The Effectiveness of Contextual Inquiry-Based Worksheet on the Matter of Fungi on Food Towards Students' Higher-Order Thinking and Science Process Skills of Biology Education

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***Abstract*— Learning material is one of the main components for students to achieve their learning purposes in higher education. Nowadays, the most innovative learning material commonly used is a student's worksheet. This study aimed to find out the effectiveness ofworksheet on the matter of fungi on food based on the contextual inquiry learning model towardsstudents' higher-orderthinking skills of Microbiology in Muhammadiyah University of South Tapanuli (UMTS). The research method applied in this study was a quasi experimental technique. The population was all the fourth semesterstudents of biology education program in UMTS. The sample consisted of two classes, namely: class A (control group)was taught by applying a conventional learning strategy with a conventional worksheet and class B(experimentalgroup) was taught by applying a contextual inquiry-based worksheet and they wereselected by a cluster random sampling technique. The results showed that students' higher-order thinking skill of group treated by using a contextual inquiry-based worksheet were better than the control ones, in which the score was 83.33 compared to 73.33 on the standard deviation of 14.76. Furthermore, students who were given the treatment have also affected their own science process skills, it was proved by achieving a higher score of experimental group, (89.44 compared to 73.45) on the significance level of α = 0.05. It was clearly revealed that the contextual inquiry-based worksheet was very effective on students' higher-order thinking skills and science process skills of Microbiology as well.**

Keywords—worksheet, fungi, higher-order thinking, science process skill

I. INTRODUCTION

On the teaching and learning process, an educator will definitely require a learning material [1] [9] [7]. One of the learning materials commonly used is a worksheet. 34 students in Muhammadiyah University of South Tapanuli (UMTS) who had completed the lecture matter of microbiology were given a questionairre to find out any obstacles during the learning process occurs. 90% of students mentioned that except books, they have been using worksheets as the learning media. The use of worksheets on the learning process was that 90% of students claimed that any worksheets in which they usually have used was still incomplete, 73% of students claimed that they required worksheets to be able to improve their self-participation in investigating what they have experienced in the world directly.

Besides, to increase students' science process skills, the use of contextual inquiry-based worksheet has also increased their higher-order thinking skills [2] [6] [8]. According to the study of that learning steps or indicators of inquiry learning model could develop or improve students' science process skills [4] [7] [11] [12]. The results of this observation proved that students' science process skills and higher-order thinking skills in UMTS were classified in low category on the average of 46,03 towards their higher-order thinking skills and science process skills on the average of 14,49 respectively. It was expected that the use of contextual inquiry-based worksheet on the matter of fungi on food could improve students' science process skills and higher-order thinking skills of Biology Education in UMTS, Padangsidimpuan.

From the description aforementioned above, the researcher has conducted a study in the title of "The effectiveness of contextual inquiry-based worksheet on the matter of fungi on food towards students' science process skills and higher-order thinking skills in Muhammadiyah University of South Tapanuli, Padangsidimpuan.

II. METHOD

2.1. Research Method

The research method was a quasi experimental technique with all the fourth semester students of Biology Education in UMTS [3].The sample consisted of two classes, namely Class A was treated as control group and Class C was treated as experimental group with *cluster random sampling [3]*. The learning process on the experimental group applied the contextual inquiry based-worksheet on the matter of fungi on food, and the control group applied a conventional worksheet on the matterof fungi on food. Those treatmentwere conducted for four sessions or eight hours per semester credit.

2.2. Test Instruments

The test of higher-order thinking skills contains 15 multiple choice and the test of scientific process skills contains 15 essay tests.

2.3. Technique of Data Analysis

Before the test instruments used, those instruments had been initially tried out to students which were excluded to the research samples. Data had been analyzed from the result of instrument test in which validity, reliability, item discriminant index and item difficulty level of those tests had been completely conducted.

2.4. Hypotheses Testing

After students' pretest and post-test obtained, so that data testing had applied the test of normality, test of homogeneity and the test of hypotheses, respectively.

III. RESULTS AND DISCUSSION

3.1. The Results of Instrumental Testing

To be capable of being used as the instruments in this study, those instruments which were made by researcher must be tested either any validity, reliability, discriminant index and also difficulty level as well. Those instruments were initially validated its content and construct aspect by three expertised lecturers in Microbiology and then they had been empirically validated to the students of sixth semester who had completed the lecture topic of microbiology in UMTS.

3.2. Pretest

Pretest was given to students before the treatment conducted to find out the scores of students' higher-order thinking skills and science process skills of both classes. The average score of higher-order thinking skills in control group was 46.03, with standard deviation of 14.28. Meanwhile the experimental group had the average score of 49.17, with standard deviation of 13.87. The average score of science process skills in control group was 14.44, with standard deviation of 4.753. Meanwhile the experimental group had the average score of 14.79,with standard deviation of 6.56.

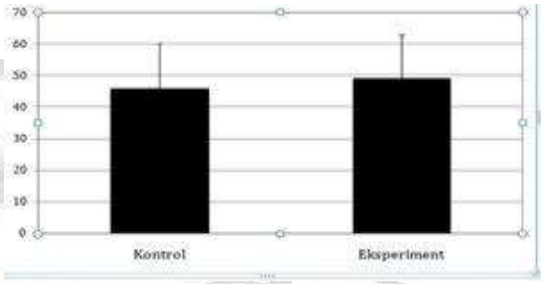

Figure 1: Pretest of students' higher-order thinking skills

Students on experimental group, 49.17±13.87 (X±SD) showed that their own higher-order thinking skills were almost similar with the control group, 46.03±14.28 (X±SD). (t = 0,74(< 1.681)).

The results of pretest on students' higher-order thinking skills of both classes were calculated by a *student's t-test* showed that both classes did not possess any significant differences, so that both classes were used as the objects of this study.

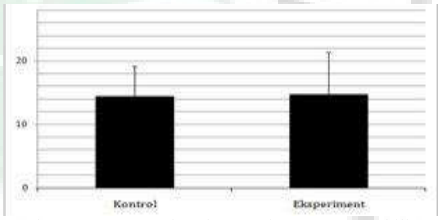

Figure 2: Pretest of students' science process skills

Students on experimental group, 14.79 ± 6.56 (X±SD) showed that their own science process skills were almost similar with the control group, 14.44 ± 4.753 (X±SD). (t = 1.17 (<1,681)). The results of students' scientific process skills on both classes were calculated by a *student's t-test* showed that both classes did not possess any significant differences, so that both classes were used as the objects of this study.

3.3. Post-test

The average score of students' higher-order thinking skills in control group was 73.33, with standard deviation of 14.76. Meanwhile the experimental group had the average score of 83.33, with standard deviation of 11.63.

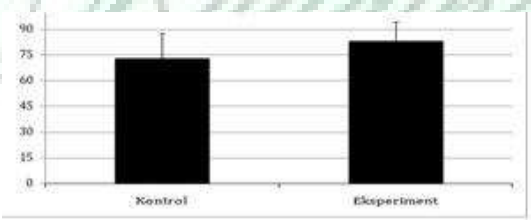

Figure 3: Post-test of students' higher-order thinking skills

Students on the experimental group, 83.33±11.63 (X±SD) showed that their own higher-order thinking skills were higher than control group, 73.33±14.76 (X±SD). (t = 2.5411 (>1,681)).

The results of post-test that were visualized in Figure 3 showed that higher-order thinking skills on the experimental group taught by using a contextual inquiry-based worksheet were much better than control group taught by using a conventional worksheet in Microbiology.

The average score of students' science process skills in control group was 72.14, with standard deviation of 8.517. Meanwhile the experimental group had the average score of 89.17, with standard deviation of 6.29.

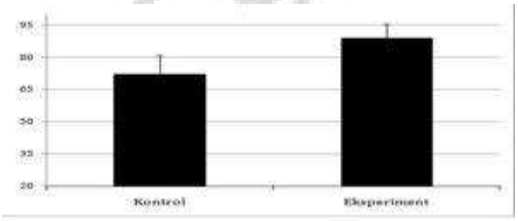

Figure 4. Post-test of students' science process skills

Students on experimental group, 89.17±6.29 (X±SD) showed that students' science process skills were higher than the control group, 72.14±8.517 (X±SD). (t = 7.53 (>1,681)).

The results of post-test that were visualized in Figure 4 showed that science process skills on the experimental group taught by using a contextual inquiry-based worksheet were much better than control group taught by using a conventional worksheet in Microbiology.

3.4. Test of Normality

Test of normality was conducted by using liliefors test. The results of normality test on the control and experimental group for pretest and post-test were normally distributed on the significance level of α = 0.05. There were no extreme data and beyond the normal range available. The result of normality test could be seen in Table 1.

Table 1. The Calculation of Normality Test

NO	Data penelitian			Lhitung	Ltabel	Kesimpulan
1.	Kelas kontrol	kemampuan berpikir tingkat tinggi	Pretest	0,14	0.19	Normal
			Posttest	0.1	0.19	Normal
		keterampilan proses sains	Pretest	0.17	0.19	Normal
			Posttest	0.09	0.19	Normal
2.	Kelas eksperim ent	Kemampuan berpikir tingkat tinggi	Pretest	0,12	0.18	Normal
			Posttest	0.14	0.18	Normal
		keterampilan proses sains	Pretest	0.15	0.18	Normal
			Posttest	0.09	0.18	Normal

From the result of normality test described in Table 2 could be concluded that all the L_{count} was higher than L_{table}, it means that the entire data was normally distributed.

3.5. Test of Homogeneity

Test of homogeneity was conducted by dividing the highest variant score with the lowest ones on the control and experimental group using two similar data. The result of homogeneity test could be seen in Table 2.

Table 2.The Calculation of Homogeneity

NO	Data Penelitian		Fhitung	Ftabel	Kesimpulan
1	kemampuan berpikir	Pretest	1,05	1,634	Homogen
2	tingkat tinggi	Posttest	1,6	1,634	Homogen
3	keterampilan proses	Pretest	1,9	1,634	Homogen
4	sains	Posttest	1,831	1,634	Homogen

Test

From the data result of homogeneity test described in Table 3 could be concluded that all the F_{count} was lower than F_{table}, it means that the entire data was homogenous on the significance level of 0.05

3.6. Hypotheses Testing

On the pretest of students' higher-order thinking skills, the average score of control group was 46,03 with standard deviation of 14, 28 and the average score of experimental group was 49,17 with standard deviation of 13,87. The score of $t_{count}$was 0,658. The score of t_{table} with thesignificance level of $\alpha = 0.05$ and $df = (n_1 + n_2) - 2 = (21 + 24) - 2 = 43$, was 1,681. The comparison between the value of t_{count} and t_{table} was that $t_{count}<t_{table}$or (0,74<1,681). This condition has stated that the average score of students' higher-order thinking skills on the pretest of both classes did not have any significant differences and possess the same capability.

On the post-test of students' higher-order thinking skills, the average score of control group was 73.33 with standard deviation of 14.76 and the average score of experimental group was 83, 33 with standard deviation of 11,63. The value of $t_{count}$was 2,5411. The value of t_{table} with the significance level of $\alpha = 0.05$ and $df = (n_1 + n_2) - 2 = (21 + 23) - 2 = 43$, was 1,681. The comparison between t_{count} and t_{table} was that $t_{count}>t_{table}$or (2,5411>1,681) showed that H_0 was rejected and Ha was accepted for sure.

In the manner of this case could be concluded that there were any differences of students' higher-order thinking skills on the class taught by using a contextual inquiry-based worksheet on the matter of fungi on food rather than taught by using a conventional worksheet on the matter of fungi on food of Microbiology in UMTS, Academic Year 2016/2017.

On the pretest of students' science process skills, the average score of control group was 14,44 with standard deviation of 4,753 and the average score of experimental group was 14,79 with standard deviation of 6, 56. The value of $t_{count}$was 1, 17. The value of t_{table} with the significance level of $\alpha = 0.05$ and $df = (n_1 + n_2) - 2 = (21 + 24) - 2 = 43$, was 1,681. The comparison between t_{count} and t_{table} was that $t_{count}<t_{table}$ or (1,17<1,681). This condition has stated

that the average score of students' science process skills on pretest of both classes did not have any significant differences and possess the same capability.

On the post-test of students' science process skills, the average score of control group was 72,14 with standard deviation of 8,517 and the average score of experimental group was 89,17 with standard deviation of 6,29. The value of $t_{count}$was 7,53. The value of t_{table} with the significance level of $\alpha = 0.05$ and $df = (n_1 + n_2) - 2 = (21 + 23) - 2 = 43$, was 1,681. The comparison between t_{count} and t_{table} was that $t_{count} > t_{table}$or (7,53>1,681) showed that H_0 was rejected and Ha was accepted for sure.

In the manner of this case could be concluded that there were any differences of students' science process skills on the class taught by using a contextual inquiry-based worksheet on the matter of fungi on food of Microbiology in UMTS, Academic Year 2016/2017.

IV. CONCLUSION

There were the effects in using the contextual inquiry-based worksheet on the matter of fungi on food towards students' higher-order thinking skills and science process skills of Biology Education in Muhammadiyah University of South Tapanuli in academic year 2016/2017. Students on the experimental group taught by using a contextual inquiry-based worksheet on the topic of fungi on food showed that their higher-order thinking and science process skills were much better than the control group taught by using a conventional worksheet on the topic of fungi on food in Microbiology [10].

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