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Student's Critical Thinking Skills Through Discovery Learning Model Using E-Learning on Environmental Change Subject Matter

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Abstract: This study aimed to analyze the critical thinking skills of students in learning of environmental change material using e-learning madrasah. This study used explanatory sequential design by mixed-methods experiment. The data were collected by interviewing, observing, and essay testing that have indicators modified from critical thinking skills by Watson-Glaser, Facione, and Ennis. There were 67 participants in this study as 7th grade student at a junior high school in Sleman district. Quantitative data analyzed by determining average score and standard deviations and, qualitative data analyzed from interviews and observation. Quantitative analysis showed that there were 3 levels of student's critical thinking skills which were 14 students (20.90%) in the high category, 38 students (56.72%) in the middle category, and 15 students (22.38%) in the low category. Qualitative analysis indicated learning model made students to learn actively, independently, and enthusiastically looking for several sources. This study provided information about student critical thinking skills in junior high school, especially in the environmental change matter which are still low. Thus, the alternative learning strategies to improve students critical thinking skills are very needed. Besides, information on the application of the discovery learning model with e-learning Islamic school was obtained in the COVID-19 pandemic.

Keywords: *Critical thinking skills, e-learning, environmental change, discovery learning.*

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Introduction

To face the industry era 4.0 and society 5.0, teacher and all of stockholder in the school have to work together in preparing students to have capable skill and good attitude (Wyner, 2014). The development of technology in a few last decades indicated the future trend to be faced of the students. Digital era, where technologies have more roles in daily live from simple activity through production activity, indicated that, in the future, human resources which is needed are not to do production activity, but to make the tools and sophisticated machine that will do production activity (Fantini et al., 2020; Ismail et al., 2019; Khalifa et al., 2019).

According to previous statement, there are several competences which must be possessed by students. These competences related to how student know the technology or literacy technology (Pan & Fan, 2020; Pötzsch, 2019; Santoso & Lestari, 2019; West, 2019) and how student adapted with globalization (Nursalam, 2020; Shaleha & Purbani, 2019). Not only student, teachers are also required to understand these subjects so they can facilitate the students optimally (Carpenter et al., 2020; Falloon, 2020).

Based on analyzed of educational system in according to current development, there are some transformations called 21st century educational system. In the 21st century, education has changed with a pattern of transformation in several forms such as learning activities where students were required to participate actively during the learning process (Chuntala, 2019; Cruz & Dominguez, 2020; Frache et al., 2019). This transformation changed the learning focus from teacher to student, from one way interaction to interactive learning, from the isolation students to the student who have environmental network, from passive to active students, from the abstract to the contextual subject matter, from factual to critical learning, and from transfer knowledge to exchange knowledge (Saleh, 2019; Vong & Kaewurai, 2017;

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Wang, 2017). According to Genuba and Abellanosa (2018), there are several skills that must have of each student which are Critical Thinking Skills (CTS), problem-solving, communication, and collaboration.

One of the important skills that student need to have in 21st Century Skills is the CTS (Chusni et al., 2020a; ŽivkoviL, 2016). In many country in the world, CTS has become the main concern and goal of educational system development (Larsson, 2017). Because of the CTS is effective to solve any problems, the implementation of CTS on learning activity is related to any subject of learning today and it will be preparing the student about the problems they will encounter daily. In concert with this research, Wallace et al. (2008) found that CTS has been important factor in problem solving because the students who have CTS may solve an issue easily. Thomas and Lok (2015) state that learning process which integrated with CTS in the classroom gave a pleasant experience to both, the students and the teacher. The CTS should be implemented in learning process, so it can give students a chance to hone their skills (Chukwuyenum, 2013; Švecová et al., 2014).

The CTS became an important ability that must be have of each student in the class, online or offline (Afify, 2019; Chou et al., 2019; Saleh, 2019) and had the benefits of students to learn effectively in learning and to contribute actively in their daily lives (Aizikovitsh-Udi & Cheng, 2015). CTS is very important to be empowered. This is because CTS affected learning outcomes of the students (Siburian et al., 2019; Yerimadesi et al., 2019). Besides, the CTS are needed to develop at the present time, because students who have the ability to think critically may be able to avoid making wrong decisions (Afshar et al., 2017; Kuhn, 2018). Moreover, these abilities make students easily to process the information they found and use it to solve problems (Ismail et al., 2018; Reynders et al., 2020).

Literature Review

Nowadays, the development of CTS has become a concern of educational system around the world (Chusni et al., 2020; Nygren et al., 2019). The CTS has very important roles, and each of them is needed to improve other ability of the students (de Bie et al., 2015; Visande, 2014), so, in line with that the CTS must be the purpose of the learning and teachers must prepare it in all field of science. CTS becomes important because it can prepare students to assess the fact and to find out the relevant explanation. Thus, the student might be able to make decision, or expressing self-attitude towards a subject, better. In the implementation in the school, CTS has integrated in the learning process or there is no special learning about CTS. Thus, students will have a better CTS.

The students will not have a CTS if not practiced early. Therefore, CTS should be included in the learn agenda since the first years, starting from junior and senior high school junior through at the university. Thus, students can adapt to changing times, overcome more complex problems, and become the most useful individuals in the future. The students' CTS should be prepared as good as possible in the face of industrial era 4.0 and society 5.0. Preparation of CTS in learning process can be conducted by practicing student to work together or cooperation, to think critically, to think analytically, to communicate well, and to be able in solving problems (Özkahraman, 2011).

Natural science is one of subject course that teach students in junior high school. This course learns and discuss about general phenomena of biology, physics, or chemist. In Indonesian curriculum, natural science has 11 basic competences in 7th grade, 12 basic competences in 8th grade, and 10 basic competences in 7th grade. All of the basic competences have been taught as knowledge and skills (Ministry of Education and Culture, 2016). Environmental change is a competence taught at 7th grade where students must be having the ability to analyse the environmental change and its effect to the ecosystem. The characteristics of this concept are mostly related with daily life activity. Thus, it can be triggering the student's CTS. In this study, the questions have been developed from CTS by Facione (2000), Ennis (2011), and Watson and Glaser (1980). The CTS Indicators included: (1) clarity assumption; (2) Interpretation; (3) Analysis; (4) Inference; (5) Evaluation; (6) Reason; and (7) Self-regulation.

This study was conducted with the discovery learning model using e-learning madrasah (Islamic School). Student and teacher have communicated from that platform because of COVID-19 pandemic. The interaction was limited; teacher gave the softcopy, such as text file or audio file or video file, and students learned independently. As a control system, teacher usually gives the assignment regularly. Sometimes, teacher and student used the video conference if there were some important information, but it was very rare.

Methodology

The research method used mixed-methods by using convergent parallel explanatory design (Creswell & Clark, 2017). In the convergent parallel explanatory design, data were collected in sequent phases. The first, data analyzed quantitatively, then, in the second phase, the data for qualitative analysis were related to the outcomes from the first, quantitative phase. The overview of convergent parallel explanatory research design can be seen in Figure 1.

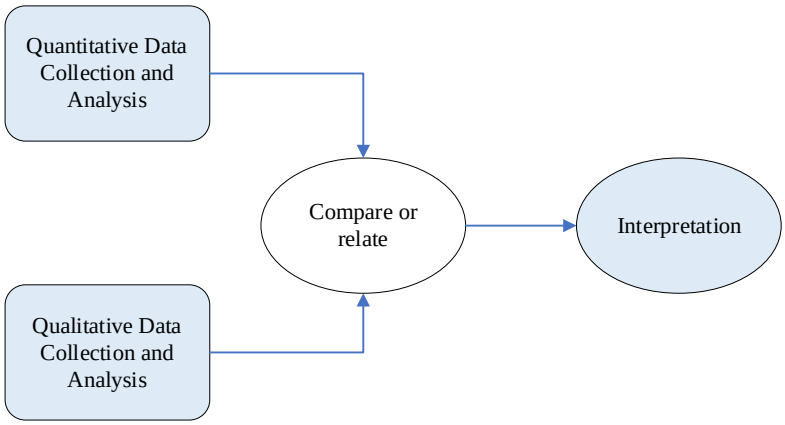

Figure 1. The overview of convergent parallel explanatory research design (Creswell & Clark, 2017)

In this study, premier data used are derived from quantitative methods. Meanwhile, data from the qualitative method is used to obtain descriptions of quantitative data, to prove, to deepen and to strengthen the quantitative data. The quantitative methods collected data about students' CTS through a post-test, after learning process. The qualitative methods are used to obtain in-depth data about students' CTS in learning with the Learning Management System (LMS). The quantitative research design used pre-experiment with design as one group post-test only (Fraenkel, 2007).

The treatment is learning process by using LMS. This LMS was provided by Ministry of Religion of the Republic of Indonesia as the respond to pandemic COVID-19, namely "e-learning madrasah" accessed in http://madrasah.kemenag.go.id/elearning. The learning interface is in Figure 2.

Figure 2. The interface of LMS

The data collected from 67 participants who uses this LMS in Sleman regency. All participants were selected by using purposive sampling that following several considerations. After the students were given treatment, they are filling up the post-test served in google form (Chusni, 2020).

The given CTS test consisted of 7 items which is valid in the construct and has high reliability with score 0.91 and strata-separation score 4.57 (Fisher Jr, 2007). For each test question, a statistical test was employed using Winstep version 3.7.3 to analyze how the reliability of the person (subject) and items, and how measure order of items referred to the RASCH analysis. Every question in this test is scored based on formulas in Table 2 which are using means, or average score, and standard deviation. Then, the score is interpreted into several categories according to comparison results between the average scores and standard deviations (Permatasari et al., 2019).

Hypothesis

The preliminary study of this research states that students' critical thinking skills can be improved by implementing distance learning. This is based on the results of other studies that show better student learning outcomes with the help of the LMS platform.

Findings / Results

RASCH Model Analysis

Student's CTS measured by giving 7 question, 1 question represent 1 indicator. The result showed that students have low level of CTS. Person reliability, item reliability, and fit item measure were all included in the Rasch analysis. Person reliability or score that shows how consistent the students in answering correctly is 0.70 with separation 1.52. In other words, students may answer question, with correct answer, in "fair" category (Boone & Noltemeyer, 2020). Separation score, or score that shows how well a sample of people is able to separate the items, 1.52 indicated that students score of CTS have not well distributed or well differentiated (Boone & Noltemeyer, 2017).

In item reliability, the given CTS questions have reliability index in "excellent" category with score 0.97 and have separation index 5.41 with "excellent" interpretation (Boone & Noltemeyer, 2020). In other word, it can be stated that the given CTS questions to the students have good quality in other to classify students competences and it can measure student's CTS very well (Linacre, 2012).

Table 1. Item Measure

Entry Number	Item	OUTFIT	
		MNSQ	ZSTD
2	Q2	1.53	2.6
1	Q1	1.04	0.3
3	Q3	0.51	-3.2
5	Q5	0.96	-0.2
7	Q7	1.40	2.1
6	Q6	0.76	-1.5
4	Q4	0.80	-1.3

The next is item measure that reviews the level of difficulties of each question based on student's answer. Table 1 indicates that there is question number 2 or Q2 is the most difficult question in which there are only some students who can answer it correctly and it can be concluded that Q2 is the lowest learning achievement. In the OUTFIT column, Q2 has MNSQ score 1.53 > 1.5 and ZSTD 2.6 >2.0 that means Q2 has relatively low reliability. This is because the range of score MNSQ is 0.5 to 1.5 and the range of score ZSTD is -2.00 to +2.00 (Boone & Noltemeyer, 2020; Linacre, 2012). On the other hand, item with the highest learning achievement is Q4 which is indicated by the number of students who answered right for this question. Detailed explanations for each question will be presented in the discussion section.

Student's CTS

The test result showed that the average score of student's CTS is still relatively low. Table 2 shows the average score of each aspect indicators.

Table 2. The Results of Each Indicators Analysis in CTS

Sub CTS Indicators	Average score	Interpretation
Clarity assumption	32.84	Low
Interpretation	17.16	Low
Analysis	48.76	Middle
Inference	75.62	High
Evaluation	38.43	Low
Reason	49.25	Low
Self-regulation	44.03	Low
Average	43.73	Low

According to Table 2, it can be concluded that students' CTS are low. The highest average score is in inference indicators and the lowest for the indicator interpretation. Based on the form of question, the interpretation question is the question about how to present the data in Graph. Thus, it can be concluded that student ability to transform data, from descriptive number to graph, is weak. This is unique, because the question number 3 is also about interpretation data from graph to descriptive. Thus, another implication from this result is students may be able to describe data from graph to descriptive and yet from another side, or, students may be able to describe data from graph to descriptive and from another side, but they cannot make it to digital.

Generally, the students' CTS might be classified as seen as in Table 3.

Table 3. Student's CTS Results

Interval	Category	Number of Students	Percentage
X > Mean + SD	High	14.00	20.90%
Mean – SD ≤ X ≤ Mean + SD	Middle	38.00	56.72%
X ≤ Mean - SD	Low	15.00	22.39%

According to Table 3, there are 3 levels of students' critical thinking skills. They are 14 (20.90%) students in the high category, 38 (56.72%) students in the middle category, and 15 (22.38%) students in the low category. Besides, these results are confirmed with teachers and students by using interview for several aspects. The interview aspect and the results are shown in Table 4.

Table 4. Interview Results

No.	Aspects	Findings
1.	Natural science learning in 21st century	Techers have known the 21st century competences called 4C (*communication*, *collaboration, critical thinking,* and *creativity*). However, they did not understand the components and indicators of each competence. Related to 21st century learning process, or how it can be integrated with technology in the process.
2.	Preparation learning	Teachers have not been able to apply the CTS components specifically in order to formulate the learning purpose/s and achievement indicator/s in lesson plan.
3.	Learning implementation	E-learning allows learning anytime, anywhere. Students, in learning interaction, become more active, self-study outside the class, and be able to explore any reference. For the teachers, it can be used to analyze the student understanding and gave the feedback, optimally.
4.	Assessment and Evaluation of Science Learning	Students still have difficulty in completing CTS questions that are presented in the form of multiple representations, because the teacher has not applied the assessment of high-order thinking, especially in aspects of CTS.
5.	Innovation in Science learning	Teachers and students have implemented online learning, to adapt to the COVID-19 pandemic. At first, teachers and students had difficulties in operating e-learning madrasah, but as time went by, they became accustomed.

The results of the interview in Table 4 shows that the teacher is basically aware of the importance of CTS competence, it is just that there are problems on how to teach CTS competencies, especially in the implementation of online learning. The unfamiliarity factor tends to dominate the problems in planning and implementing learning using online platforms. In addition, teachers also experience problems in stimulating multiple representations of questions. This in turn confirmed the finding that students tended to have lower CTS.

Discussion

Clarity Assumption

The first question in this test excepted student to be able to make a "formulation of the problem" correctly. The students gave the clue or the problems from scientific paper (see Figure 4). From the presented paper, students must identify the issue that discussed in the paper, from the abstract, and presenting the issue well.

Figure 3 shows that student's answer can be classified into three categories. In category 1, or S1, student identified the problems on the paper and they also giving the formulation of the problem correctly. In category 2, or S2, students basically have been able to identify what problems must be solved based on the text. However, students in this category have not been able to compile a problem statement that must be solved properly. While in category 3, or S3, students did not fully understand the context of the problems contained in the paper, so the answers given by students did not lead to the problem formulation.

Student's achievement in this indicator is relatively low indicated by student score 32.84 out of 100 points. This can be caused by several things, such as lack of understanding of the text and lack of understanding of how to formulate scientific questions (Barr et al., 2008). In numbers, 46 students or 68.66% of all students were in the S1 category, 4 students or 5.97% in S2 and only 9 students or 13.43% were in the S3 category while the other 5.97% were undefined, or did not answer. In addition, in this indicator, students' answers can be categorized into three groups, namely 5.97% wrong, 80.60% almost correct, and 13.43% students answered correctly.

Q1: Look at the information in the journal. Based on the article, what is the important problems that have to solved?

TIMBULAN SAMPAH B3 RUMAHTANGGA DAN POTENSI DAMPAK KESEHATAN LINGKUNGAN DI KABUPATEN SLEMAN, YOGYAKARTA

(Generation of Household Hazardous Solid Waste and Potential Impacts on Environmental Health in Sleman Regency, Yogyakarta)

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Abstract

Household solid waste containing hazardous and toxic materials such as batteries, electric light, electronics, pesticides, bleach, cleaner, paint, pressurized cans (aerosol), unused medicines, thermometers and syringes can threaten human and environment. Although the quantity of Household Hazardous Solid Waste (HHSW) in Sleman Regency only 2.44 g/person/day or approximately 0.49% of domestic waste, but because it has the characteristics of explosive, flammable, reactive, toxic, infectious and/or corrosive then potentially cause health and environmental issues (water, soil, air) seriously. Until now, HHSW in Sleman still handled like domestic waste, which is burned, dumped into the river, dumped in the yard, disposed into illegal dumping or dumped into the final disposal site (TPA Piyungan). Types of HHSW most common are electronic waste (24.91%), electric lamps former (18.08%) and used batteries (16.71%). Those HHSW contain a variety of heavy metals such as Cd, Pb, Hg, Cr, As, Ni, Co, Zn, Cu, Al, Mn, Li, Sb and Fe, which are generally toxic, carcinogenic and bioaccumulative that can be entered into the human body directly or through the food chain. Exposure to harmful and toxic materials can cause damage to various tissues/organs of the communities around the dumping, garbage worker, scavengers, collectors, users and recycler of HHSW. Therefore HHSW in Sleman Regency needs to be managed properly in accordance with the nature and characteristics.

***Keywords**: environmental health, household hazardous waste, impacts, toxic material.*

Student Answer

S1: How to solve the household waste that contains Dangerous and Toxic Material (B3)?

S2: Household waste containing dangerous and toxic materials (B3), such as batteries, pressurized cans (aerosols), remnants of medicines, thermometers, and syringes has the potential to threaten health of humans and the environment.

S3: Do not use excessive waste

Figure 3. The question (left) and student's answer (right) in question number 1

Interpretation

In this sub-indicator students are given descriptive data or phenomena associated with the pollution. The student expected to make a simple graph that describe the whole text. In simple description, this indicator called "decoding" where student have to transform their data into Table or Graph. Based on Table 3, this indicator is the lowest score achievement with average score 17.16. This score is execrable and it is shown that the students is not capable to present the information in any way (Chance et al., 2007). The answer given by one of the students can be seen in Figure 4.

Q2: Gendis has conducted research to find out "whether the snacks sold on the edge of the highway are experiencing air pollution from motor vehicle fumes containing Pb or not". The study was conducted by putting *getuk*, a traditional food made from cassava, at the ring road crossroad. The results showed that the *getuk* was positive containing Pb. Then, Gendis continued her research to find out "whether the length of time the exposure affects the Pb content in *getuk* or not". Laboratory test results showed that within 30 minutes the concentration of Pb in 3ppm *getuk*, after 60 minutes the concentration of Pb becomes 7 ppm, at 90 minutes the concentration of Pb is 12 ppm, and after 120 minutes the concentration of Pb became 15ppm. Based on these results, help Gendis process the data into graphical form, so that Gendis can easily analyze it! (Upload graphics in the form of photos / images).

Student answer:

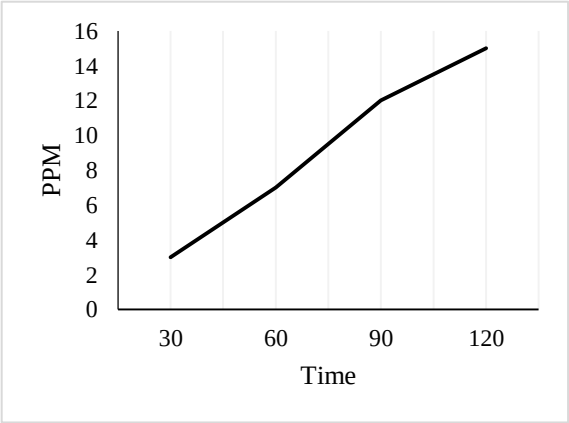


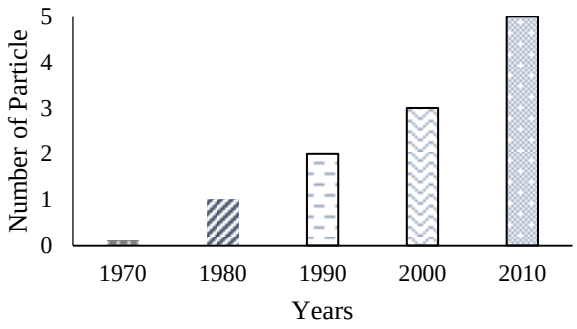
Figure 4. The question (left) and student's answer (right) in question number 2

In CTS, the ability of data presentation is important because it is a part of scientific communication. Students must have the skill to provide data in any ways such as Table or graph. Based on the result, this skill needs improvement because the student who have met the criteria are only 22.39% or about 16 students from 67 students. In this indicator, students' answers can be categorized into three groups, namely 53.73% wrong, 46.27% almost correct, and 0% of students answered correctly.

Analysis

. The sub-indicator analysis expects students to be able to understand and express, descriptively, what is contained in the table/ graph. Some competencies in this indicator are looking for data relationships and providing detailed explanations. The form of the questions and answer samples are in Figure 5.

Q3: Based on the picture, analyse how the amount of CO2 gas particle emissions from year to year?



Student answer:

Based on the Figure, at least, there are two conclusions, 1) there is a significant increase in every decade, and 2) An increasing number of particles has a quadratic trend.

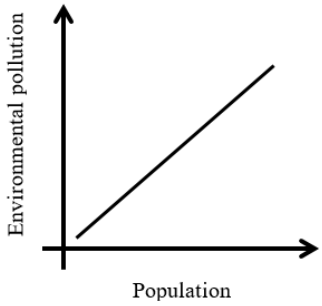
Figure 5. The question (left) and student's answer (right) in question number 3

Most students have been able to provide an interpretation related to how the number of particles changes from decade to decade, but students have not been able to identify trends or graph trade lines. This is very important in massive data exchange and processing, where by discovering trends in patterns, students can predict outcomes. This capability is certainly very crucial in preserving the environment, considering that environmental stability is not only used incidentally, but is continued to the next generation (Haunberger & Hadjar, 2020). In this indicator, students' answers can be categorized into three groups, namely 1.98% wrong, 98.51% almost correct, and 0% of students answered correctly.

Inference

Expected competence in the inference indicator does not differ significantly from the analysis indicator. Based on this indicator, students are expected to be able to make conclusions and querying evidence based on data. Data sources used are not limited, can be in the form of descriptive, table, or graph. In the given test in this study, students are asked to make accurate conclusions about the graphs provided. The graph only shows trends without having numbers / values on each axis, so students must be able to analyze and conclude something abstract (Chen & Hu l., 2018). Questions and answers to these questions are found in Figure 6.

Q4: Based on the graph, what can you conclude?



Student Answer:

Based on the graph, it can be concluded that the increase in population is proportional to environmental pollution, or environmental pollution increases with increasing population

Figure 6. The question (left) and student's answer (right) in question number 4

In question number 4, students tend to give answers that were still abstract. Most of the students revealed that "the population affects environmental pollution". These answers certainly cannot explain how the correlation between the two variables, so that students did not get the best score. Overall, this indicator has the highest achievement with an average of 75.62 or with a high category. Even so, there were still 18 students or 26.87% who made a false statement. In this indicator, students' answers can be categorized into three groups, namely 0.00% wrong, 46.27% almost correct, and 53.73% students answered correctly.

Evaluation

In this indicator, students must have the ability to analyze the sources, facts, and conclusions. They have to check every detail data or information. This indicator takes on student's CTS to think critically and to understand highly, so the students can find out strategy to answer the questions. In this test, question 5 provided several choices which have to choose by the student and made the best conclusion that can be adapted in everyday life in according to environment issue (Basri & As'ari, 2018). Students' answers on question number 5 can be seen in Figure 7. According to Figure 7, student achievement on this indicator is also classified as very low where students only have an average score of 38.43 with low interpretation. The majority of students have difficulty in identifying other factors as implied in the impact column. In this indicator, students' answers can be categorized into three groups, namely 7.46% wrong, 77.61% almost correct, and 14.93% students answered correctly.

Q5: Based on the data in the table, determine the pH value that is safe for the river ecosystem? Are there other factors besides those that influence?

pH number	Impact
6.0 – 6.5	• Plankton and benthos diversity decreased slightly • Total abundance, biomass and productivity did not change
5.5– 6.0	• A decrease in the diversity of plankton and benthos was increasingly apparent • Total abundance, biomass and productivity had not experienced significant changes • filamentous green algae begin to appear in the literal zone
5.0 – 5.5	• The decrease in plankton diversity and composition of plankton, periphyton and benthos species is getting bigger • Reduction in total abundance and zooplankton and benthos biomass • More green filamentous algae • Nitrification was inhibited
4.5 – 5.5	• The decrease in plankton diversity and composition of plankton, periphyton and benthos species was getting bigger • Reduction in total abundance and zooplankton and benthos biomass • More green filamentous algae • Nitrification was inhibited

Student answer:

Safe pH for river ecosystems is 6.0-6.5. Another factor is the level of river pollution

Figure 7. The question (left) and student's answer (right) in question number 5

Reason

In resonance indicators, students must be able to justify procedures based on abstract information provided. The justification given must also be able to be expressed or presented through strong arguments. In the given test, there are general environmental damage phenomena, such as waste disposal and waste management that have not been effective, are presented, and then students are asked to formulate procedures or stages that might be carried out to overcome these problems. Here, students must think more broadly and rationally without getting a clue to solve the problem. They must be able to process and use the information they have obtained in their daily lives (Ahmady et al., 2020). The questions and sample answers of students are in Figure 8.

Q6: Based on the image of water pollution and waste pollution, how do you treat different types of waste?

Student answer:

1. Separate waste according to type
2. Organic waste processing
3. Inorganic waste processing
4. Processing hazardous waste
5. Reduce, Reuse and Recycle!

Figure 8. The question (left) and student's answer (right) in question number 6

The main thing that must be considered from solving the problem here is specific, logical and effective. Every action idea formulated must meet all three indicators because students do not get a single clue related to problem solving. In this regard, students are able to provide good ideas, however, the ideas provided by students are still not specific, logical and effective. In this indicator, students' answers can be categorized into three groups, namely 1.49% wrong, 79.10% almost correct, and 19.40% students answered correctly.

Self-regulation

The last indicator is self-regulation. In this indicator, students are expected to be able to give statements about self-improvement and self-reflection. The main factor in this indicator is how each student responds to problems. Students are asked to formulate personal actions, on a small scale, but can have a major impact. In this test, students are asked to provide solutions through self-regulation related to the issue of melting ice in the pole and its impact to the ecosystem. Questions and answers are in Figure 9.

Q7: How do you act to overcome these environmental problems?

Student answer:

1. Reducing excessive electricity usage
2. Turn off the lights if not needed
3. Planting trees on the roadside
4. Reforestation

Figure 9. The question (left) and student's answer (right) in question number 7

The question of self-regulation is basically not demanding amount or truth. However, students are asked to be able to express ideas and efforts to solve problems according to their abilities. In this indicator, student achievement is also still relatively low because the ideas and forms of problem-solving efforts proposed are considered beyond the ability of individuals as action figures (Azevedo et al., 2019). In this indicator, students' answers can be categorized into three groups, namely 2.99% wrong, 74.63% almost correct, and 22.39% of students answered correctly.

Learning Process

Based on the presented results, CTS learning conducted with the discovery learning model using e-learning madrasah has not been considered effective. This is due to the lack of interaction that practice the CTS. In the learning process, students only get soft-copies of material or assignments from the teacher. They are very limited to explore their minds which can usually be a trigger for CTS. However, this is not the final result, some previous studies actually were able to improve student CTS by using similar learning (Dehghanzadeh & Jafaraghaee, 2018). Referring to the results of previous studies, in e-learning, the part that can be improved is the form of assignments and information presented in soft-copy of student material. This means that the teacher must prepare teaching materials in such a way as a substitute for himself in training CTS online (Umam et al., 2019).

Interview results show that students have not difficulties in solving the CTS question of environmental change content (seen Table 5), because teachers have not formulated the CTS components in learning purpose or indicators, so in the

learning activity are not practicing the CTS. Carson said even the students know the concepts, but it not guarantee they will know how to use it to analyze, to interpret, or to conclude data (Meltzer, 2002). Students, when they answer the question, were less attention to other information which sometime is important to solve the problems so students have difficulty in predicting or using logic to answer the questions. These results indicate that students have to make more practice to use concepts in daily life, so the CTS can be empowered.

Another result is regarding the implementation of online learning. Based on the findings in this study, students and teachers need more habituation in using online learning. The aim is to facilitate subjects (teachers and students) in carrying out learning activities. This is in line with findings of Syakur et al. (2019) which state that habituation of learning, in the sense that teachers and students master the media used, will increase efficiency and learning outcomes. However, as an emergency learning process e-learning madrasah is considered to be good enough in the process because it is able to overcome face-to-face learning constraints.

Conclusion

From this research, there are several conclusions they are a) the average percentage of students' CTS was 43.73 with a low category; b) The results of analysis for each answered showed the average score in clarity assumption is 32.84 in low category, interpretation or decoding is 17.16% lower categories, analysis is 48.76% in middle categories, inference 75.62% category high, evaluation is 38.43% in low categories, reason is 49.25%, and self-regulation is 44.03%. The implementation of the learning process using e-learning madrasas is considered effective in overcoming face-to-face learning problems, but on a learning scale that practice CTS this has not been able to optimally increase students CTS. Training for teachers is needed, especially regarding the technical online media used. The more teachers master the online media used, the easier it is for teachers and students to carry out learning activities.

Recommendations

This study provides an overview for teachers and researches that learning conducted by e-learning madrasah was not effective in order to enhance student critical thinking skills. The problems come from teachers who can control the class and then make learning lose control and besides, the students do not familiar with practicing critical thinking skills from their device. Thus, in the further study researches or teacher have to modify and optimize the learning syntax by combining model or strategy so the virtual class looks like real class. Teachers are expected to improve its ability to vary learning model, then in the implementation of learning should be designed in such a way that can encourage the implementation of active, effective, and fun learning, also use authentic assessment in assessing learning.

Limitations

This research is limited to analyze the level of critical thinking skills of students in learning environmental change with the discovery learning model using e-learning madrasah for the junior high school grade 7th in Sleman district. The research provides a general description of the teachers, principals, and stakeholder about the condition of learning quality of junior high school students on science learning, particularly discovery learning model.

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Authorship Contribution Statement

Chusni: Contributed to the writing of the article and research data collection. Saputro: Formulated of the communicated idea and supervising the research from the beginning of the study until the end of the research. Rahardjo: Assisted to expand a theoretical basis and strengthen discussion. Suranto: Examined the result and commented on the writing of the manuscript.

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