> grade Biology second semester using Quizizz to measure high order thinking skills of student in SMAN 1 Tarik. This research is development research of assessment instrument for HOTS questions during the Covid-19 pandemic used Quizizz was novelty.

## METHOD

This research type was development research used Analysis, Design, Development, and Evaluation (ADDIE) research model (Kurniawan & Taqwa, 2018). The research was done in August 2020 - April 2021. The object of this research was HOTS question assessment instrument which includes test item, 10 multiple choice and 5 essay item of questions, assessment rubric, scoring guidelines, and answer keys that have been declared valid

by the validator. The development of test items contain of question which measure students' ability to analyze and evaluate a problem that presented from figures, graphs, and concepts. The questions also involved students' knowledge of procedural and metacognitive thinking. The questions were packaged using Quizizz which was tested on 30 students of 12<sup>th</sup> grade of MIPA 6 at SMAN 1 Tarik.

Making of HOTS test items was done by analyzing basic competencies based on dimensions of knowledge and cognitive levels from revised edition of Taxonomy Blooms, describing basic competencies into several question indicators, and compiling items containing stimuli in the form of data, concepts, info graphics, and case examples (Julianingsih, et al., 2017). Data collection methods used interview, validation, gave HOTS test questions and gave student response questionnaires. Data validation results was analyzed used calculations that refer from rating scale then interpreted used a rating scale (Mardapi, 2017) which is presented in Table 1.

Table 1. Interpretation Criteria of Validity analysis

Score	Interpretation criteria
1,00 – 1,75	Less valid
1,76 – 2,50	Quite valid
2,51 – 3,25	Valid
3,26 – 4,00	Highly valid

(Mardapi, 2017)

Validity analysis of multiple choice and essay test items were analyzed used Microsoft Excel program on biserial point correlation formula (CORREL function). Items was declared valid if *r* (biserial correlation coefficient) value was greater than *r* table. *R* value of the product moment table was determined based on the number of subjects and 5% significance level (Murdiyah et al., 2016).

The reliability of multiple choice questions was analyzed used Kuder Richardson 20 calculation (Yusup, 2018).

$$r_i = \frac{k}{k-1} \left( \frac{s_t^2 - \sum p_i q_i}{s_t^2} \right)$$

$r_i$  = Kuder Richardson 20 reliability coefficient

$k$  = total of items in instrument

$p_i$  = proportion's total of subjects who answered in *i* item

$q_i$  = 1-  $p_i$

$s_t^2$  = total variance

(Sugiyono, 2015)

Reliability of essay questions was analyzed used Alpha Cronbach's calculation

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

$r_i$  = Cronbach's alpha reliability coefficient

$k$  = total of question items

$s_t^2$  = total variance

$\sum s_t^2$  = total variance of each item

(Yusup, 2018)

Calculation results of reliability was interpreted based on criteria that presented in Table 2.

Table 2. Criteria of test reliability

Interval	Criteria
0.8 – 1.0	Very high reliability
0.6 – 0.7	High reliability
0.4 – 0.5	Medium reliability
0.2 – 0.3	Low reliability
0.0 – 0.2	Very low reliability

(Arikunto, 2018)

In addition calculated validity and reliability of questions, student response questionnaires was also needed to assess student's responses about practicality of Quizizz learning tool as HOTS assessment tool for 11<sup>th</sup> grade Biology second semester. The results of the student responses questionnaire were analyzed used the Guttman scale. Score from data results calculated based on this formula.

$$\text{appropriateness percentage}(\%) = \frac{\text{total score}}{\text{maximal total score}} \times 100\%$$

(Riduwan, 2016)

Calculation result of Percentage of appropriateness based on student responses was interpreted based on categories that presented in Table 3.

Table 3. Interpretation Criteria of Student's Responses

Percentage	Criteria
81% - 100%	Excellent
61% - 80%	Good
41% - 60%	Satisfactory
21% - 40%	Less than satisfactory
0% - 20%	Bad

(Riduwan, 2016)

## RESULT AND DISCUSSION

This research succeeded developed assessment instrument of HOTS questions used Quizizz to measure high order thinking skills of students of 11<sup>th</sup> grade Biology second semester. Questions that developed include 14 question indicators that had a cognitive level of analyze (C4) and evaluate (C5) and had dimensions of procedural and metacognitive knowledge. The subject matter that used was subject matter for second semester of 11<sup>th</sup> grade which include subject material of respiration, coordination, reproduction and immunity system. These four subject matters required high order thinking skills and closely related to problems in everyday life. The specifications of HOTS items subject matter in respiration, excretion, coordination, reproduction, and



immunity system or 11<sup>th</sup> grade of Biology second semester can be seen in Table 4.

Table 4. Spesification of HOTS Question Items

Basic Competency	Item's Indicator	Cognitive Level	Knowledge dimensions	Item's type	Item's number
<b>3.8</b>	Analyze relationship between tissue structures that construct organs in the respiration system in relation with bioprocesses and functional disorders that can occur in the human respiration system	C4	Metacognitive	Multiple choice	3
				Essay	5
	Presented a respiration system concept and data of O <sub>2</sub> and CO <sub>2</sub> pressure, students are able to relate the structure of the functions of respiration system organ to its bioprocess appropriately.	C4	Procedural	Multiple choice	8
<b>3.9</b>	Analyze relationship between tissue structures that construct organs in the excretory system in relation with bioprocesses and functional disorders that can occur in the human excretory system	C4	Metacognitive	Multiple choice	1
	Presented a picture of normal urine color and urine color after consume dragon fruit, students are able to make decision is there organ disorder in relation with functional structure of kidney appropriately.	C5	Metacognitive	Multiple choice	9
<b>3.10</b>	Analyze relationship between tissue structures that construct organs in the coordination system (nerves, hormones and sensory organs) in relation with coordination and regulatory mechanisms and also functional disorders that can occur in the human coordination system.	C5	Metacognitive	Multiple choice	4
	Presented a picture of epinephrine hormone mechanism, students are able to relate structure and function of neural networkss and hormones of human coordination system mechanism appropriately..	C4	Metacognitive	Multiple choice	10
<b>3.11</b>	Evaluate the dangers of using psychotropic compounds and their impact on personal health, the environment and society	C5	Metacognitive	Multiple choice	5
	Presented a graph of alcohol consumption in Indonesia and example alcohol abuse case, students are able to analyze the impact of alcohol use in personal health appropriately	C4	Metacognitive	Essay	4
<b>3.12</b>	Analyze relationship between tissue structures of the	C4	Metacognitive	Multiple choice	6

	reproductive organs and their functions in human reproductive system	students are able to relate the structure in female reproductive organs to their function in human reproductive system appropriately.				
		Presented a picture of ectopic pregnancy, students are able to relate the structure of the composition of the female reproductive organs to their function in the human reproductive system appropriately.	C4	Metacognitive	Essay	3
3.13	Analyze application of reproductive principles in humans and exclusive breastfeeding in family planning programs as an effort to improve the quality of Human Resources.	Presented a graphic about infant mortality based on maternal age while give birth, students are able to relate application of reproductive principles with family planning programs to improve the quality of public health appropriately.	C4	Metacognitive	Multiple choice	2
		Presented a diagram of giving breastfeeding in Indonesia, students are able to relate the importance of breastfeeding to improving the quality of human health appropriately.	C4	Metacognitive	Essay	2
3.14	Analyze role of immune system and immunization to physiological processes in the body	Presented a picture of vaccine mechanism, students are able to relate of giving vaccine to the immune system response in physiological processes of human body appropriately.	C4	Metacognitive	Multiple choice	7
		Presented concept of non-specific immune system, students are able to relate the role of immune system in human physiological processes appropriately.	C4	Procedural	Essay	1

Question items that developed include 3.8 - 3.14 KD on the subject matter of respiration, excretion, coordination, reproductive system and the immune system. The question items that developed was analyzed based on the equality of cognitive process knowledge dimensions in 3.8 - 3.14 KD. The aims were assessment instrument can accurately measure students' abilities in subject matters that studied in school. Biology subject matters for 11<sup>th</sup> grade second semester have a basic competency which is students need high order thinking skills because cognitive processes that reached was analyze and evaluate in procedural and metacognitive knowledge dimensions.

Cognitive process and knowledge dimensions that contained in development of HOTS questions required students to analyze, consider, integrate and relate the material that obtained during previous lessons in school to real life. HOTS question assessment instrument that has been made by the researcher, accordance to high order thinking competencies that could familiarize students to ingenious answer on questions that require high level

thinking so that students can answer questions appropriately. These skills very necessary to face problems in everyday life. This is supported by Annuru (2017) that high order thinking skills guided students to construct ideas with systematic method and related those information to real life.

Integrating subject matter to problems in everyday life also required a process of analyzed and assessed a problem that occurs by involving procedural and metacognitive abilities. These was accordance to Bloom's Taxonomy thinking skills classification which classified high order thinking skills including analyze, evaluate and create and classified knowledge dimension into four groups, namely factual, conceptual, procedural and metacognitive knowledge (Anderson & Krathwol, 2015).

The validity of the HOTS question assessment instrument that developed by researcher was obtained from validation results of two biology education experts and a 11<sup>th</sup> grade biology teacher in SMAN 1 Tarik and also has been refined by a Biology lecturer at FMIPA Unesa. The validation results was presented in Figure 1.

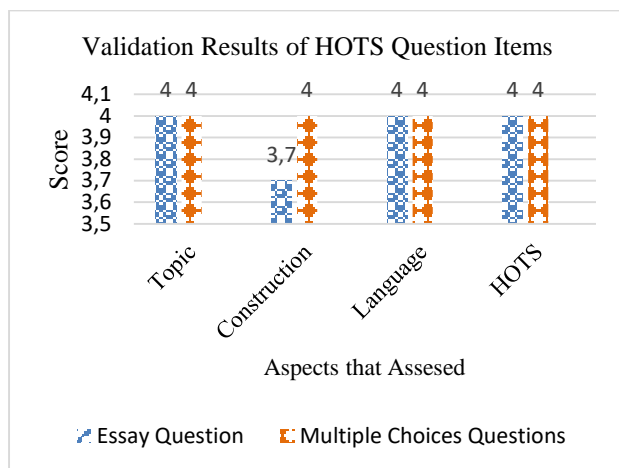


Figure 1. Validation Repots of HOTS Question Items

The topic aspect that assessed by validators include 4 criteria, namely, (1) test items was appropriate to indicators, (2) test items was appropriate to basic competencies, (3) test items was appropriate to 11<sup>th</sup> grade second semester of Biology, and (4) answer key was appropriate. Multiple choice and essay questions was obtained 4 of total score, which mean that items were highly valid in topic aspect.

The construction aspect that assessed by validators include 5 criteria, namely, (1) test items was clearly, (2) test items did not appoint to answer key, (3) answer choices did not use statement "all answers was right or wrong", (4) Instruction of test questions was clearly, and (5) test items did not depend on answers from previous questions. Multiple choice questions was obtained 3.7 of total score and essay questions was obtained 4 of total score, which means that multiple choice and essay items were highly valid in construction aspect.

The language aspect that assessed by validators includes 3 criteria, namely, (1) used of appropriate to PUEBI, (2) sentences did not cause multiple meanings, and (3) used of language easy to understand. Multiple choice and essay questions obtained 4 of total score, which mean that items were highly valid in language aspect.

The HOTS aspect assessed by the validator includes 4 criteria, namely (1) items in accordance with the indicators of high-order thinking skills, (2) items according to HOTS cognitive level, (3) items according to HOTS knowledge dimensions, and (4) there are stimulus that can encourage students to think. Multiple choice questions and descriptions obtain a total score 4, which means that items were highly valid on the HOTS aspect, so they can be used to measure students' high order thinking skills.

Topic, construction, language, and HOTS aspects in test items of assessment instrument used Quizizz that

developed, was validated by validators. Validation results showed that assessment instrument was highly valid, which mean that the assessment instrument was very suitable to be used to measure students' higher order thinking skills because it was appropriate to 3.8 - 3.14 basic competency which refer to HOTS questions that used construction items rules and communicative language in subject matter of respiration system, excretory system, coordination system, reproductive system, and immune system for 11<sup>th</sup> grade Biology second semester at SMAN 1 Tarik.

This was similar with Budiastuti & Bandur (2018) that valid items were items that could be precise to measure students' higher order thinking skills, this was mean that questions developed could be trusted as a correct measuring tool. Supported by Arikunto (2018) that the assessment instrument was good as a measuring tool if instrument was valid, this was mean that items in assessment instrument were able to measure high order thinking skills.

Validity analysis of multiple choice and essay test items were after trial were analyzed used Microsoft Excel program on biserial point correlation formula.. Data of validity analysis presented in Table. 5

Table 5. Data of Validity Analysis Used Biserial Point Correlation

Multiple choice item			
Test item	R <sub>xy</sub>	R table	Interpretation
1	0.456	0.361	Valid
2	0.457	0.361	Valid
3	0.393	0.361	Valid
4	0.619	0.361	Valid
5	0.573	0.361	Valid
6	0.464	0.361	Valid
7	0.398	0.361	Valid
8	0.392	0.361	Valid
9	0.427	0.361	Valid
10	0.485	0.361	Valid
Essay item			
Test item	R <sub>xy</sub>	R table	interpretation
1	0.768	0.361	Valid
2	0.686	0.361	Valid
3	0.819	0.361	Valid
4	0.834	0.361	Valid
5	0.722	0.361	Valid

Based on Table 5. Data of validity analysis indicated that all multiple choice and essay test items were valid because R<sub>xy</sub> are greater that Rtable, so that all items were descent and may be analyzed to reliability.

Reliability was obtained based on student test results. Reliability value of multiple choice questions was 0.62 in high reliability criteria, while the essay questions was 0.83 in very high category. This showed that multiple choice

and essay questions were reliable. Reliable meant that HOTS question assessment instrument that developed by researcher had same measurement results even though it was answered at different times, so that the assessment instrument could be relied as a tool to measure students' high order thinking skills repeatedly at SMAN 1 Tarik, or in another SHS. As expressed by Basuki & Hariyanto (2016) that HOTS questions could be used as a consistent measuring tool to measure students' high order thinking skills. Arikunto (2018) expressed that reliability was an important aspect to show results consistency of assessment instruments that developed. Assessment instrument that declared reliable was instrument that produced the same value when tested to students at different times.

Determination of instrument reliability was obtained if items that have been tested was declared valid, appropriate to basic competency bill in subject matter of respiration system, excretion system, coordination system, reproductive system, and immune system in 11<sup>th</sup> grade Biology second semester. This matter because concept of reliability was closely related to validity. This statement was appropriate with Azwar (2016) that reliable item were valid item, so that item will function as an accurate and constant measuring tool.

Student responses were used to determine practical of Quizizz learning tool as HOTS assessment tool for 11<sup>th</sup> grade second semester. Student responses presented in Figure 2.

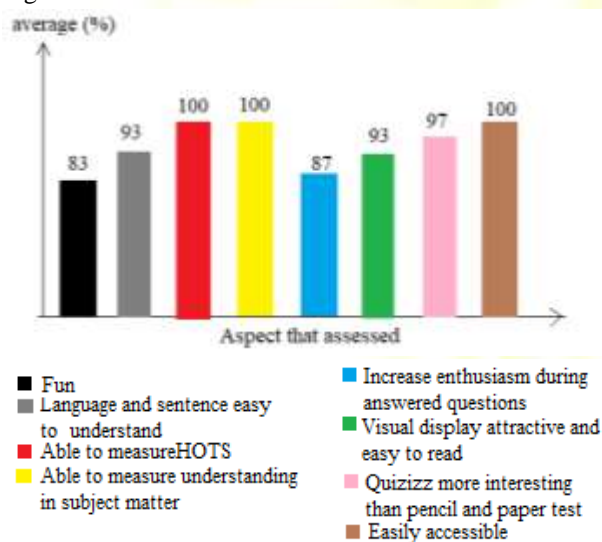


Figure 2. Student's responses Result of Quizizz as Assessment Tool of HOTS Questions in 11<sup>th</sup> grade second semester subject matters.

Figure 2. Shows that each aspect has received a positive response from students. The average result of total aspects that assessed by students to Quizizz as an

assessment tool was 94%, in excellent category. This matter indicated that Quizizz as a tool of HOTS assessment was practice. 87% of students agreed that answered HOTS questions used Quizizz. They declared their reasons that they were enthusiastic because the assessment activities used Quizizz was fun, language and sentences easy to understand, attractive visual displays and more interesting than pencil and paper tests. Quizizz was very suitable to be used as an assessment tool because of its visual display such as interesting images and colors, writing easy to read, interesting audio features such as sound effects such as games, questions and answer options could be read automatically, could see ranking of learning outcomes directly and the ease of access so that students feel happy and enthusiastic when answered questions. Students that answered questions used Quizizz could see ranking of learning outcomes directly on the leaderboard so that they can make students more excited and challenged to be better when answered questions (Ju & Zalika, 2018).

100% of students agreed that the items can measure HOTS and understanding of 11<sup>th</sup> grade Biology second semester subject matter and their reasons that subject matter which is tested accordance with topic that have learned in school. Students declared the reasons that when answered questions required complex ways of thinking such as analyzing and connecting information or theories that have learned with real problems in daily life. This supports that the questions developed were suitable for measuring HOTS, but only 17% of students were able exceed minimum completeness criteria (KKM), namely got score  $\geq 78$  in multiple choice items and 10% of students exceed  $\geq$  KKM in essay items.

Utilized of Quizizz as an assessment tool could increase enthusiasm when students answered questions, but it does not affect the results of students' scores. The results of many student scores did not exceed KKM because there were several factors such as planning and implementation of learning less than satisfactory, mismatched implementation of learning goals, methods and media used during learning (Sudaryono, 2018). This was also supported by the result of interviews with 11<sup>th</sup> grade teacher that learning evaluations during daily assessments, midterm assessments, and final assessments were rarely given HOTS questions.

## CONCLUSION AND SUGGESTION

### Conclusion

Based on research results that have been described, it concluded that HOTS question assessment instrument used Quizizz to measure high order thinking skills was valid,



reliable, and practice based on the results of student responses used Quizizz.

### Suggestion

For 11<sup>th</sup> grade Biology teachers, it is better if the development of HOTS questions using Quizizz is carried out as daily practice questions with a greater number of learning by referring to Bloom's Taxonomy of high level thinking so that students are more critical to facing problem in everyday life. For the next researcher, it is better if analysis of items on assessment instrument is not only to describe the validity and reliability of the assessment instrument, but also to describe the difference, the effectiveness of the distractor, and the level of difficulty as well.

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