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CCDSR Learning Model: Innovation in Physics Learning

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ABSTRACT

The innovation of this research is to develop and produce the CCDSR teaching model with the main objective to improve the science process skill of pre-service physics teachers and have a companion effect that teacher candidates can improve the way of teaching science process skills to the students. The purpose of this research is to analyze the validity of the CCDSR learning model. The CCDSR learning model that was developed was validated by 3 experts in a discussion forum commonly called Focus Group Discussion (FGD). The results of the validator assessment indicate that the content and construct validity of the CCDSR learning model are very valid criteria. The valid CCDSR learning model means having several characteristics, namely meeting the need (need), state (the state of the art), having a strong theoretical and empirical foundation, and there is consistency between the components of the model. The implication of this research, the CCDSR learning model is included in the criteria of validity, both content and construct so that it can be used as a guide in preparing plans to improve SPS and SPS learning for students of prospective physics teachers.

INTRODUCTION

One of the most important aspects of physics is the science process skills (In & Tongperm, 2014). Science process skills are used by scientists to build knowledge, find problems, and make conclusions (Aydin, 2013; Karsli & Ayas, 2014). Along with its development, the process contained in the scientific approach is packed more systemic in the form of skills that must be owned by pre-service physics teachers to conduct a scientific approach. This skill is called science process skills (SPS). Science process skills are procedural, experimental, and systemic skills of science as the basis of science (Colvill & Pattie, 2002; Dogan & Kunt, 2016; Karsli & Şahin, 2009; Suyidno et al., 2018; Zeidan & Jayosi, 2015), so it is important for physics teachers to have a good understanding of science process skills.

The results of the preliminary study by (Limatahu, 2016) in the Physics Education Study Program, University of Khairun showed that physics learning planning by physics teacher candidates is still low. The results of interviews and observations on some students, teachers, and lecturers in the city of Ternate found that (1) Limited time teachers and lecturers develop learning models and tools that emphasize learning planning; (2) Students are not well trained in making learning tools that train the science process skill indicators including formulating problems, formulating hypotheses, identifying variables, formulating operational definitions of variables, conducting experiments, designing tables, graphs, analyzing data, and formulating conclusions; (3) Physics teachers in the city of Ternate have not yet optimal ability in preparing learning tools; (4) There is no standard guidance on learning tools that will be used by lecturers to teach on pre-service physics teacher, then they will teach to students on the Senior High School (Limatahu et al., 2018). This phenomenon should be handled by a lecturer or lecturer. As the essence of the function of a lecturer is a professional educator and scientist with the main task of transforming, developing, and disseminating science, technology through education, research, and community service. In general, students must gain and be able to learn science process skills that will be useful in real life. The perspective of John Dewey (1916), schools should be the laboratories for solving real-life problems (Arends, 2012).

The inquiry model of learning can overcome problems with the weakness of science process skills. The advantages of inquiry learning model are (1) Increase student learning motivation, (2) allow students to think carefully about ideas, problems, and questions, (3) Provide opportunities for students to participate fully that will increase their curiosity both inside and outside the classroom, (4) Encourage students to have a spirit of initiative, (5) Encourage patience, cooperation, unity, and decision making among students, (6) Improve students' understanding of science process skills, conceptual understanding, and relationships, and (7) Provide educational rights and knowledge that enable them to explore the social environment (Arabacioglu & Unver, 2016; Berg et al., 2003; Crawford, 2000; Crockett, 2002; Dewi et al., 2017; Luft, 2001). This inquiry model can develop the basic skills that are necessary for working and in everyday life in the 21st century (Gerald, 2011; Opara & Oguzor, 2011). The previous research found that the inquiry model was able to improve the science process skills of teacher candidates, high school students, and junior high school students (Arabacioglu & Unver, 2016; Prahani et al., 2015; Stone, 2014; Sudiarman et al., 2015).

The results of the above studies indicated that innovation is still needed from the inquiry model, which is specifically developed to improve the science process skills for pre-service physics teachers. The innovation of this research is to develop and produce the CCDSR teaching model with the main objective to improve the science process skill of pre-service physics teachers and have a companion effect that teacher candidates can improve the way of teaching science process skills to the students. The CCDSR teaching model is a physics learning with the scientific approach by design approach to improve science process skill and its learning of pre-service physics teachers (Limatahu, 2017) is based on Modelling process flow by Bandura and is supported by learning theories, they are cognitive-social constructivist theory, cognitive learning theory, behavioural learning theory, and learning theory behaviours and motivational learning theories (Arends, 2012; Moreno, 2010; Slavin, 2011).

Research Focus

In the previous research, the CCDSR learning model has been developed to improve science process skills for pre-service physics teachers. The CCDSR model has been specially designed to increase the skills of science process skills for pre-service physics teachers. The CCDSR learning model consists of 5 phases, including (1) Condition, (2) Construction, 3) Development, (4) Simulation, and (5) Reflection. The previous research developed a device of learning physics as an operational form of CCDSR model developed (Limatahu et al., 2018). In this research, CCDSR mode designed to improve the skills of creating a lesson plan and worksheet SPS for pre-service physics teachers. The implementation of the CCDSR model that has been developed quality of pre-service physics teacher. The purpose of this research is to analyze the validity of the CCDSR model.

METHOD OF RESEARCH

The CCDSR learning model that was developed was validated by three experts in a discussion forum commonly called Focus Group Discussion (FGD). FGD is a small group discussion in which participants respond to a series of questions focused on one topic (Marrelli, 2008). The FGD results are used as a reference to revise the CCDSR learning model. Calculation of reliability and validation of the CCDSR learning model is strengthened by using Cronbach's Alpha analysis (Fraenkel, Wallen, & Hyun, 2012; Hinton et al., 2014; Erika et al., 2018; Pandiangan, et al., 2018).

RESULTS AND DISCUSSION

Physics is a branch of natural science that underlies the development of advanced technology and the concept of living in harmony with nature. As a science that studies natural phenomena, Physics also provides good lessons for humans to live in harmony based on natural laws (Rosyid, 2015). In the learning process after the transfer of knowledge is developed by students following their respective cognitive readiness, so that it has added value (Lin, 2015; Ding, 2011; Suyono & Harianto, 2011). Quality learning reflects the desire of students to learn. Physics learning is essentially a transformation of physical knowledge. Learning physics is expected to provide an opportunity to acquire the knowledge, skills and attitudes needed in modern life. Physics learning cannot be separated from systematic scientific inquiry processes and requires science process skills. Physics learning must emphasize the acquisition of SPS and competence for the productive application of knowledge gained to produce human well-being.

The role of the teacher in the learning process is considered very important (National Research Council, 1996), because the teacher plays an important role in planning what is taught in class and how to teach it (Abell, 2007). Regulation of the Minister of Research, Technology and Higher Education regarding National Standards for Higher Education, Part Four Standard Learning Process Article 11 Paragraph (5) Scientific as referred to in paragraph (1) states that the learning achievements of graduates are achieved through a learning process that prioritizes scientific approaches to create an environment academics that are based on a system of values, norms and scientific principles and uphold the values of religion and nationality (Dikti, 2015).

The teacher is obliged to plan to learn and implement quality learning processes, assess and evaluate learning outcomes; improve, develop academic qualifications and competencies on an ongoing basis in line with the development of science, technology, and art (UURI No. 14/2005 Article 20). This shows the importance of mastering the skills to plan SPS learning for prospective physics teachers before they teach at school. Learning in the 2013 curriculum uses a scientific approach or a scientific process-based approach. In the regulation of the Minister of Education and Culture No. 65 of 2013 concerning process standards state that the learning process standards in K-13 use learning with a scientific, integrated thematic, and thematic approach.

Physics learning cannot be separated from the process of systematic scientific inquiry. Along with its development, the processes contained in scientific inquiry are packaged more systematically in the form of skills that a person must possess to carry out scientific investigations, these skills are referred to as "Science Process Skills (SPS)." SPS is a procedural, experimental, and systematic science inquiry as a basis for scientific literacy (Colvill & Pattie, 2002; Dogan & Kunt, 2016; Zeidan & Jayosi, 2015), so teachers need to have a good understanding of SPS. The teacher must master SPS in learning physics. The Science - A Process Approach (SAPA) has been grouped into basic process skills and integrated skills. Basic process skills, there are eight basic SPS as a learning foundation; observing, using space-time relations, grouping, using numbers, measurements, drawing conclusions, communication, and predicting. Integrated process skills consist of controlling variables, interpreting data, arranging hypotheses, defining operational variables, and conducting experiments (Abdullah, 2015; Dogan & Kunt, 2016). This shows that SPS is very necessary in learning science. Science learning must facilitate how to obtain scientific information, how science and technology work in shaping procedural knowledge, including scientific work habits, which is always referring to investigative techniques for a phenomenon, gaining new knowledge, or correcting and integrating prior knowledge (Orlich, 2010).

SPS has a variety of performance indicators according to the developer. Many experts develop performance indicators related to SPS. According to Limatahu et al. (2018), both basic science process skills and integrated science process skills must be trained to students so that students not only become recipients of information, but also can search for information related to things learned. This study uses SPS indicators which include formulating problems, formulating hypotheses, identifying variables, defining operational variables, carrying out experimental procedures, conducting data analysis, and formulating conclusions. The results showed that when the initial SPS was low (Dogan & Kunt, 2016; Rosa, 2015), it would hamper the physics learning process in the classroom. This shows that the importance of SPS must be owned by prospective physics teacher students and is used in physics learning. Therefore lecturers are required to train and improve SPS to prospective physics teacher students as a provision in the physics learning process.

The CCDSR learning model is specifically designed with the following characteristics: 1) CCDSR learning model to equip and improve science process skills and learning planning for physics teacher prospective students 2) The syntax of the CCDSR learning model is structured to give experience to physics teacher students working in large groups/classes which consists of 3-4 groups. 3) The CCDSR learning model is designed so that prospective physics teacher students have the skills to plan SPS learning and skills in implementing SPS learning. The CCDSR learning model developed by researchers is said to be valid if it meets the need (need), state of the art, has a strong theoretical and empirical foundation, and there is consistency between the components of the model (Nieveen et al., 2007). The characteristics of the CCDSR learning model refer to 5 (five) main components in the model, namely: (1) syntax, (2) social system, (3) reaction principle, (4) support system, and (5) instructional impact and accompaniment impact (Joyce et al., 2009) are described as follows.

(1) The syntax of the CCDSR learning model consists of 5 phases, namely (a) condition students (condition), (b) construct SPS (construction), (c) develop SPS-oriented (development) devices, (d) practice science process skills-based learning through simulation activities (simulation), and (e) reflect on the learning process of construction, and simulation (reflection). (2) The social system states the role and relationship between lecturers and students. Pro-active students in learning activities by contributing to science process skills in their workgroups. Lecturers act as mentors, moderators, facilitators, consultants, and mediators in the learning process to improve science process skills and learning. (3) The principle of this reaction is related to how the lecturer pays attention to and treats the students, including the lecturer, responds to questions, answers, responses, or what students do.

In the CCDSR learning model, the way lecturers pay attention to and treat students should be by way of motivating lecturers and reminding students to always emphasize science process skills and learning. (4) Support systems for a learning model are all tools, materials, and tools for implementing the CCDSR learning model. The supporting facilities for the CCDSR learning model in the form of physical are as follows. (a) Learning tools. (b) Availability of learning needs in the form of laboratory equipment, and ICT media along with supporting systems such as laptops, LCDs and the smooth operation of internet networks. Non-physical facilities include: a conducive learning environment, readiness of lecturers and prospective physics teachers to carry out learning so that good reciprocal communication occurs.

The CCDSR learning model is prepared based on these provisions and is manifested in the form of a CCDSR learning model book. The CCDSR learning model that has been validated and revised based on the validator's suggestions is in the Appendix of the CCDSR learning model book. The hypothetical CCDSR learning model developed needs to be validated both content and constructively before being tested. Content validation describes the need and need for state of the art and construct validation illustrates the consistency between the CCDSR learning model and supporting theory and consistency between component models (Nieveen et al., 2007). The content and construct validation of the CCDSR learning model was conducted by three experts in the Focus Group Discussion (FGD) activities at the Surabaya State University Postgraduate. The FGD of the CCDSR learning model was held on October 14, 2016. The validator of the CCDSR learning model consisted of three education experts, namely learning experts, physics material experts and evaluation experts.

This FGD activity was held for 2 hours and was led by a moderator. The FGD procedure consists of three stages, namely introduction, core and closing. The introduction was carried out for 20 minutes with presentation activities by researchers explaining the CCDSR learning model developed. The core activities are carried out for 90 minutes, the activities are discussion and question and answer between researchers and experts. Expert questions include: rational models, theoretical and empirical foundation procedures for forming CCDSR learning models, model characteristics, model syntax, social systems, reaction principles, support systems and instructional and accompaniment impacts, Planning learning, learning environments, classroom management and learning model evaluation systems CCDSR. The closing activity was carried out for 10 minutes, by the moderator and before closing the results of the temporary FGD were presented in the form of recommendations from education experts. The validation (filling in the validation instrument) is carried out by experts after the suggestions given at the time of the FGD were carried out.

A summary of the results of the analysis of the content validity of the CCDSR learning model is shown in Table 1. The data in Table 1 shows that the content validity score based on the average for each component of the model in the range of scores 3.00 - 4.00, the content validity of the CCDSR learning model, namely the need for the development of the CCDSR learning model, the CCDSR learning model is designed based on current knowledge, support for the theory of the CCDSR learning model, planning and implementation of the CCDSR learning model, management of the learning environment, and the use of the latest evaluation techniques, all valid and very valid criteria with a score of 3.58 each; 4.00; 4.00; 4.00; 3.00; and 4.00.

Table 1. Content validity of CCDSR learning model.

No	Components of the CCDSR Learning Model	Score of validity	Criteria	*α*	Reliability
1	The need for development CCDSR Learning Model	3.58	Valid	.97	Excellent Reliability
2	CCDSR Learning Model Designed Based Advanced Knowledge (State of the art of knowledge)	4.00	Very Valid		
3	Support for the Theory of the CCDSR Learning Model	4.00	Very Valid		
4	Model Planning and Implementation CCDSR Learning	4.00	Very Valid		
5	Management of the Learning Environment	3.00	Valid		
6	Use of techniques Latest Evaluation	4.00	Very Valid		

α = *Cronbach's Alpha*

The score of each component of the CCDSR learning model can be determined to look for the reliability of the content validity of the CCDSR learning model. The data in Table 1 shows that reliability based on Cronbach's Alpha coefficient of .97 belongs to high-reliability criteria which shows that the results of the validation of the contents of the CCDSR learning model are reliable. The results of the validator assessment indicate that the content validity of the CCDSR learning model includes very valid criteria. The CCDSR learning model has fulfilled the criteria for content validity, namely fulfilling the need (need) and state of the art (Nieveen et al., 2007).

A summary of the results of model construct validity analysis is shown in Table 2. The data in Table 2 shows that the construct validity score is based on mode for each component of the model is in the range of scores from 3.00 to 4.00. The construct validity of the CCDSR learning model, namely the need for model development, models are designed based on current knowledge, empirical support models, model planning and implementation, learning environment management, and the use of advanced evaluation techniques are all valid and very valid criteria with each score at 4.00; 3.50; 4.00; 4.00; 3.00; and 3.00.

Table 2. Construct validity of CCDSR learning model.

No	Components of the CCDSR Learning Model	Score of validity	Criteria	*α*	Reliability
1	The Idea of the CCDSR Learning Model CCDSR Learning Model	4.00	Very Valid	.98	Excellent Reliability
2	Theoretical and Empirical Support CCDSR Learning Model	3.50	Very Valid		
3	Model Planning and Implementation CCDSR Learning	3.43	Very Valid		
4	Management of the Learning Environment	3.00	Valid		
5	Implementation of Evaluation	4.00	Very Valid		

α = *Cronbach's Alpha*

The score for each component of the CCDSR learning model can be determined by the reliability of the content validity of the CCDSR learning model. The data in Table 1 shows that reliability based on Cronbach's Alpha coefficient of .98 is classified as high-reliability criteria which indicates that the results of the validation of the contents of the CCDSR learning model are reliable. The results of the validator's assessment indicate that the construct validity of the CCDSR learning model includes very valid criteria. The CCDSR learning model meets the criteria of construct validity, which is to meet the consistency between the components of the model (Nieveen et al., 2007).

Based on the description of the few paragraphs above and the search results on the rational models found in the CCDSR learning model book and items validated in the CCDSR learning model as contained in the content validity and constructs in Table 1 and Table 2 can be synthesized about the novelty and consistency of the learning model CCDSR. The state of the art and the need (need) indicate that the CCDSR learning model is valid in content, while the consistency between parts of the model and consistency between the model and the underlying theory shows that the CCDSR learning model is valid constructively. The CCDSR learning model developed has focused on the design of learning environments that are in line with learning theory and explain the learning process and how the learning environment was created. Validation is done to see the compatibility of theories related to learning activities, learning steps, and how to teach (Gravemeijer & Cobb, 2006). A valid CCDSR learning model can be used as a guide for practitioners in planning a learning program. The results of this study are in line with the opinion of Arends (2012) which states that in the learning model is a comprehensive approach in

The need for the CCDSR learning model is related to the need for the role of the CCDSR learning model to improve science process skills, learning planning, and skills in implementing science process skills learning, which is a demand in the 21st century. This is following the content validity of the CCDSR learning model in Table 1. The content validity of the CCDSR learning model is declared valid because it is considered to meet the needs of the learning model that will be used to anticipate and improve SPS, learning planning, SPS learning skills, which are demands in the 21st century. The role of the CCDSR learning model in training one of the 21st-century skills and its supporter's shows that students feel science process skills, learning planning skills, skills in implementing their SPS learning increases after SPS learning uses the CCDSR learning model. Based on the above description, a review of all aspects of validation shows that the CCDSR learning model is included in the criteria of validity, both content and construct so that it can be used as a guide in preparing plans to improve science process skills and learning science process skills for students of physics teacher candidates. The results also support the results of research that has recently been carried out by Astutik & Prahani (2018); Alfin et al (2019); Evendi et al (2018); Hunaidah et al (2018); Jatmiko et al (2018); Madeali & Prahani (2018); Pandiangan et al (2017); Purwaningsih et al (2018); Sunarti et al (2018); Suyidno et al (2017); Sari et al (2018) which states that learning, models, and valid media can be used to improve and achieve learning goals.

CONCLUSIONS

Thus the results of the validator's assessment indicate that the content and construct validity of the CCDSR learning model are very valid criteria. The valid CCDSR learning model means having several characteristics, namely meeting the need (need), state (the state of the art), having a strong theoretical and empirical foundation, and there is consistency between the components of the model. The implication of this research, the

CCDSR learning model is included in the criteria of validity, both content and construct so that it can be used as a guide in preparing plans to improve SPS and SPS learning for students of prospective physics teachers.

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