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Quality of Electronic Student Worksheets on The Concept Ferns (Pteridophyte) to Improve High School Level Critical Thinking Skills

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Abstract: 21st century learning is an era in which science and technology are developing very rapidly and demand quality human resources and can compete globally. One of the skills that meet the demands of this century is critical thinking skills which are developed through the provision of Student Worksheets. This study aims to describe the validity, practicality, and effectiveness of the e-student worksheet on the concept of Ferns (Pteridophyte) based on Critical Thinking Skills. The subjects of the validity test were three experts, the individual test was three students of class X high school level and the small group test was four students of class X high school level. This type of research is development research to produce valid, practical, and effective products. The results showed that: 1) the validity of the e-student worksheet has a valid category, 2) the practicality of thee-student worksheet has a good category, and 3) the effectiveness of e-student worksheet expectations based on the assessment of students critical thinking skills in doing tasks on thee-student worksheet has a very good category (covering interpretation, analysis, evaluation, inference, and explanation) and good category on self-regulation aspect.

Keywords: 21st Century Development, Critical Thinking Skills, E-Student Worksheet, Ferns (Pteridophyte), Development Research

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INTRODUCTION

21st century learning has a learning paradigm that emphasizes critical thinking skills, able to connect science with the real world, mastering information technology, communicate and collaborate (Kivunja, 2014). In addition, in the 2013 revision of the 2017 curriculum, four must appear, namely character strengthening education, school literacy, 21st century skills or 4C (Critical thinking, Collaboration, Communication, Creativity), and Higher Order Thinking Skills (HOTS) (Afriyanti et al., 2018).

The development of ICT by developing e-student worksheet can be an alternative for students during the Covid-19 pandemic. Face-to-face learning has not been carried out optimally (Adedoyin & Soykan, 2020; Aidoo et al., 2022). This makes the current development of ICT able to change the way of delivering knowledge and can be an alternative for distance learning implementation. So, the use of mobile has a major contribution in educational institutions, including the achievement of distance learning goals (Sadikin & Hamidah, 2020).

In general, the definition of Critical Thinking Skills (CTS) is part of cognitive skills which include interpretation, analysis, evaluation, inference, explanation, and self-regulation (Ismail et al., 2019). Each of these CTS has its own sub-skills and descriptions that are more complete and detailed, making them easier to understand (Facione, 1990). In addition, critical thinking is also an important thing that must be taught to students to be successful in an increasingly complex world of education, because critical thinking is an important foundation in the world of education (Vieira et al., 2011).

One of the learning tools that are in accordance with the 2013 Curriculum and can help improve students' critical thinking skills in the learning process is student worksheet (Wahyuni et al., 2021). Based on the literature study, there are several statements obtained from student worksheet developments, namely that they have not been able to stimulate students' thinking skills, the form of short student worksheet questions such as filling in with answers using short sentences, and such as repeating learning material (Fendi et al., 2021).

This statement is supported by research that has been done previously, namely (Farkhati & Sumarti, 2019; Fitriana et al., 2016; Permatasari & Kuntjoro, 2019). Based on this, it is necessary to improve from printed student worksheet to e-student worksheet, but still adjust to Facione's CTS (Facione, 1990) and the structure of student worksheet (Daryanto, D., & Cahyono, 2014). In addition, due to adjusting to the conditions of the Covid-19 pandemic and the rapid development of ICT in the world of education (Ali, 2020).

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The final result of e-student worksheet is through development research in the form of a pre-prototype (Tessmer, 1993). This is because this research was only carried out up to the small group test stage. In addition, the products developed are expected to have valid, practical and effective criteria.

METHOD

This research is a type of development research using the Tessmer formative evaluation design which includes four stages, namely: 1) The self-evaluation stage is carried out by the researcher; 2) The expert test stage is three experts, two lecturers of Biology Education FKIP ULM as academics and one biology teacher at MAN Kapuas as practitioners; 3) The individual test stage is three students of class X at MAN Kapuas; and 4) The small group test phase consisted of four students in class X at MAN Kapuas.

This study aims to improve/improve the existing student worksheet, namely from Damanik (2019). There are four student worksheets from the concept of ferns (Pteridophyte) which have been improved. After analyzing the weaknesses of each existing student worksheet, the researcher began to improve each printed student worksheet into an e-student worksheet based on Facione's (1990) critical thinking skills with six skills (including interpretation, analysis, evaluation, inference, explanation and self-regulation) and refers to on student worksheet systematics from Daryanto and Dwicahyono. In this study, only small group test data were used, it aims to determine the effectiveness of e-student worksheet expectations. In addition, the intrapersonal skills (rigorous) of each student are also seen based on the answers to each sub-concept contained in the e-student worksheet.

Data collection techniques at the small group test stage through the effectiveness of expectations with four students obtained from the tasks given to each e-student worksheet and based on the student's CTS through answers to each e-student worksheet by giving the maximum score assigned to each CTS.

The data analysis technique is done by calculating the average value and dividing by the maximum score, then multiplied by 100%. The scores obtained were matched with the categories namely 85.01 – 100.00% (very good), 70.01 – 85.00% (good), 50.01-70.00% (less good), 01.00 – 50.00% (not good) (Akbar, 2013).

FINDING AND DISCUSSION

The electronic Student Worksheet (e-student worksheet) which was developed aims to improve the Critical Thinking Skills (CTS) of students by doing the tasks contained in the e-student worksheet. This research can be seen based on the CTS of each student at the small group test stage with each student working on an assignment on the e-student worksheet. In addition, e-student worksheet and printed student worksheet are also learning tools that can train students in developing interpersonal and intrapersonal skills which also need to be possessed and improved in 21st century education (Capraro & Cococcioni, 2015). This is because the 21st century also demands quality Human Resources (HR) and is able to compete globally. The characteristics of quality human resources are being able to manage, use and develop thinking skills (Nuraini, 2017).

The stages of testing the effectiveness of expectations are carried out online by students through the live worksheet's website. Before the work process was carried out, the researcher explained in advance how to work through the website by meeting using the Zoom Meeting with four students who were the subject of the study. During the explanation in the zoom meeting which took ± 25 minutes, the students actively asked about something they still didn't understand when the researcher opened the link as an example of working on an assignment, with that the students understood how to do it. The live worksheets website link for e-student worksheet I-IV concept of Ferns (Pteridophyte) was sent by researchers via the WhatsApp and students immediately worked on the tasks on the link.

The results of research that has been carried out through a small group test at stage of the expected effectiveness with four students show that the e-student worksheet on the concept of Ferns. (Pteridophyte) is stated to have a percentage with an average effectiveness expectation of e-student worksheet I-IV with the category " very good", namely in the aspects of interpretation, analysis, evaluation, inference and explanation. Except for the aspect of self-regulation with an average percentage of the "good" category. This is because the scores obtained by students in the CTS aspect 1-5 on average above from the category score of 85.01% and also students can be said to be quite thorough and precise in the process of working and understanding the tasks and commands contained in the e-student worksheet. In addition, these results are also in line with the development of the 21st century which requires human resources to be more qualified and able to compete globally, as well as Information and Communication Technologies (Redhana, 2019).

The learning theory that underlies Facione's CTS (Facione, 1990), is constructivism learning theory. Based on this theory, students must be active in learning. According to this

theory, knowledge is formed by individuals and experience is the main key to learning. In addition, there is also an educational goal according to constructivism learning theory, which is to produce individuals who have the ability to think to solve every problem they face. This is where the importance of CTS is mastered by students (including interpretation, analysis, evaluation, inference, explanation, and self-regulation) (Dwiyogo, 2018).

The assessment is carried out for each aspect of the CTS by determining the maximum score that has been determined and based on the answer key for each aspect of the CTS. Based on the results of research that has been carried out at the expected effectiveness stage with six aspects of the CTS from Facione (1990), it is explained as follows:

1) The results of the CTS on the interpretation aspects contained in the e-student worksheet I and II obtained an average score of 14 so that the final result was 100% with "very good" category. Therefore, in this aspect there is no visible increase in CTS because both e-student worksheet have the same final result, namely the "very good" category. Interpretive ability can be fulfilled, that is, it can be seen based on the students' answers as illustrated in the e-student worksheet I and II regarding the information obtained in each of the and is also related to the commands contained in the e-student worksheet.
2) The results of the CTS in the analysis aspect obtained an average score of 9 contained in the e-student worksheet II so that the final result was 90% with the "very good" category and an average score of 9.5 contained in the e-student worksheet IV so that it was obtained the final result is 95% with the "very good" category. In this aspect, there is no visible increase in CTS results from e-student worksheet II to e-student worksheet IV because it is already classified in the "very good" category. Furthermore, the analytical ability can be fulfilled, which is seen based on the students' answers as described in the e-student worksheet II and IV by determining the component parts obtained in each sub-concept and also relating to each command contained in the e student worksheet.
3) The results of the CTS on the evaluation aspect obtained an average score of 20 contained in the e-student worksheet IV so that the final result was 100% in the "very good" category. Therefore, in this aspect it cannot be seen an increase in each e-student worksheet, because there is only one e-student worksheet that contains an evaluation aspect. However, the final score was in the "very good" category. This evaluation ability can be fulfilled, namely based on the students' answers as described in the e-student worksheet IV by recognizing the relevant factors to refer to relevant sources of

information such as the sub-concepts and also relating to the instructions contained in the e-student worksheet.

4) The results of the CTS on the inference aspect obtained an average score of 24 contained in the e-student worksheet II so that the final result was 100% in the "very good" category. The average score of 23.25 contained in the e-student worksheet III so that the final result was 97% in the "very good" category. The average score of 23.75 contained in e student worksheet IV so that the final result is 99% with the "very good" category. Based on the inference aspects contained in the three e-student worksheet there was no increase, but the final score obtained was in the "very good" category. The inference ability can be fulfilled, that is, it can be seen based on the answers of students depicted in e-student worksheet II, III and IV by collecting information and assessing any relevant information according to the sub-concepts, making hypotheses, drawing temporary conclusions and also relating to the commands contained in e-student worksheet.

5) The results of the CTS on the explanation aspect obtained an average score of 16.75 contained in the e-student worksheet I so that the final result was 84% in the "good" category. The average score of 18.5 contained in the e-student worksheet II so that the final result was 93% in the "very good" category. The average score of 18 contained in the e-student worksheet III so that the final result was 90% in the "very good" category. The average score of 18.31 contained in the e-student worksheet IV so that the final result was 92% in the "very good" category. In this aspect, it can be seen for the improvement of the CTS on e-student worksheet I-IV from the "good" category to the "very good" category, because the four e-student worksheets developed contain an explanatory aspect. The explanatory ability can be fulfilled, that is, it can be seen based on the students' answers as depicted in the e-student worksheet I, II, III and IV with statements from the results of the analysis, presenting relevant evidence and providing appropriate reasons to strengthen the arguments for each sub-concept and related as well. with the orders contained in the e-student worksheet.

6) The results of the CTS on the self-regulation aspect obtained an average score of 10.13 contained in the e-student worksheet I so that the final result was 84% in the "good" category. Just like in the evaluation aspect, in this aspect it cannot be seen that there is an increase in each e-student worksheet, because there is only one e-student worksheet which contains the self-regulation aspect. However, the final score obtained is in the "good" category. Furthermore, self-regulation ability can be fulfilled, namely based on

the students' answers as depicted in the e-student worksheet I by verifying the results obtained and revealing errors or deficiencies in completing the tasks in the sub-concept and also relating to the commands contained in the e-student worksheet.

Based on the elaboration of each aspect of the CTS described above, each of these aspects has its own provisions which are described below (Susilowati et al., 2017).

1) Interpretation is a person's ability to understand and state the meaning or intent of experiences in various situations, data, events, decisions, conventions, beliefs, rules, procedures or criteria.
2) Analysis is the ability to identify the true intentions and conclusions between statements, questions, concepts, descriptions based on beliefs, decisions, experiences, reasons, information or opinions.
3) Evaluation is the ability to assess the credibility of statements or other presentations by assessing or describing one's perceptions, experiences, situations, beliefs, decisions and using the logical power of the expected inferential relationships or actual inferential relationships between statements, questions, descriptions or other forms of representation.
4) Inference is the ability of students to identify and select the elements needed to form reasonable conclusions or to form hypotheses by paying attention to relevant information and reducing the consequences arising from data, statements, principles, evidence, judgments, opinions, descriptions, beliefs, or other forms of representation.
5) Explanation is the ability to state the results of the consideration process, justify a reason based on evidence, methodology, concept or a certain criterion, present reasons in the form of convincing arguments.
6) Self-regulation is the ability related to awareness to monitor self-cognition, elements used, thinking and developed results, drawing conclusions in the form of questions, confirmation, validation and correction.

CONCLUSION

The electronic Student Worksheet (e-student worksheet) at the expectation effectiveness test stage has a very good category of (covering interpretation, analysis, evaluation, inference, and explanation) and has a good category in the aspect of self-regulation based on the tasks assigned to it. contained in the e-student worksheet by students.

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