Next, calculate the average pretest and posttest:

$$\bar{x} = \frac{\sum x \text{ student}}{n}$$

information: *n* is the number of students

To test the similarity of the two averages, do the test of normality first to find out whether the sample comes from a population that is normally distributed or not.

In addition, homogeneity tests were also conducted to determine whether the study sample had homogeneous variance or not. After that, two similarity tests were conducted on average using the Independent Sample T Test with the help of SPSS version 16.0. Furthermore, for the posttest value a two-difference difference test was performed with the help of SPSS version 16.0.

N-gain Calculation

From the pretest and posttest scores, the increase is calculated for each student with the normalized gain formula (Hake, 1998):

$$\langle g \rangle = \frac{\% \text{ posttest score} - \% \text{ pretest score}}{100\% - \% \text{ pretest score}}$$

This value is then calculated as the average n-gain in each research class using the formula:

$$\langle \bar{g} \rangle = \frac{\sum \langle g \rangle}{n}$$

The results of calculation of n-gain averages are then interpreted using the criteria from [19] presented in Table 2.

TABLE 2. Criteria *n-gain*

<g>	Category
≥ **0,7**	High
0,7< g ≥0,3	Medium
< 0,3	Low

RESULT AND DISCUSSION

The results of this study are in the form of pretest and posttest scores related to students' critical thinking skills. The average pretest and posttest scores in both experimental and control classes are presented in Figure 1.

Figure 1 shows that the pretest scores of students' critical thinking skills in the control class are not different. Then to ascertain whether the two research sample classes have the same initial ability of critical thinking, then the average value of critical thinking pretest of students in the two research classes was tested using two average similarity tests. Before the two similarity tests were carried out, the normality test and homogeneity test were conducted on the students' average critical thinking pretest. The results of the normality test using the Kolmogorov-Smirnov Z test, can be presented in Figure 2.

Some common challenges found in the problem that asked the students to draw resonance structures involved movement of electrons, arrow drawings, usage and placement of charge, number of resonance structures to draw, following octet rule, and the stability and contribution to the hybrid of each structure. This shows that the students did not possess a developed conceptual understanding of resonance theory and that they face several challenges learning it.

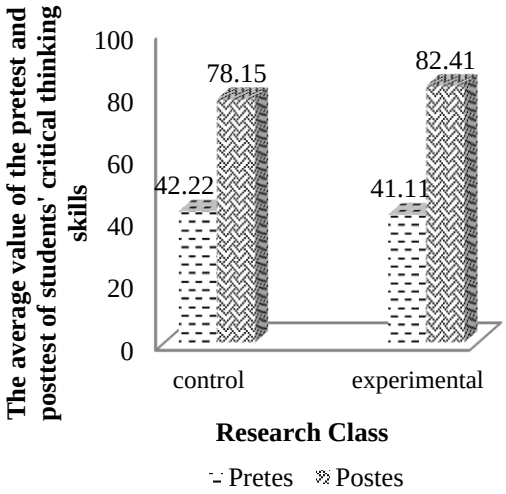

FIGURE 1. Average value of pretest and posttest critical thinking skills.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
experimental	.151	30	.079	.943	30	.109
control	.157	30	.058	.938	30	.080

a. Lilliefors Significance Correction

FIGURE 2. the result of the normality test

In Figure 2, the sig. values obtained for the experimental class and the control class> 0.05. Based on the test criteria, the experimental class and the control class come from populations that are normally distributed. Then the homogeneity test using the One Way ANOVA test presented in Figure 3.

Test of Homogeneity of Variances

critical thinking skills

Levene Statistic	df1	df2	Sig.
.055	1	58	.815

FIGURE 3. The result of the Homogenity test

Obtained sig value of 0.815. Based on the test criteria, the experimental class and the control class have a homogeneous variant. Because the data are normally distributed and homogeneous, the test used is the two average similarity test using the Independent Sample T Test which is presented in Figure 4.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
critical thinking skills	Equal variances assumed	.055	.815	-.282	58	.779	-1.110	3.940	-8.997	6.777
	Equal variances not assumed			-.282	57.941	.779	-1.110	3.940	-8.998	6.778

FIGURE 4. The result of average similarity

Based on the results of the SPSS 16.0 output, the sig (2-tailed) value of 0.779 was obtained. Based on the test criteria, the average score of students' critical thinking pretest in the experimental class is the same as the average value of the critical thinking pretest of students in the control class.

Figure 1 also shows that after learning has taken place an increase in students' critical thinking skills in the experimental class and the control class. Judging from the posttest value, the experimental class was higher than the control class. To ensure that the two research classes have different critical thinking skills, the two difference test is carried out. Before the two difference test is carried out on average, a normality test and a homogeneity test are conducted before the students' critical thinking posttest scores. The results of the normality test using the Kolmogorov-Smirnov Z test, can be presented in Figure 5.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
experimental	.132	30	.195	.952	30	.192
control	.159	30	.052	.920	30	.027

a. Lilliefors Significance Correction

FIGURE 5. the result of normality test

In Figure 5, the sig values obtained for the experimental class and the control class > 0,05. Based on the test criteria, the experimental class and the control class come from populations that are normally distributed. Then the homogeneity test using the One Way ANOVA test presented in Figure 6.

Test of Homogeneity of Variances

critical thinking skills

Levene Statistic	df1	df2	Sig.
3.373	1	58	.071

FIGURE 6. The result of the Homogenity test

Obtained a sig value of 0,071. Based on the test criteria, the experimental class and the control class have a homogeneous variant. Because the data are normally distributed and homogeneous, the test used is the two-mean difference test using the Independent Sample T Test which is presented in Figure 7.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
critical thinking skills	Equal variances assumed	3.373	.071	2.094	58	.041	4.270	2.039	.188	8.352
	Equal variances not assumed			2.094	53.331	.041	4.270	2.039	.181	8.359

FIGURE 7. The result of two-mean difference test

The test results of the difference in two mean state that the value of sig. (2-tailed) < 0.05. That is, accept H_1 or in other words the average value of posttest critical thinking skills of students in the experimental class using the PBM model is higher than the average posttest value of the control class using conventional learning. Thus, a problem-based learning model is effective for improving students' critical thinking skills related to some foods and drinks.

Then calculate the n-gain in the experimental class and the control class presented in Figure 8. In Figure 2, the average n-gain of the experimental class is 0,7 and the control class is 0,6. This is shows that the value of n-gain of students' critical thinking skills in the experimental class is categorized as high, while in the control class it is medium.

Differences in n-gain averages and categories in the experimental class and control class can be explained based on the activities of students in each stage of learning.

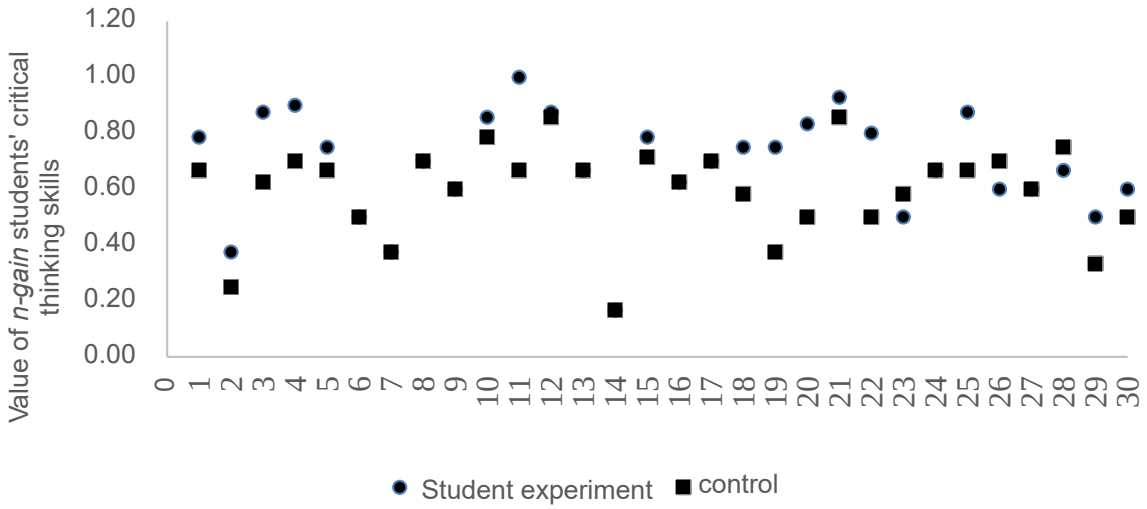

FIGURE 8. Value of n-gain critical thinking skills of students in the experimental class and the control class

Stage I Student Orientation to Problems

At this stage, students are faced with a problem related to hoax information presented in the discourse based on the discourse, students are asked to write the main questions. The following are some of the statements written by students:

Student 1: why are carbonated drinks still sold on the market?

Student 2: Why can carbonated drinks be used to clean the toilet?

Seeing a few students is not appropriate in formulating the main questions, the teacher directs how to determine the main questions that are in accordance with the discourse. The result is they are able to improve the main question statement.

Student 1: Is it true that information on carbonated drinks can clean the toilet?

Student 2: what are the ingredients in carbonated drinks?

Stage II Organizing Students for Learning

At this stage there are 2 activities, namely defining problems and organizing learning tasks related to discourse, as well as collecting appropriate information so as to obtain initial conclusions and can hypothesize. Students in groups are given 3 days to define problems, and gather information. After that students must include sources of information / references.

In addition to these activities, students periodically report the results of assignments to the teacher. The teacher evaluates the task and gives direction if there is information that is less relevant, and the source is not credible. On this suggestion, students make improvements and obtain information, including: (1) the content contained in carbonated drinks, (2) acidity of carbonated drinks, (3) buffer solution in blood, and (4) metal corrosion, from sources who have high credibility.

Stage III Guides Individual and Group Investigations

At this stage, students are guided to collect data by carrying out investigations and experiments to prove rust cleaning and pH testing in a solution or drink that has a pH similar to carbonated drinks. This investigation activity requires students to be actively involved and train students in their opinions to get explanations and problem solving. From the experiments they did, students could gather further information to strengthen the hypothesis, determine the purpose of the experiment, design experimental procedures, tools and materials, and be able to determine the variables involved to create their own ideas then consult the teacher. Based on the direction given by the teacher, students improve the experimental design.

Stage IV Develops and Presents Works

After designing the experiment correctly, for four days students were asked to make research reports related to solving hoax information problems related to some foods and drinks. Reports that have been made are then submitted to the teacher. In this stage students write down experimental results, then answer challenging questions related to experimental data to develop ideas or ideas by linking the results obtained during the experiment with the various information they have obtained from various previous sources. , and report the solutions obtained as a work.

Stage V Analyze and Evaluate the Problem Solving Process

At this stage, student learning outcomes are evaluated related to the material that has been learned and ask each group to communicate their work. In this way students will ask questions about the results of work between groups so that they will come up with various opinions, ideas such as using used plastic cups instead of beakers, as well as ideas from friends, so that they will understand the problem more deeply and can develop broader ideas.

Students are trained to be able to formulate the main questions. Students must also gather information needed to confirm the truth of the information circulating based on discourse. In searching for information, students are trained to choose relevant and credible sources, so that the information they obtain can be trusted and students can make temporary conclusions (inference) When making research reports, it means that students can determine what actions should be taken to confirm the truth of information circulating based on discourse. In presenting the work, various ideas can be raised such as the use of used plastic cups instead of beakers. Students are also able to communicate their work to others. With this learning stage, it can be ascertained that students' critical thinking skills can be trained.

CONCLUSION

In problem-based learning, students ask the main question, gather information needed to solve the problem, consider the credibility of the source of information, make temporary conclusions (inference), decide actions to resolve the problem and communicate it to others. Students have made a research report to overcome hoax information problems. Based on the average pretest, posttest and n-gain values obtained, it can be concluded that the problem-based learning models is effective for improving students' critical thinking skills: (related to some foods and drinks).

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