

basis for the importance of the SPS by physics teacher candidates through innovative learning model. The indicators of SPS learning ability include: Orientation of SPS, knowledge of SPS, knowledge of learner's understanding about SPS, knowledge of SPS strategies, and SPS assessment [6-13]. The five indicators of SPS are based on the results of literature studies and preliminary study by researchers, the five indicators are still low and need to be improved by pre-service teachers.

The results of preliminary research at the Universitas Khairun and STKIP Kie Raha Ternate by researchers [14-16] was as follows. (1) The ability of SPS learning of physics teacher candidates was still in low category. (2) There is no innovative learning model that specifically trains and improves the ability of SPS. (3) There is limitations of time that lecturers have in physics education to develop innovative learning models to train and improve the ability of SPS learning. In order to improve the learning skill of SPS by physics teacher candidates an innovative learning model is needed. One of them is CCDSR learning model as an alternative solution to improve SPS learning ability of physics teacher candidates [15-16].

The CCDSR is learning Model a developed specifically to enhance SPS learning ability of physics teacher candidates[16]. The CCDSR Learning Model has been proven to be feasible to improve SPS skills learning ability of physics teacher candidates [16]. The CCDSR Learning Model has five syntaxes: (1) Condition, (2) Construction, 3) Development, (4) Simulation, and (5) Reflection. The main objective of this research is to improve the learning ability of science physics teacher process skill through the implementation of CCDSR Learning Model. The focus of this study is a follow-up study based on recommendations [16] to see the effectiveness of the CCDSR Learning Model by doing generalization. The results of this study are expected to be empirical evidence in the process of dissemination of the CCDSR Learning Model's effectiveness to improve the ability of SPS learning ability of physics teacher candidates.

2. Experimental Method

2.1 General Background of Research

The objective is to analyze the improvement of physics teacher candidates' learning ability of SPS through the implementation of CCDSR Learning Model. The improvement of physics teacher candidates' learning ability of SPS through implementation of CCDSR Learning Model is determined based on: (1) Statistic improvement on score between pre-test and post-test of physics teacher candidates' learning ability of SPS, (2) Post-test of physics teacher candidates' learning ability of SPS is at least minimal at medium category; (3) The average n-gain of physics teacher candidates' learning ability of SPS is at least on the low improvement criteria, and (4) The consistency of average n-gain score of SPS learning ability of physics teacher candidates in all groups.

2.2 Sample of Research

The sample in this research was 110 pre-service teacher of Universitas Khairun and STKIP Kie Raha Ternate, academic year 2017/2018 (Ternate, Indonesia) academic year 2016/2017 that took course of Field Practice Program I (i.e. PPL I). The sample determination used purposive sampling technic; which is in the four groups, namely: group I (physics teacher candidates class A of Universitas Khairun), group II (physics teacher candidates class B of Universitas Khairun), group III (physics teacher candidates class A of STKIP Kie Raha Ternate), and the IV-group (physics teacher candidates class B of STKIP Kie Raha Ternate).

2.3 Instrument and Procedures

The physics teacher candidates' learning ability of science process were measured using the SPS Learning Ability Assessment Sheet (SPSLAAS) with indicators: Orientation of SPS teaching, knowledge of SPS, knowledge of learner's understanding of SPS, knowledge of SPS learning strategies, and SPS assessment that have been declared valid and reliable [16]. Physics materials in this study were selected to be in line with the characteristics of the CCDSR Learning Model, it was basic physics. This study used one group pretest-posttest design, O1 X O2 [17-19]. The learning began by giving pre-test (O1). Every physics teacher candidates worked on SPSLAAS. After the pre-test, the lecturer applied the CCDSR Learning Model and lecture instrument of PPL I (valid and reliable) to

each group (X). Implementation of CCDSR Learning Model had been conducted for eight meetings on PPL in physics learning. Physical learning that used the CCDSR Learning Model has five syntaxes: (1) Condition, (2) Construction, 3) Development, (4) Simulation, and (5) Reflection. Each phase of the CCDSR Learning Model by design trains the physics teacher candidates' learning ability of science process that include: Orientation of SPS teaching, knowledge of SPS knowledge of learner's understanding of SPS, knowledge of SPS learning strategies, and SPS assessment. After the implementation of the CCDSR Learning Model, the physics teacher candidates worked on the post-test (O2) by using SPSLAAS. Every pre-service physics teacher was required to complete SPSLAAS on the post-test.

2.4 Data Analysis

The improvement of SPS learning ability of physics teacher candidates through implementation of CCDSR Learning Model was analyzed based on pre-test, post-test, and n-gain data of SPS learning ability of physics teacher candidates was analyzed by using inferential statistic. The score of SPS learning ability of physics teacher candidates was based on indicator: Orientation of science process skill teaching, knowledge of SPS, knowledge of learner's understanding SPS, assessment of SPS, knowledge of SPS learning strategies, and N-gain of SPS learning ability of physics teacher candidates was determined by using the equations by Hake [20-21]. The inferential statistical tests with Paired t-test (analysis of the increase on SPS learning ability of physics teacher candidates) and n-gain consistency analysis of all groups of physics teacher candidates after the implementation of CCDSR Learning Model used ANOVA t-test.

3. Result and Discussion

The results are presented in Table 1, Table 2, and Table 3 which will be described as follows.

Table 1. Average score of SPS learning ability of physics teacher candidates.

University	Group	SPS learning ability of physics teacher candidates					
		Pre-test		Post-test		N-gain	
Universitas Khairun	Group I	0.91	Low	2.97	High	0.67	Medium
	Group II	0.93	Low	2.83	High	0.62	Medium
STKIP Kie Raha Ternate	Group III	0.89	Low	2.70	High	0.59	Medium
	Group IV	0.90	Low	2.82	High	0.63	Medium

Table 1 describes the average scores of the SPS learning ability of physics teacher candidates. In all groups the average pre-test score was 0.90-0.91 (low category). This is because the physics teacher candidates still did not maximized the lectures in semester 1 to semester 5. The SPS learning ability of physics teacher candidates are rarely taught by lecturers to be implemented in physics lessons. These results are consistent with the findings of preliminary research that the SPS learning ability of physics teacher candidates is still low [16].

In contrast to post-test scores after the implementation of the CCDSR Learning Model in all groups that were 2.97, 2.83, 2.70, and 2.82 and are in the high category as shown in Table 1. Table 1 shows that the n-gain of SPS learning ability of pre-service physics in all groups were 0.67, 0.62, 0.59, and 0.63 in the medium category. The results of this study proves that the implementation of the CCDSR Learning Model is ineffective to improve the SPS learning ability of physics teacher candidates. This is because the developed CCDSR Learning Model meets the validity, practicality and effectiveness to improve the SPS learning ability of physics teacher candidates [15-16]. This is supported by the results of the study [21-32] that models, media, methods, instruments that are eligible for validity, practicality and effectiveness will be able to improve and achieve the learning objectives.

Table 2. Average score of SPS learning ability of physics teacher candidates indicator.

Groups	Scores	SPS learning ability of physics teacher candidates									
		Orientation of SPS		Knowledge of SPS of physics teacher candidates		Knowledge of learner's understanding of SPS		Knowledge of SPS learning strategies		SPS assessment	
Group I	O1	1.00	Low	1.00	L	0.89	L	0.74	L	0.91	L
	O2	3.03	H	3.03	H	2.91	H	2.94	H	2.91	H
	<g>	0.68	M	0.68	M	0.65	M	0.68	M	0.65	M
Group II	O1	1.00	L	1.00	L	0.86	L	0.80	L	1.00	L
	O2	2.91	H	2.91	H	2.77	H	2.77	H	2.77	H
	<g>	0.64	M	0.64	M	0.61	M	0.62	M	0.59	M
Group III	O1	1.00	L	1.00	L	0.76	L	0.68	L	1.00	L
	O2	2.84	H	2.84	H	2.60	M	2.60	H	2.60	M
	<g>	0.61	M	0.61	M	0.57	M	0.58	M	0.53	M
Group IV	O1	1.00	L	1.00	L	0.84	L	0.76	L	0.88	L
	O2	2.92	H	2.92	H	2.76	H	2.76	H	2.76	H
	<g>	0.64	M	0.64	M	0.61	M	0.62	M	0.60	M

Note: L (Low), M (Moderate), H (High)

Table 2 shows that all indicators of SPS learning ability of physics teacher candidates are in low category (0.76-1.00), whereas after the implementation of the CCDSR Learning Model, all indicators of SPS learning ability of physics teacher candidates has increased. The N-gain in general of SPS learning ability of physics teacher candidates was in medium category with grades above 0.53-0.68. The positive result was caused by the implementation of the CCDSR Learning Model that had been designed to improve the SPS learning ability of physics teacher candidates include the orientation of SPS teaching, knowledge of SPS, knowledge of the learner's understanding of the SPS, the knowledge of SPS learning strategies, and SPS assessment through five phases of the CCDSR Learning Model: (1) Condition, (2) Construction, 3) Development, (4) Simulation, and (5) Reflection [15-16]. The results of the normality and homogeneity test of variance informed that the pre-test, post-test, and n-gain scores of SPS learning ability of physics teacher candidates were homogeneous and normally distributed. Paired t-test and ANOVA test results are presented in Table 3.

Table 3. Recapitulation of inferential statistical test results of SPS learning ability of physics teacher candidates.

Inferential test (two-tailed)	University	Class	Asymp Sig. ($\alpha = 5\%$)
Paired t-test (Differential test of Pretest-Posttest)	Universitas Khairun	Group I	There is an increase SPS learning ability
		Group II	There is an increase SPS learning ability
	STKIP Kie Raha Ternate	Group III	There is an increase SPS learning ability
		Group IV	There is an increase SPS learning ability
ANOVA (N-gain consistency test)	Universitas Khairun and STKIP Kie Raha Ternate	Group I, II, III, and IV	There is an increase SPS learning ability

Table 3 shows the SPS learning ability of physics teacher candidates for all groups in which each Asymp Sig scores. is considered significant, because Asymp Sig. <0.05. It also indicates that the

impact of applying the CCDSR Learning Model can significantly improve the SPS learning ability of physics teacher candidates significantly for all groups. Table 3 also informs that for n-gain (SPS learning ability of physics teacher candidates scores significance value of Asymp Sig => 0.05). This clearly indicates that there is no significant difference (existence of consistency) n-gain in SPS learning ability of physics teacher candidates from the impact of the CCDSR Learning Model application in physics learning to all groups, because the CCDSR Learning Model has been developed by design to improve the SPS learning ability of physics teacher candidates with the following phases: (1) Condition, (2) Construction, 3) Development, (4) Simulation, and (5) Reflection [15-16]. As the outline, the implementation process of designing the physics learning in the CCDSR learning model is in Phase 3: develop the SPS oriented learning instruments (Development). Students create learning instruments to develop learning plan skills on the SPS (focus on learning to train the SPS). Students are guided by lecturers to see the skills of planning their learning. Systematically this process trains the indicators of formulating problems, formulating hypotheses, identifying experiment variables, defining operational definitions of experiment variables, designing experiments, collecting data, creating observation tables, analyzing data, and formulating conclusions. In phase 4: The simulation of science-oriented process instruments that was made in phase 3. Phase 4 is an important phase to trace the science process skill learning ability of physics teacher candidates.

The CCDSR Learning Model is developed specifically to enhance the SPS learning the ability of physics teacher candidates [16]. The CCDSR Learning Model has been proven to be feasible to improve the SPS learning the ability of physics teacher candidates [16]. The CCDSR Learning Model has the characteristic of SPS learning the ability of physics teacher candidates through scientific investigation activities by design based on motivational theory, the theory of social behavior learning, constructivist theory, and the theory of cognitive psychology [15-16, 34-36]. Therefore the CCDSR learning model has been proven to be effective in improving the SPS learning the ability of physics teacher candidates. The implication of CCDSR learning model research can be used as a solution to improve the SPS learning the ability of physics teacher candidates.

4. Conclusion

The CCDSR learning model has been developed to improve the SPS learning the ability of physics teacher candidates. The results show that: (1) The average post-test score of SPS learning the ability was in the high category, (2) There was improvement on the SPS learning the ability of physics teacher candidates at $\alpha = 5\%$, (3) Average n-gain score of SPS learning the ability of physics teacher candidates was in medium category, and (4) There is no difference (consistency) n-gain on the SPS learning ability of physics teacher candidates in all groups. Therefore the CCDSR learning model has been proven to be effective in improving the SPS learning ability of physics teacher candidates. The implication of CCDSR learning model research can be used as a solution to improve the SPS learning ability of physics teacher candidates. Further research needs to replicate the CCDSR Learning Model in improving the SPS learning ability of physics teacher candidates at various levels (science, chemistry and biology education).

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