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The Effects of Using Predict-Observe-Explain Strategy Assisted by Conceptual Change Text towards the Conceptual Mastery of Prospective Primary School Teachers on the Matter and its Changes

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Abstract. This research aims at determining the differences in the increase of conceptual mastery of the matter and its changes between students who study with the Predict-Observe-Explain Strategy assisted by Conceptual Change Text (POE-ACCT) and students who study with the Expository Strategy. This study involved 63 students who were divided into 2 groups, a control group (33 students) and an experiment (30 students). The research instrument is in the form of a five-tier diagnostic test. The instrument has gone through an expert and empirical validation process. The data obtained were analyzed with descriptive and inferential statistics. The results showed a significant increase in the conceptual mastery of the experimental group (*N-gain* = 0.26) and in the control group (*N-gain* = 0.06), which were significant ($p < .05$). The POE-ACCT strategy was found more beneficial compared to the Expository Strategy in increasing the conceptual mastery of the prospective elementary school teachers. Although the POE-ACCT strategy provided an increase in the conceptual mastery, an increase of 0.26 was categorized in a low category and this indicated the need for improvement of the strategy.

Keywords. POE strategy assisted by text of conceptual change, Conceptual mastery, Matter and its changes

Introduction

One of the very important basic concepts and a prerequisite for understanding other science concepts at the next level is the topic of matter and its changes, which are solids, liquids, and gases, and the changes caused by heat and other forces (Howe & Jones, 1993; Johnson, 1998; Snir, Smith & Raz, 2003; Merritt, Shwartz & Kracjik, 2007; Treagust et al., 2010; Ozmen, 2011; Ozmen, 2013; Sopandi, Latip & Sujana, 2017; Banawi et al., 2017). An understanding of objects, substances, and particles is a prerequisite concept for learning science (chemistry) at a higher school level.

However, some research results indicated that teachers' understanding of the basic science concepts to be taught is not optimal and is classified in a sufficient category (Jaelani, 2015). Conceptual understanding of elementary school teacher candidates on the topic of matter and its changes has not been optimal, there are still many who experience misconceptions and do not understand the topic (Sopandi, Latip & Sujana, 2017). The understanding of the students who will be prospective teachers about the presence of particles (solid, liquid, and gas) is good enough. However, most of them do not understand the existence of freeform particles.

At the macroscopic level, most of them understand the concepts of expansion, evaporate, condense, melt, and freeze, but they do not understand the concepts of sublimation and crystallization. In fact, the subjects of the above research have studied the topic of matter and its changes in the previous level (elementary, junior high, and high school) as well as in the subjects of Natural Sciences (Basic Physics, Basic Chemistry, Basic Concepts of Natural Sciences, and Elementary School Science Learning) (Banawi et al., 2017). A recent study showed that prospective elementary school teachers did not develop a strong foundation regarding chemistry during their schooling. Therefore, science teaching methods need to be handled more effectively for prospective teachers in primary schools (Harmala-Brasken, Hemmi & Kurten, 2020).

Solutions for the weaknesses of teachers and prospective teachers need to be sought. It can be done with suitable learning models applied in elementary schools. Provision of lectures with a suitable model applied in elementary schools will be a provision for prospective teachers to teach it to their students later. One strategy that can be tried is the Predict-Observe-Explain (POE) strategy. This strategy is known to improve students' mastery of concepts on certain topics (Cos et al., 2021; Cinici & Demir, 2013; Kibirige, Osodo & Tlala, 2014). This strategy is also seen to increase student understanding (Liew & Treagust, 2004; Adebayo & Olufunke, 2015; Teo, Yan & Goh, 2016; Sreerekha, Arun & Swapna, 2016) and can improve misconceptions of teacher and teacher candidates (Ipek et al., 2010). A laboratory activity with Predict-Observe-Explain (POE) can improve and enhance the understanding and attitudes of prospective teachers compared to traditional learning (Vadapally, 2014; Hilario, 2015; Gernale, Aranes & Duad, 2015; Acarsesen & Mutlu, 2016). This strategy also has limitations, including: (1) for elementary school students, writing answers can be a barrier to communicating the idea, students with limited abilities may have difficulty explaining the reason for their predictions; (2) not suitable for all topics, for example, topics that are not "hands-on"; (3) some demonstrations must be chosen selectively and not repeatedly; and (4) educators need to be careful in making predictive questions (Joyee, 2006).

In order for cognitive conflict to occur based on constructivist understanding as an effort to recognize and minimize the occurrence of misconceptions, the Predict-Observe-Explain (POE) Strategy would be an alternative solution. Even so, the use of POE Strategy still leaves a misconception in students (Theodorakakos, Hatzikraniotis & Psillos, 2010). In addition, this strategy requires a long time for cognitive conflict and concept change. Thus, more efforts related to the concept change activities are needed.

One strategy approach to conceptual change is Conceptual Change Text (CCT). It is a text containing theories to convince students that they have misconceptions related to scientific facts (Hynd, 2001; Ozkan & Selcuk, 2015). It can also identify and analyze misconceptions and is designed based on the process of concept change Kim & Van Duensen (1998), as cited in (Setyaningrum, 2016). In the Conceptual Change Text, students are asked to provide predictions of a situation, a description of misconceptions, and a scientific explanation of the situation presented (Chambers & Andre, 1997; Balci, 2006; Sahin & Cepni, 2011; Aydin, 2012; Özmen & Aseriazar, 2017). In addition, this text determines students' misconceptions, explains their reasons, and explains why they are wrong by using concrete examples (Guzzetti, et al., 1997; Ozkan & Selcuk, 2015). The presentation of a misunderstanding in reading material is important to be conducted because it can help the teacher in planning a better learning process (Keles & Demirel, 2010).

Conceptual Change Text or CCT can be integrated with POE as it starts with prediction questions, students can predict answers with the initial knowledge they already have. To observe scientific explanations related to this case, students can undertake activity to express new knowledge that is reasonable and clear. After that, students can explain scientific answers related to these questions (Ültay, Durukan & Ültay, 2014).

However, the use of POE strategy assisted by Conceptual Change Text (POE-ACCT) to master the topic of matter and its changes has never been raised. Besides, investigations regarding the use of POE strategy assisted by Conceptual Change Text on the understanding of prospective elementary school teachers at the macroscopic, submicroscopic (verbal and visual), and symbolic levels, and the direction of its effectiveness have not been carried out. Thus, this research used POE strategy assisted by Conceptual Change Text with a learning tool for the topic of matter and its changes that had been developed previously.

Referring to the background above, the proposed research question is "Is there a difference in increasing understanding of the concept of matter and its changes between students who study with the POE Strategy assisted by Conceptual Change Text (POE-ACCT) and students who study with the Expository Strategy? This research is expected to enrich the data of conceptual mastery and strategies that are used so that it becomes an inspiration for improvement and further research.

Method

This research employed quasi-experimental methods. The design used was a non-equivalent pretest-posttest control group design, which aims at comparing two different treatments to the research subjects. The difference between the two measurements is considered to be caused by the treatment. Quasi-experimental design (McMillan & Schumacher, 2001; Cohen, Manion & Morrison, 2007; Sugiyono, 2013; Creswell, 2016; Ridwan et.al., 2020; Malawat et al., 2021; Muhammad et al., 2021) conducted in this research is presented in Figure 1 below:

Experimental Group (A)	:	O_1 ————	χ_1 ————	O_2

Control Group (B)	:	O_3 ————	χ_2 ————	O_4

Figure 1. Quasi-Experimental Design

Description:

χ_1	:	Treatment with POE-ACCT Strategy
χ_2	:	Treatment with Expository Strategy
O_1	:	Pre-test of POE-ACCT group
O_2	:	Post-test of POE-ACCT group
O_3	:	Pre-test of Expository group
O_4	:	Post-test of Expository group
-------	:	Random class

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The two classes were given a pre-test, a lecture on the topic of matter and its changes, and a final test (post-test). The initial test and final test are the same.

Instrument

This research used a five-tier diagnostic test instrument in the form of multiple-choices (reliability test, r = 0.774) and non-test instruments in the form of a questionnaire, interview guidelines, and observation sheets. The instrument has been validated by an expert and has been going through an empirical validation process. Expert validation of the test instrument was carried out by three experts (Sugiyono, 2013); a chemistry education expert, a chemist, and a basic education expert. Based on the validity score criteria (Akbar, 2013 in Fatmawati, 2016), in general, the validated instruments belong to the valid category. However, some of the errors contained in the device were corrected. Of the 18 numbers with 81 test instruments, there was one item (Number 3 with 4 items) and 9 other items that were not used, while the other questions were corrected before use so that the questions used were 17 questions with 68 items (obtained from 17 times 4). The order of the number of questions also had an adjustment.

Research Subject

The subjects were prospective elementary school teachers in one of the Primary School Teacher Education Study Program (PGSD) in Maluku in 2017/2018 Academic Year consisting of two classes. Based on randomization, incidentally, Class A was selected as the experimental group and Class B as the control group with 33 (28 female, 5 male) and 30 (24 female, 6 male) students respectively. They come from high school graduates in natural sciences, social sciences, languages, and vocational high schools and they have attended six semesters in their study programs. Lectures that have been taken include the Basic Concepts of Natural Sciences, Elementary School Science Learning, and Elementary School Science Practicum.

Data Analysis

All answers from 63 subjects were typed in the MS-Excel program, and grouped and scored according to the combination of the Five-tier Diagnostic Test answers (Banawi, et al., 2019). To calculate the magnitude of the increase of students' conceptual understanding based on their pre-test and post-test scores, a normalized gain (N-gain) that was developed by Meltzer (2002) was used. The N-gain calculation results were classified into High ($g \geq 0.70$); Moderate ($0.30 \leq g < 0.70$); and Low ($g < 0.30$) classification. The measurements were based on scores obtained by students based on test results, questionnaires, observations, and interviews. The quantitative data were analyzed with descriptive and inferential statistics. Inferential statistics include the average similarity test (normality and homogeneity) and the average difference test processed with the help of a computer using the SPSS Program 20.0 for Windows (Ghozali, 2006, p. 246).

Results

Some differences in an increase of conceptual understanding of the topic of matter and its changes in the experimental and control groups are presented in the following Tables.

Table 1. Pretest, Posttest, and N-gain Scores of the Students

Student	Experimental Group			Student	Control Group		
	Pretest	*Posttest*	*N-gain*		*Pretest*	*Posttest*	*N-gain*
E-01	8.82	29.41	0.23	C-01	51.47	60.29	0.18
E-02	45.59	73.53	0.51	C-02	40.44	51.47	0.19

E-03	31.62	71.32	0.58	C-03	28.68	34.56	0.08
E-04	0.74	58.09	0.58	C-04	22.79	23.53	0.01
E-05	27.21	72.79	0.63	C-05	20.59	19.12	-0.02
E-06	18.38	11.76	-0.08	C-06	30.88	33.82	0.04
E-07	47.06	62.50	0.29	C-07	20.59	22.06	0.02
E-08	33.82	42.65	0.13	C-08	11.03	4.41	-0.07
E-09	18.38	33.82	0.19	C-09	38.24	47.79	0.15
E-10	60.29	93.38	0.83	C-10	18.38	19.12	0.01
E-11	39.71	32.35	-0.12	C-11	74.26	86.76	0.49
E-12	19.85	20.59	0.01	C-12	17.65	60.29	0.52
E-13	25.00	51.47	0.35	C-13	36.03	46.32	0.16
E-14	12.50	50.00	0.43	C-14	0.74	7.35	0.07
E-15	27.21	20.59	-0.09	C-15	-0.74	7.35	0.08
E-16	80.15	86.76	0.33	C-16	31.62	38.24	0.10
E-17	-6.62	-5.88	0.01	C-17	-1.47	-3.68	-0.02
E-18	25.00	2.94	-0.29	C-18	33.82	29.41	-0.07
E-19	18.38	66.91	0.59	C-19	5.15	31.62	0.28
E-20	11.76	45.59	0.38	C-20	20.59	13.97	-0.08
E-21	25.00	44.85	0.26	C-21	16.18	25.00	0.11
E-22	6.62	27.21	0.22	C-22	30.88	22.79	-0.12
E-23	44.12	88.97	0.80	C-23	-3.68	13.97	0.17
E-24	22.79	20.59	-0.03	C-24	9.56	22.79	0.15
E-25	-5.88	21.32	0.26	C-25	2.94	-8.82	-0.12
E-26	7.35	16.18	0.10	C-26	16.91	0.74	-0.19
E-27	19.12	64.71	0.56	C-27	11.76	4.41	-0.08
E-28	24.26	79.41	0.73	C-28	27.21	27.21	0.00
E-29	34.56	25.00	-0.15	C-29	22.06	38.24	0.21
E-30	27.94	33.82	0.08	C-30	49.26	25.00	-0.48
E-31	28.68	21.32	-0.10				
E-32	2.21	48.53	0.47				
E-33	13.97	9.56	-0.05				
Total	795.59	1422.06	8.65	Total	683.82	805.15	1.74
Average	24.11	43.09	0.26	Average	22.79	26.84	0.06
Std.Dev.	18.22	26.59	0.30	Std. Dev.	17.51	21.03	0.19

Table 1 above presents that the mean pretest scores of the experimental and control groups were not much different (only 1.32 points difference).

Table 2**.** Summary of Statistical Test Results for Final Pre-test, Post-test, and N-gain of Experimental and Control Groups

Test	Group	Average Score	Average Similarity Test				Conclusion	Average Difference Test		p(sig)
			Normality Test *)		Homogeneity Test**)			t-test		
			Stat Test	p	Stat Test	p		Stat Test	p	
Pretest	Experimental	24.11	0.128	0.184	0.001	0.971	Normal and Homogeneous	0.291	0.772/2	Not Significantly Different [a] p = 0.386
	Control	22.79	0.100	0.200						
Posttest	Experimental	43.09	0.121	0.200	3.631	0.061	Normal and	2.673	0.010/2	Significantly

	Control	26.84	0.101	0.200			Homogeneous			Different [a] p = 0.005
N-gain	Experimental	0.26	0.101	0.200	9.239	0.003	Normal and Not	3.218	0.002/2	Significantly
	Control	0.06	0.115	0.200			Homogeneous			Different [a] p = 0.001

Description: [*]) Kolmogorov-Smirnov (Normal: $p > .05$)
[**])Levene Statistics (Homogenous: $p > .05$)
[a]) t-test ($p/2 > .025$), H_0 accepted

Table 2 above presents that the initial conceptual understanding of the experimental and control group students on the topic of matter and its changes is the same or not significantly different ($p > .05$). After conducting lectures in the experimental group, there was an increase in conceptual understanding. However, the increase is still in the low category (0.26). The N-gain of the experimental group was 0.20 points greater than the N-gain of the control group.

The final conceptual understanding of the experimental and control group on the topic of matter and its changes was significantly different ($p = .005$). The increase in conceptual understanding (N-gain) of the experimental group students was significantly different ($p < .05$) with the increase in conceptual understanding of control group students. This means that the POE strategy assisted by Conceptual Change Text (POE-ACCT) can improve the conceptual understanding of elementary school teacher candidates related to the topic of matter and its changes.

Table 3. *Summary of Statistical Test Results of Average Pre-test, Post-test, and N-gain Scores on the Aspect Level of Conceptual Understanding*

Level Score	Group	Average Score	Average Similarity Test				Conclusion	Average Difference Test		Conclusion p(sig)
			Normality Test*)		Homogeneity Test **)					
			Stat Test	P	Stat Test	P		Stat Test	P	
Macroscopic										
Pretest	Experimental	59.00	0.170	0.016	0.537	0.466	Abnormal and Homogeneous	0.0578	0.0578	Not Significantly Different[b]), p = 0.0578
	Control	58.04	0.136	0.163						
Posttest	Experimental	66.49	0.155	0.043	0.030	0.863	Abnormal and Homogeneous	0.068	0.068	Not Significantly Different[b]), p = 0.068
	Control	58.82	0.096	0.200						
N-gain	Experimental	**0.14**	0.217	0.000	0.054	0.817	Abnormal and Homogeneous	0.081	0.081	Not Significantly
	Control	**-0.01**	0.112	0.200						

										Different[b], p = 0.081
Verbal Submicroscopic										
Pretest	Experimental	45.81	0.168	0.019	0.461	0.500	Abnormal and Homogeneous	0.332	0.332	Not Significantly Different[b], p = 0.332
	Control	48.63	0.135	0.169						
Posttest	Experimental	60.61	0.146	0.072	1.529	0.221	Normal and Homogeneous	2.533	0.014/2	Significantly Different[a], p = 0.007
	Control	50.20	0.126	0.200						
N-gain	Experimental	**0.26**	0.087	0.200	0.007	0.934	Abnormal and Homogeneous	0.001	0.001	Significantly Different[b], p = 0.001
	Control	**-0.06**	0.178	0.016						
Visual Submicroscopic										
Pretest	Experimental	39.39	0.160	0.032	0.325	0.570	Abnormal and Homogeneous	0.263	0.263	Not Significantly Different[b], p = 0.263
	Control	48.63	0.173	0.023						
Posttest	Experimental	58.47	0.159	0.033	3.591	0.063	Abnormal and Homogeneous	0.141	0.141	Not Significantly Different[b], p = 0.141
	Control	47.45	0.125	0.200						
N-gain	Experimental	**0.33**	0.106	0.200	6.082	0.016	Normal and Homogeneous	3.008	0.004/2	Significantly Different[a], p = 0.002
	Control	**0.10**	0.159	0.051						
Symbolic										
Pretest	Experimental	42.25	0.121	0.200	0.006	0.941	Abnormal and Homogeneous	0.454	0.454	Not Significantly Different[b], p = 0.454
	Control	39.41	0.163	0.040						
Posttest	Experimental	58.29	0.140	0.099	0.427	0.516	Normal and	2.578	0.012/2	Significantly

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	Control	43.33	0.142	0.127			Homogeneous			Different[a)], p = 0.006
N-gain	Experimental	**0.27**	0.108	0.200	2.604	0.112	Normal and Homogeneous	2.344	0.022/2	Significantly Different[a)], p = 0.011
	Control	**0.06**	0.079	0.200						

Description: *) Kolmogorov-Smirnov (Normal: $p > .05$)
**) Levene Statistics (Homogenous: $p > .05$)
a) t-test ($p/2 > .025$), H_0 accepted
b) Mann-Whitney Test ($p > .05$), H_0 accepted

From Table 3, it appeared that the increase of students' understanding of the verbal submicroscopic, visual submicroscopic, and symbolic level from the experimental and control groups was significantly different (each *p-value* < .05). While the understanding of the macroscopic level was the same or not significantly different ($p > .05$). This means that in general, the POE-ACCT Strategy can improve the understanding level of prospective elementary school teachers regarding the topic of matter and its changes.

The percentage description of the increase in the average score of each level of understanding of the experimental and control groups is presented in Figure 2. From the figure, it appeared that the increase in the average score of each level of understanding of the experimental group is higher compared to the control group.

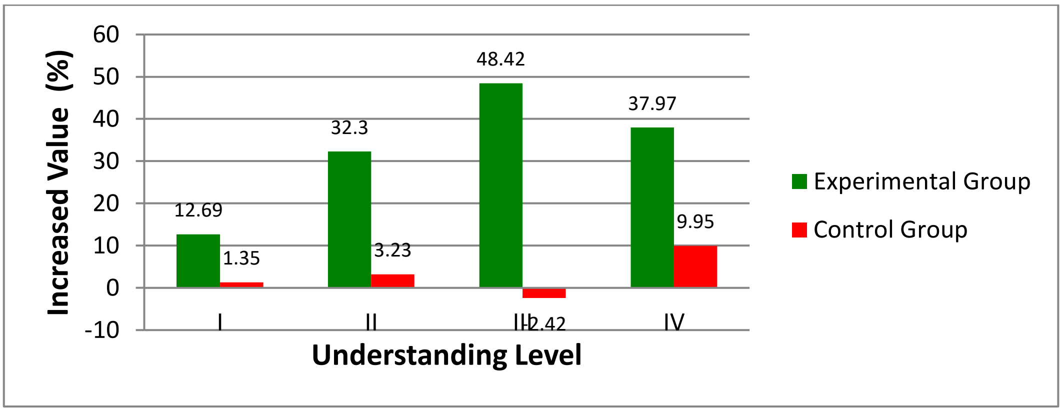

Figure 2. Percentage of Increase in Average Score for Each Understanding Level

To see whether there are significant differences in scores between groups and levels of understanding, the Anova test was used. Anova test is used to measure differences between groups to determine whether there are significant differences or not (Wahyuddin, 2015). In the case of metric dependent variables and two or three categorical independent variables, Two-ways Anova (Ghozali, 2006: 58) is used. Statistical test results are presented in Table 4 below.

Table 4. Summary of Statistical Test Results of Post-test Score with Anova

Source	Type III Sum of Squares	F	Sig.	Conclusion *p(sig)*
Level	5006.975	4.250	0.006	Significantly Different[c)]
Group	7622.024	19.410	0.000	Significantly Different[c)]
Level * Group	426.264	0.362	0.781	Not Significantly Different[c)]

Description: [c)] Two-ways Anova ($p > .05$), H_0 accepted

Table 4 above show that (1) the mean scores of the four levels (Macroscopic, Verbal Submicroscopic, Visual Submicroscopic, and Symbolic) are significantly different ($p < .05$), (2) the mean scores of the two groups (Experimental and Control) are significantly different ($p < .05$), and (3) there is no interaction between Level and Group (*F count* = 0.362; $p > .05$). This means that the lecture of matter and its changes through the POE-ACCT strategy for prospective elementary school teachers was superior compared to lectures with the Expository Strategy in improving conceptual understanding of elementary school teacher candidates.

Table 5. Percentage of Change in Concept Patterns of Elementary School Teacher Candidates (E-C)

Results	***Post-test***											
Category	Experimental Group						Control Group					
Pre-test	PK	TPSK	MSK	TPK	M	E	PK	TPSK	MSK	TPK	M	E
PK	6.06*	1.78	0.71	0.00	0.36	0.00	2.75*	3.14	0.20	0.00	0.20	0.00
TPSK	14.44	31.19*	8.02	0.00	1.43	0.71	6.47	37.84*	11.96	0.20	4.51	0.98
MSK	4.10	8.20	3.57*	0.18	2.67	0.18	1.76	10.98	4.71*	0.00	1.57	0.98
TPK	0.18	0.36	0.00	0.00	0.18	0.00	0.00	0.59	0.00	0.00	0.00	0.20
M	1.96	3.92	0.89	0.00	1.07*	0.71	0.20	4.12	1.96	0.00	1.96*	0.59
E	0.36	4.46	1.07	0.00	0.53	0.71*	0.00	0.59	0.59	0.00	0.78	0.20*
Total	**27.10**	49.91	**14.26**	0.18	6.24	2.31	11.18	57.26	19.42	0.20	9.02	2.95

Description: PK = *Paham Konsep* (Understand the Concept); TPSK = *Tidak Paham Sebagian Konsep* (Do not Understand Some Concepts); MSK = *Miskonsepsi Sebagian Konsep* (Some Misconceptions); M = *Miskonsepsi* (Misconceptions); TPK = *Tidak Paham Konsep* (Do not Understand the Concept) and E = Error.
* No change in conception.

From Table 5 above, more than half the number of students in the experimental group (57.40%; 100% - 42.60%) experienced a change in conception. The unchanged conceptions that were found is 42.60% (PK-PK: 6.06%; TPSK-TPSK: 31.19%; MSK-MSK: 3.57%; M-M: 1.07%; E-E: 0, 71%). In total, 24 patterns of conception were found.

Discussion

The mean post-test and pre-test showed that the understanding of elementary school teacher candidates (experimental and control groups) at four levels of understanding (macroscopic, verbal submicroscopic, visual submicroscopic, and symbolic) was varied. The percentage of understanding of the symbolic level is smaller than the other three levels. The results of this research are in line with the previous research (Banawi et al., 2019)

The mean score of the experimental group was 24.11 and the control group was 22.79 (Table 1). However, there was an increase in the understanding of the experimental group that is in the low category compared to the control group (Table 2). The students that are categorized in the low category is due to the increase in scores obtained by students is also low. The acquisition of a low final score is allegedly caused by students' lack of understanding in completing the form of test questions used and the doubt in determining the score of Confidence Rating Index (CRI) (Setyaningrum, 2016). Misunderstanding in completing the five-tier diagnostic test caused a lot of students to be included in the error category which subsequently resulted in a low final score. In addition, inaccuracies in determining CRI can impact the final score and the conception category of the students.

Learning with POE-ACCT strategy (or its variants) certainly positions students to solve problems proposed by lecturers through various stages such as predicting, conducting experiments or observing directly, and giving explanations (Nurmalasari, Jayadinata & Maulana, 2016). Thus, the role of lecturers has changed slightly and is increasingly challenging. One effort to answer this challenge is by changing the role of educators, from providers and suppliers to facilitators so that lecturers can share information and knowledge, and practice problem-solving skills with students (Mayasari et al., 2016).

Changing the role of lecturers is certainly not an easy thing. It requires knowledge, lesson planning, and adequate training. Meanwhile, students also need to adapt to lessons conducted by lecturers. Therefore, it is strongly suspected that another factor that caused the low acquisition of student scores is related to learning adaptation. Students are not yet familiar with the stages used in lectures with the POE-ACCT Strategy. Thus, lecturers need to improve the process or how to present the lecture materials. One alternative is to improve the lecture presentation process, for example, by using the Dual Modes program. Lectures with this program combine a scheduled face-to-face learning system and a self-instruction system by studying printed learning materials (Kadarohman & Nurihsan, 2008).

Self-instruction system is designed for individuals to develop a set of knowledge through cognitive restructuring, problem solving, and self-control. Through the existing process, it is expected that adaptive behavior will occur in the form of changes in individual's self-verbalization from negative to positive. It is believed that independent learning can help students' understanding of learning content (Setiawan, Solehuddin & Hafina, 2019). With the presentation of lectures using the Dual Modes program, it is expected that the effectiveness and efficiency of lectures held can increase. In the end, it can train students to control their academic performance and support the conceptual understanding of the prospective elementary school teacher candidates on the concepts being studied.

When discussing the difference in the average of post-test scores of the experimental and control groups, it was obtained that the understanding of the macroscopic level and the visual submicroscopic level of the experimental and control group students on the topic of matter and its changes were not significantly different ($p > .05$). Meanwhile, the understanding of verbal submicroscopic and symbolic levels of experimental and control group students on the topic of matter and its changes were significantly different ($p < .05$). Most students understand the phenomenon (macroscopic level) of the topic of matter and its changes but they cannot explain it well at the submicroscopic level (verbal and visual) and symbolic level (Banawi et al., 2019).

To test the significant increase of understanding in each level of understanding (Macroscopic, Verbal Submicroscopic, Visual Submicroscopic, and Symbolic) of experimental and control groups, the examination of the N-gain test scores of the two groups (Table 3) was conducted. After that, it was obtained that the understanding of the macroscopic level in both groups is the same or not significantly different ($p > .05$). These results are in line with previous studies (Sopandi, Latip & Sujana, 2017; Banawi, et al., 2017; Banawi, et al., 2018). In the experimental and control groups, the teaching patterns on the surface (listening to lectures and doing exercises) are quite imprinted. The learning experience with conventional learning experienced by students has become the initial knowledge and initial conception of students in both groups.

Based on the results of inferential statistical tests with the Two-ways Anova (Table 4), it can be concluded that the POE-ACCT strategy is more effective than conventional lecture program (expository) in increasing the conceptual mastery of prospective elementary school teachers at the macroscopic, verbal submicroscopic, visual submicroscopic, and symbolic levels. The experimental group experienced an increase in conceptual mastery and a decrease in misconceptions compared to the control group (Perdana, Suma & Pujani, 2018).

From the pattern of changes in the conception of prospective elementary school teachers that emerged, it is known that there are still misconceptions about the topic of matter and its changes. This topic is indeed one topic or concept where most students have alternative concepts. This finding is in line with previous findings (Bilgin, et al., 2017; Sopandi, 2017; Sopandi et al., 2018). Some misconceptions on the concept (MSK) are indeed different from misconceptions (M). However, an error percentage of more than 10% of the sample (14.26%, see Table 5) can be considered a significant error Caleon & Subramaniam, 2010[a]; Caleon & Subramaniam, 2010[b]; Kaltakci-Gurel, Eryilmaz & McDermott, 2017).

The results of the descriptive analysis and statistical tests above showed that the understanding of prospective elementary school teachers before and after the use of the POE strategy assisted by Conceptual Change Text (POE-ACCT) is different. Lectures on the matter and its changes through the use of POE strategy assisted by Conceptual Change Text (POE-ACCT) for prospective elementary school teachers is superior compared to the conventional lecture program (Expository Strategy) in improving the conceptual understanding of the prospective elementary school teachers. This is in accordance with similar studies conducted by Setyaningrum and Sopandi (2015) that stated that the conceptual change text can have a better influence on students' understanding than traditional text.

The understanding of elementary school teacher candidates related to the topic of matter and its changes at the macroscopic, verbal submicroscopic, visual submicroscopic, and symbolic levels can certainly be influenced by the delivery of the learning material. Learners can easily understand the subject matter with learning methods from educators who are adapted to the material Khausar, 2014). Science lecturers should believe that learning can shape the competencies and behavior of their students according to the strategies and subject matter they provide. The results of this research can be used as diagnostic data for corrective actions in learning. The questions such as "Are the lesson planning, stages of the POE-ACCT strategy, media, and learning resources appropriate?" can improve the lecture process and the learning tools. Evaluation and reflection on the entire learning process that has been carried out is a necessity. By looking at the results of this research, educators and/or educational researchers can see this as educational research results that can be used as a starting point in the context of educational practice and/or further educational studies (Suyitno, 2009; Banawi, 2017).

Conclusions

From the results of this research, it can be concluded that the understanding of elementary student teacher candidates on the topic of matter and its changes at the macroscopic, verbal submicroscopic, visual submicroscopic, and symbolic levels before and after the use of POE strategy assisted by Conceptual Change Text (POE-ACCT) is different. The POE-ACCT strategy can improve the conceptual understanding of elementary school teacher candidates at the verbal submicroscopic, visual submicroscopic, and symbolic levels. However, the increase is still in the low category. The use of the POE-ACCT strategy has succeeded in increasing the understanding of prospective elementary school teachers to more than a quarter (27.10%) in the

'Understand the Concept' (PK) category. However, there are still many students who are categorized in the TPSK category. The percentage of misconceptions was found more in the control group, so the change in concept in the experimental group students tended to be more positive than the control group. Prospective elementary school teachers tend to change their conception according to existing scientific concepts after they learn with the POE-ACCT strategy.

The results of this research have several implications for classroom practice. Improving the lecture process and learning tools used are necessary. The lecture process improvement is directed towards what students and lecturers must do in class so that the understanding level of prospective teachers can be improved from the 'low category' to the 'high category.' The improvement of the lecture process is directed at the importance of students knowing the learning objectives undertaken and the importance of intrinsic learning motivation. While the Conceptual Change Text used needs to be improved according to the needs and ways to study it in lectures. Another implication of this research is that there is a need for further research to find out the efficient use of the Conceptual Change Text on the topic of matter and its changes in the classroom with a self-instruction system.

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