The use of scientific direct instruction model with video learning of ethnoscience to improve students’ critical thinking skills

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Abstract. In this disruption era, students are encouraged to develop critical thinking skills and important cultural conservation characters. Student's thinking skill in chemistry learning has not been developed because learning chemistry in schools still uses teacher-centered, lecture method, is less interesting and does not utilize local culture as a learning resource. The purpose of this research is to know the influence of the application of direct Instruction (DI) model with video learning of ethnoscience on the improvement of students’ critical thinking skills. This study was experimental research. The population was the students from class XI MIPA MA Negeri Gombong with the sample chosen by purposive random sampling. The material of local wisdom as the study of ethnosciences which was the focus of the research was the production of genting, dawet, lanting, and sempor reservoirs which is integrated with colloidal chemical contents. The learning video of ethnoscience before being applied was validated by experts. Students’ critical thinking skills were revealed through the concept of conceptualizing test instruments. The data analysis technique used was the test of proportion and Kolmogorov-Smirnov test. The results of this study suggested that the experimental class that was treated by scientific direct instruction model with the learning video of ethnoscience shows cognitive learning and critical thinking which were better than the control class. Besides, the students indicated their interest in the application of scientific direct instruction model with ethnoscience learning video.

1. Introduction
Chemistry is a study of everyday natural phenomena. There are three main reasons for studying chemistry: Ebbing and Gammon [1] chemistry has important applications in everyday life, Sudarmin [2] Chemistry is the way to explain all materials in the world and Adnyana [3] chemistry related to other sciences [1]. Chemistry is useful to seek answers to the questions of what, why, and how natural phenomena are related to the composition, structure and properties, changes, dynamics, and energetic of substances [2].

Studies of chemistry in high schools found the fact that students find it difficult to learn chemistry. The analysis results of several articles and research in chemistry learning found that students consider chemistry as knowledge that contains concrete and abstract knowledge at once leading to difficulties
Critical thinking skills include the abilities to give an example, video learning, science is the competencies stated in the Regulation of the Minister of Education and Culture No. 20 of 2016 [7] is critical thinking skills. Critical thinking skills include the abilities to analyze facts, awaken and organize ideas, defend opinions, make comparisons, draw conclusions, evaluate arguments and solve problems [8]. Critical thinking is needed to explain the application of chemistry to solving problems related to everyday phenomena, such as explaining the process of making dawet drinks which is easier for a dissolution process if the water is hot, or why a liquid drug should be shaken before drinking. Critical thinking is an organized process that allows students to evaluate the evidence, assumptions, logic, and language that underlies others' statements. In this research, the thinking skill consists of five indicators, namely [1] giving simple explanation, [2] building basic skill, [3] making inference, [4] making further explanation, and [5] arranging strategy and techniques [9]. The purpose of critical thinking is to achieve a deep understanding. The ability to think critically can be trained because the human brain is constantly trying to understand the experience [10].

Chemistry learning can help equip students with not only chemical concept but experiences and facts that exist in everyday life and culture. The experience can be achieved from the surrounding culture. Each region has its own culture. One of the Indonesian cultures listed in the Abonyi study (11) is the Family Medicinal Plant (TOGA). A learning that uses culture a learning resource is known as ethnoscience-filled learning. Ethnoscience is the knowledge possessed by a nation or more precisely ethnicity [5]. The culture in Kebumen Regency is related to the colloid topic in chemistry learning, such as dawet drinking, lanting, Sempor Reservoir, and Genting Sokka.

As the object of ethnoscience, Kebumen Regency has many beach tourism destinations. The beach being targeted in this study is Menganti Beach. A beach was used in this study because sea water is an example of a solution, colloidal, or mixed, whereas the white sand in the beach is an example of suspension, and clouds include liquid aerosol. Sempor Reservoir is also an object of this study because water treatment in the Sempor Reservoir applies the concept of colloids, particularly mud coagulation.

This research was carried out as a development of the previous research that is the research conducted by [1] with the title Skills Profile of Science and Appreciation of Students to the Profession of Tempe Artisans in Science Learning Approach Ethnoscience. The research included the material for making tempe in science learning, so that students can appreciate tempe makers. Further research was
conducted by [12] under the title of Chemical Learning Model Based on Ethnoscience to Improve Student Critical Thinking Ability. The study showed that the cognitive and critical thinking improvement of experimental class students is higher than the cognitive improvement and critical thinking of control class students. Based on the results of the previous research, it is argued that the video learning chemistry that integrated science and ethnoscience can improve students' experiences of Kebumen’s culture. Students can be more active during the learning process because learning videos are equipped with worksheets that need to be done in groups. Group activities can be used as a means for exchanging information among students when there is information which is not listed in the video. The new experiences that students get are expected to improve students' critical thinking skill. Thus, the purpose of the research is to know the effectiveness of direct instruction learning model using ethnoscience-based learning video on students' critical thinking skills of colloid concepts.

2. Research method

2.1. Type of research
The research was an experimental study which was conducted within three meetings using direct instructional scientific approach and media ethnoscience to develop students' critical thinking skills. The second and third meetings were designed to practice local colloid food and beverage products based on local wisdom followed by tests on conceptual mastery and critical thinking skills.

2.2. Population and sample research
The population of this study was students of class XI MIPA MA Negeri Gombong with a total of 111 students. The technique used to choose the sample was purposive random sampling with the consideration of equal number of chemistry lessons and the availability of LCD in the class. The two sample classes obtained were class XI MIPA 1 as the experimental class and class XI MIPA 3 as the control class. The study was conducted during three meetings for the learning process and one meeting for evaluation. The experimental class was treated using direct instruction teaching model with video media of ethnoscience.

2.3. Research procedure
The procedure of data collection included activities of [1] determining the population, namely the students of class XI MIPA MAN Gombong with a total of 111 students; [2] determining the sample class by purposive random sampling technique; (3) validating instructional video media; [4] implementing the teaching strategies; [5] conducting trials of assessment instruments; and [6] analyzing data on critical thinking ability test. Data of critical thinking ability was obtained through a test with 15 items of short answers which were completed students after learning process. The lattice problem for critical thinking skills refers to the fifth critical thinking indicators by Ennis in [9].

2.4. Data analysis
The data analysis included analysis of the validity of ethnoscience-based video learning media, analysis of research instruments in the form of colloidal cognitive chemistry test, trial and final data analysis in the form of students' values of colloid chemistry concept and students' critical thinking ability test. The analysis of the validity of the learning video is done by calculating the percentage of validity given by the experts through a validation questionnaire. Instrumrt test mastery of concepts and test trials analyzed the validity, reliability, distinguishing power, and difficulty index. The final
data is analyzed for its effectiveness in two ways, namely classical completeness and mean comparison between classes. The final data was first tested for normality and homogeneity. Classical mastery was tested using proportion test, meanwhile interclass grade was tested using Kolmogorov-Smirnov test using SPSS program.

3. Results and discussion

3.1. Results of the Validation of Learning Media

In this study, the validity of ethnosciences-based learning video was tested using ten criteria, namely [1] the clarity and truth of chemical concepts presented, [2] the delivery strategies of learning objectives, [3] the language used, [4] the clarity of image, [5] the clarity of narration, [6] the background music, [7] the conformity with local culture, [8] students’ interest, [9] students’ activeness, and [10] the ease of operation. The results of validation by three reviewers are presented in Table 1.

Table 1. Validation results of integrated learning videos of ethnosciences.

| No. | Aspect                                      | Score | Average |
|-----|---------------------------------------------|-------|---------|
| 1   | The teaching materials are clear             | 4     | 3       |
| 2   | The goal of teaching is achieved             | 4     | 4       |
| 3   | The language used is understandable          | 3     | 3       |
| 4   | The picture is clear                         | 4     | 3       |
| 5   | The narrator’s voice is clear                | 4     | 3       |
| 6   | The background music is appropriate          | 4     | 3       |
| 7   | The video is appropriate with local culture  | 4     | 4       |
| 8   | The video is interested for students         | 4     | 3       |
| 9   | The activity motivates the students to learn | 4     | 3       |
| 10  | The video is easy to operate                | 4     | 4       |
|     | Total Score                                 | 39    | 40      | 33      |

Analysis of validity of learning video of Ethnoscience obtained validity equal to 93.33% and pertained very feasible, so that it can be applied to learning media of experimental class. After performing different treatment in each experimental class, the data of critical thinking ability for the experimental and control class were obtained 73,3 for the experimental class and 65,5 in the control class and the highest score in the experimental class 96,7 and 90,0 at control class. In this study, 15 items were developed based on Ennis's critical thinking ability in [9]. This study also analyzed each indicator of critical thinking skills. Figure 1 presented a score for each indicator of critical skills in the experimental and control classes.
In this research the critical thinking skills tested include the following indicators: [1] provide a simple explanation, [2] build basic skills, [3] make inferences, [4] make further explanations, and [5] organize strategies and techniques. Figure 1 shows all the indicators for critical thinking skills of the experimental class having a greater percentage of mastery over the control class, meaning the direct instructional instructional model with the applied video of ethnoscience is effective.

3.2. The Influence of Direct Instruction Learning With Ethnoscience Learning Videos on Student Critical Thinking Skills

In this research for the data of critical thinking ability after the application of direct instructional instruction with video media containing ethnoscience, after analyzed the data presented in Table 2 and then tested the hypothesis. At the hypothesis test stage, then the first step is to test the normality and homogeneity of data. The results of data analysis for the normality and homogeneity test are presented in Table 2.

Table 2. Normality test analysis and homogeneity.

| Test     | Formula    | Criteria                  | Sig.     | Acceptance | Conclusion |
|----------|------------|---------------------------|----------|------------|------------|
| Normality| Chi Square | Accepted H₀ if Sig.<1.1   | Experimental=26.72 Control=59.92 | H₁         | Not Normal |
| Homogeneity| F Test     | Accepted H₀ if Sig.<1.69  | 1.4      | H₀         | Homogen    |

Table 2 shows that the final data are not normally distributed and homogeneous. This situation makes the effectiveness test done through nonparametric statistical tests. The first effectiveness test is the classical completeness of the experimental class using the right-sided proportion test. The students of grade XI MIPA MAN Gombong are said to be finished on Chemistry subject if they meet the Minimum Exhaustiveness Criteria that is minimum value of 60 and Minimal Mastery Criteria (MMC) classical at least 85% of students reach 60. Formulated H₀: \( \pi \geq 85\% \) and H₁: \( \pi <85\% \). The total number of students who completed the KKM individually was 34 out of 37 students. Calculations
using Microsoft Excel applications and SPSS obtained 92% of experiment class students meet individual Minimal Mastery Criteria (MMC) on critical thinking skills tests [14].

The results of this study mean, students' critical thinking skills on the material Colloids are taught using Direct Instruction learning model with Ethnoscience learning video has achieved mastery learning in classical. The second effectiveness test is the mean comparison test between the classes. The data of critical thinking ability test shows no normal distribution, so this test uses nonparametric test statistic Kolmogorov-Smirnov. The specified $H_0$ is $\mu_1 = \mu_2$, whereas $H_1$ is $\mu_1 > \mu_2$. $H_0$ accepted by criterion $x_2^{\text{count}} < x_2^{\text{table}}$. $x_2^{\text{count}}$ obtained for 1.946, while $x_2^{\text{table}}$ is 0.103. The difference in the value of $x_2$ causes $H_0$ to be rejected. That is, the average students' critical thinking skills in learning using DI models with integrated video learning media Ethnoscience is better when compared to students who were taught using DI learning model without Ethnoscience-loaded learning videos. The results of this study are consistent with the results of Haryanti's (13) research which uses the inquiry scientific approach to solute chemicals capable of improving critical thinking skills at a moderate level based on N-gain values.

The classical exhaustiveness of experimental class thinking ability data exceeds 85%. The Kolmogorov-Smirnov test showed that the average of students' critical thinking ability was better than that of the control class. Both statements conclude that DI learning model of Ethnoscience learning video is effective on students' critical thinking ability. The effectiveness of learning model DI video Ethnoscience video on students' critical thinking skills depends on several factors. The first factor is in line with Johnson's opinion. The ability to think critically can be trained through matters relating to everyday experience. In this study, Ethnoscience Video is designed to collect the experience and knowledge of the community and students daily; and also presents the subject of Colloid. The second factor which is caused by the learning activities is in line with the scientific approach of observing, analyzing, presupposing, predicting, finding fault, estimating causes, making decisions, and creating categories or conclusions. In addition to the media video, Ethnoscience will be a lot of motivating students with discussion and questions. Questions are among others [1] What are the links between cultures that have been mentioned with the Science?; [2] How is the process of purifying the dirty water reservoir into clean water that reaches our house? and [3] How is the dialysis process linked to the concept of colloid chemistry.

The research has been conducted by S. Sudarmin, et al [12] and [15] relating critical thinking skills and mastery of chemical concepts of hydrolysis with an integrated chemical learning model of ethnoscience to its cognitive ability and critical thinking skills of Rembang students. The results showed that the model was able to improve the learning result of cognitive and students' critical thinking skills. In chemistry lessons that emphasize critical thinking skills are more easily developed if supported by learning media, and the use of ethnoscience based learning videos that play a role in improving students' thinking skills.

4. Conclusion
Based on the results of research and discussion, it is concluded that direct instruction scientific teaching model with ethnoscience learning video media is effective to improve students' critical thinking ability of colloid concepts. The effectiveness was characterized in two ways. Ebbing and Gammon [1] students who were taught using direct instructional model with ethnoscience learning video reached the classical completeness and [2] the average of critical thinking ability of students who were taught using direct instructional with ethnoscience learning video was better than the
average ability of critical thinking of students who are taught using direct instructional learning model without ethnosience learning video media.

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