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Proceedings

" The Global challenges on the development and the education of mathematics and science "

3rd ICRIEMS

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Preface

Bless upon God Almighty such that this proceeding on 3rd International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) may be compiled according to the schedule provided by the organizing committee. All of the articles in this proceeding are obtained by selection process by the reviewer team and have already been presented in the Conference on 16 – 17 May 2016 in the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. This proceeding comprises 9 fields, that is mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 3rd ICRIEMS is '*The Global Challenges on The Development and The Education of Mathematics and Science*'. The main articles in this conference are given by six keynote speakers, which are Prof. Allen Price, Ph.D (Emmanuel College Boston USA), Ana R. Otero, Ph.D (Emmanuel College Boston USA), Dr. Michiel Doorman (Utrecht University, Netherlands), Prof. Dr. Marsigit, M.A (Yogyakarta State University), Asst. Prof. Dr. Warakorn Limbut (Prince of Songkla University, Thailand), and Prof. Dr. Rosly Jaafar (Universiti Pendidikan Sutan Idris, Malaysia). Besides the keynote and invited speakers, there are also parallel articles that presented the latest research results in the field of mathematics and sciences, and the education. These parallel session speakers come from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of Mathematics and Sciences and the Education such that they are accessible by many people and useful for the Nation Building.

Yogyakarta, May 2016

The Editor Team

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Forewords From The Head Of Committee

Assalamu'alaikum warahmatullahi wabarakatuh

May peace and God's blessings be upon us all

First of all, allow me to thanks to God, Allah SWT, who has been giving us blessing and mercies so we can join this conference. Ladies and Gentlemen, it is my great honor to welcome you to Indonesia, a unique country which has more than 17,000 islands, more than 1,300 ethnic groups, and more than 700 local languages, and I am also very happy to welcome you to Yogyakarta, the city of education, culture, tourism, and a miniature of Indonesia. We wish you be happy and comfortable in attending the conference in this city.

The third International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS 3rd) 2016 is organized by the Faculty of Mathematics and Science, State University of Yogyakarta. In this year, theme of the conference is : The Global Challenges on The Development and The Education of Mathematics and Science. This conference are dedicated to the 52nd anniversary of Yogyakarta State University and to face challenges of Asean Economic Community in 2016.

This conference facilitates academics, researchers and educators to publish and disseminate their research in the fields of pure, application and education of Science and Mathematics. Furthermore, the purposes of the conference are to establish interaction, communication, and cooperation among academics, researchers and educators at an international level.

On behalf of the committee of this conference, I would like to express our highest appreciation and gratitude to the keynote speakers, including:

1. Allen Price, Ph.D. (Associate Professor of Emmanuel College, Boston USA)
2. Ana R. Otero, Ph.D. (Emmanuel College, Boston USA)
3. Dr. L.M. (Michiel) Doorman (Associate Professor of Utrecht University, Netherland)
4. Prof. Dr. Marsigit, MA. (FMIPA, Universitas Negeri Yogyakarta)
5. Asst. Prof. Dr. Warakorn Limbut (Faculty of Science, Prince of Songkla University, Thailand)
6. Prof. Dr. Rosly Jaafar (Faculty of Physics, Universiti Pendidikan Sultan Idris, Malaysia)

Furthermore, we inform you that the papers presented in this conference are about 200 papers from 302 applicants, who come from various countries and various provinces throughout Indonesia. Therefore, I would like to give my appreciation and many thanks to the presenters and participants who have been actively involved in this seminar.

Finally, I would like to thank the committee members who have been working very hard since half a year ago to ensure the success of the conference. However, if you find any shortcomings and inconveniences in this conference, please forgive us. We would very

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happy to receive your suggestions for improvement in the next conference. Thank you very much.

Wassalamu'alaikum warohmatullahi wabarakatuh.

Yogyakarta, May 2016

Dr. Warsono, M.Si.

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Forewords From The Dean Of Faculty Of Mathematics And Sciences, Yogyakarta State University

Assalamu'alaikum warahmatullahi wabarakatuh. My greetings for all of you. May peace and God's blessings be upon us all.

On behalf of the Organizing Committee, first of all allow me to extend my warmest greeting and welcome to the International Conference on Research, Implementation, and Education of Mathematics and Sciences, the third to be held by the Faculty of Mathematics and Science, State University of Yogyakarta, one of the excellent and qualified education universities in Indonesia. This conference is also celebrate the 52th Anniversary of State University of Yogyakarta.

This conference proudly presents keynote speeches by six excellent academics, these are: Allen Price, Ph.D., Ana R. Otero, Ph.D., Dr. Michiel Doorman, Prof. Dr. Marsigit, MA., Asst. Prof. Dr. Warakorn Limbut, and Prof. Dr. Rosly Jaafar, and around 200 regular speakers.

The advancement of a nation will be achieved if education becomes a priority and firmly supported by the development of technology. Furthermore, the development of technology could be obtained if it is supported by the improvement of basic knowledge such as mathematics, physics, chemistry, and biology. The empowerment of this fundamental knowledge may be achieved by conducting research which is then implemented in developing the technology and the learning process in schools and universities.

This international conference is aimed to gather researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Moreover, through this conference it is expected that we keep updated with new knowledge upon recent innovative issues and findings on the development and the education of mathematics and science, which is in accord with the theme of the conference this year. All material of the conference which are compiled in the abstract book and proceedings can be useful for our reference in the near future.

This conference will be far from success and could not be accomplished without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members who have done an excellent job in organizing this conference. I would also like to thank each of the participants for attending our conference and bringing with you your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept our sincere apologies.

To conclude, let me wish you fruitful discussion and a very pleasant stay in Yogyakarta.

Wa'alaikumsalam warahmatullahi wabarakatuh

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Yogyakarta, May 2016
Dean Faculty of Mathematics and Science
Yogyakarta State University

Dr. Hartono, M.Si.

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PE – 12

VALIDITY OF COLLABORATIVE CREATIVITY MODEL

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Abstract— Collaborative Creativity (CC) instructional model is instructional model to training students' scientific creativity and scientific collaborative with apply CC which describe procedures systematically and used to guide teachers to help students how to identify problems, exploring creative ideas, collaborative creativity, elaboration, and evaluation of creative process and scientific collaborative creativity results. Validity of instructional model determined by validating the model against its validity. The CC instructional model validity is reviewed based on two aspects, content validity and construct validity. The content validity is used to assess the CC instructional model content that reviewed from: 1) needs, and 2) state-of-the art knowledge. The Construct validity is used to assess the CC instructional model components from: 1) consistency, and 2) logically. This research aims to check the CC instructional model validity that developed to teach students' scientific creativity and scientific collaborative. The research focus is directed for the CC instructional model validity that consists of the content validity and the construct validity. Validation against the content validity and the construct validity of the CC instructional model is done through the Forum Group Discussion by 3 experts. The result of contents validity and construct validity model shows that the CC instructional model is very valid.

Keywords: *validity, collaborative creativity, instructional model, physical science*

I. INTRODUCTION

Developments in science and technology is growing rapidly so that spur us to improve human resources. Improvement of human resources required for the mastery of science and technology is largely determined by the mastery of science. Mastery of science can pursue through improving the education quality and teaching science. Science is a study to find out about a systematic nature, so that science is not only a mastery of knowledge in the form of facts, concepts or principles, but also a process of discovery. The learning process emphasizes providing direct experience through inquiry to develop competencies to explore and understand the universe around scientifically (Kemdikbud, 2013: 175). Learning science for junior high school on Curriculum 2013 is to reach competency standards graduates consisting of dimensions of attitudes, knowledge and skills. On the attitude dimension, qualifying ability is to have behavior that reflects the attitude of the faithful, noble, knowledgeable, confident, and responsible to interact effectively with the social and natural environment in a range of relationships and existence. On the dimension of knowledge, students' qualifications are mastery the factual, conceptual, and procedural knowledge in science, technology, arts, and culture with human insight, national, state, and civilization-related phenomena and events that seem eye. While the dimensions of qualification skills, students must mastery the ability to think and the ability to follow an effective and creative in the realm of the abstract and the concrete by the learned in schools and other similar sources (Permendikbud No 54/2013).

Guilford (1973) suggested ways of creativity is divergent thinking, productive thinking, inventive thinking heuristics and lateral thinking. Appropriate framework 21st Century Learning, that "Learning and Innovation" includes: creativity and innovation, critical thinking and problem solving as well as communication and collaboration in the context of high-level thinking. Higher-level thinking skills according to Krathwohl (2002) defined as the cognitive abilities of students at a level according to Bloom's taxonomy of cognitive abilities of analysis, evaluation and creative. Higher-level thinking is the embodiment of critical thinking, creative, and solve problems. According to Sternberg (2008) scientific creativity skills include creating, discovering, inverting, imagining, supposing and hypothesizing. It is

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clear that within the framework of the 21st century, in solving problems students should be able to develop creativity and innovation, critical thinking and problem solving as well as communication and collaboration. Therefore, it is necessary to do an effort on how to develop the scientific creativity of students through the CC instructional model that is able to develop the scientific creativity ability. Scientific creativity in science education consists of several aspects which include: knowledge, intellectual ability, personality and motivation, and environmental (Liu & Lin, 2013), the ability to learn scientific knowledge and solving scientific problems (Wang and Yu, 2011), producing Certain original, useful for specific purposes (Hu et al., 2013), and social or personal worth (Hu & Adey, 2010) as well as studying the essential nature and excellence of scientific thought (Zhang et al., 2014). Solving problems in science requires students to explore a collection of knowledge that he has had, imagining the way to completion and often create combinations of knowledge or new techniques to achieve a solution (Nur, 2014: 73). Therefore, to assess the scientific creativity will use the scientific creativity test developed by Hu & Adey (2010) in The Scientific Structured Creativity Model (SSCM) as a basis of measurement theory of scientific creativity.

CC is defined as the perspective of creativity, which is an inherently social process that promotes the creative process in the form of partnerships collaborative in completing group tasks (Miels & Litleton, 2007). Creativity involves a collaborative process of scientific creativity to generate the new ideas through the social processes (social production process) taking into account the motivation of groups' interaction and efficiency in groups' work. Grossen (2008: 246) states that the collaborative creativity is required in learning to produce a new understanding by making elaboration. The CC also shows how the potential and the balance of participation can improve the contribution of the scientific creativity. Thus the collaborative creativity plays an important role in determining the success of student learning and enhance the contribution of the scientific creativity skills (Partlow, Medeiros & Mumford 2012: 30). The CC instructional model is a instructional model for teach skills of scientific creativity and scientific collaborative by applying the CC which describes systematic procedures and are use to guide teachers in helping students how to identify problems, explore creative ideas, collaborative creativity, elaboration of ideas creative and evaluation process and the results of scientific creativity. The CC instructional model content validity is reviewed based on 2 aspects,1) the content validity and 2) the construct validity. The CC instructional model construct validity is to assess the content validity of CC instructional model in terms of: 1) needs, 2) advanced knowledge. The construct validity to measure the validity of CC instructional model in terms of design CC instructional model consistently and logically (Nieveen, 2007).

Based on the description above, the validation of the content validity and the construct validity of CC instructional model will be conducted by 3 experts in a focus group discussion to check the CC instructional model validity. Activities, which validate each step of the CC instructional model syntax consists of the following steps: Identify the problem, Exploration creative ideas, Collaborative Creativity (CC), Elaboration of creative ideas and the evaluation process and the results are applied to teach the skills of scientific creativity and mastery science students in learning concept. Based on the description above, it can be formulated problems: 1) How is the CC instructional model content validity that developed to teach the students scientific creativity in learning? 2) How is the CC instructional model construct validity that developed to teach the scientific creativity of students in learning?

II. LITERATURE REVIEW

A. Instructional model

The instructional model is a description of an overall approach or a teaching plan that includes goals, steps, learning environment, and system settings. Joyce and Weil (2009), says that every model of learning has the following elements.

1. Syntax are the stages of the activities of the model.
2. The social system is the situation or atmosphere and norms in the model.
3. The principle of the reaction is a pattern of activity that describes how teachers see and treat the students, including how should teachers give the response to them.
4. The support system is all the means, materials and tools necessary for implement the models.
5. Impact is the instructional learning outcomes are achieved directly by means directing students at the expected goals.

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6. Impact accompanist are other learning outcomes produced by a process learning, as a result of the creation of a learning atmosphere that is experienced directly by the students without getting the direct guidance of a teacher.

Teaching is often interpreted as an actual face to face interaction between teachers and their students (Arends, 2012: 259). Teaching is covered by the use of instructional approaches or models to suit the characteristics and nature of students in a class and type of objectives to be achieved by the teacher. Such approaches are called to teaching models (models of teaching). The concept includes a teaching model teaching approach overall broad and not specific strategy or technique. Teaching model has several attributes, which is the theoretical basis of coherent or a viewpoint on what should be learned and how they learn, and the model it recommends a variety of teaching behavior and class structure needed to realize the various types of different learning (Arends, 2012: 259). The concept of teaching model is very important function as a communication tool for teachers. According to Joyce & Weil, 1972; Joyce, Weil & Calhoun, 2004) (cite in Arends, 2012) classifies various approaches of teaching according to the instructional purpose, syntax, and the nature of learning environment. Instructional objectives related to student outcomes (results achieved by students), while the syntax of the model is the overall flow of learning activities and learning environment is the context that all measures should be implemented including teaching in a motivating and management procedures for students. Based on the above can be defined that the instructional model is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve specific learning objectives, and serves as a guideline for the designers of learning and teachers in the management of student learning. Position instructional model in teaching and learning activities as a tool or means that a concept used by a teacher during the learning in the classroom. The success of teaching purposes other than useful for the students, it is also useful for teachers is to add technical mastery in developing learning activities and can design effective teaching environment, fun, and rewarding. The use of the instructional model relies heavily on teachers, how teachers manage the class could unite model of learning to classroom conditions. Situation or atmosphere of teaching is a supporting factor in implementing the instructional model. Application of instructional models as a teaching strategy is needed in creating learning conditions that could encourage the spirit and confidence of students to learn.

B. Content validity and construct validity for CC model

The content validity according to Nieveen (20002) is "there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge." Aspects of assessment in the content validity include: 1) the needs of the development model of CC, 2) knowledge of cutting-edge (State of the art of knowledge), 3) model CC could encourage further research focus to the community, universities, primary and secondary. The Construct validity is used to measure the validity of the validity of the model in terms of the consistency (consistency design) and logically supporting component model (Nieveen, 2007: 26). Aspects of construct validity assessment in include: 1) Rationalization model of CC, 2) support theoretical and empirical of CC model, 3) Syntax of the CC instructional model, 4) Principles of reaction, 5) Learning environment and classroom management, 6) Implementation evaluation (Joyce and Weil, 2009). The CC is a creativity perspective as an inherently social process that promotes the creative process in the form of partnerships collaborative in completing creative tasks (Miels & Litleton, 2007). CC on the implementation process and the impact on student learning outcomes. Collaborative creativity is also closely linked to the social processes and the limitation on an understanding of the creative process that affects the affective aspects of the group. The discussion on creativity and behavior requires an understanding of the relationship between the content of cultural and social systems (Miell and Littleton, 2007: 148). Collaborative learning creativity requires the conditions in which students can design, build, and feel the social environment can be transformed into an idea (Jones, Miel, Littleton, Vass, 2008: 92). When the teacher gives a task related to the involvement of students in the group, then each team member can contribute a unique and every effort made students need to focus on the performance of collaboration. It encourages students to practice the skills of scientific creativity and creative while helping students who do not have the skills of teamwork.

Torrance (1990) considers fluency, flexibility, originality and creativity as the main feature. Smoothness mean number of original ideas are generated, flexibility is the ability to 'change tactics,' not bound by the establishment thinking and approach even after that approach is found no longer work efficiently Authenticity interpreted as: the answers are rare, occurring only occasionally in certain populations. Hudson (1966) considers fluency, flexibility and originality similar to the approach. In class

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activities, the students ask students to think about how much is likely to be using bricks, he gathered all the answers and give higher scores to answer rare (occurring only rarely) rather than a general answer. Fluency, flexibility and originality form one-dimensional models, one of which can be described as a personality trait that is characteristic of creative people (Hu & Adey, 2010: 3). Although divergent thinking is no longer considered synonymous with creative abilities, but it remains an important component of the creative potential (Runco 1991).

C. Focus Group Discussion (FGD)

In order to obtain a valid instrument on instructional model and learning tool, it is necessary to test to the learning tool instrument and instructional model instrument through a discussion forum called FGD. FGD is a small group discussion where participants respond to a series of questions that focused on a single topic (Marreli, 2008). FGD is a process of gathering information about a certain very specific problem through group discussion. Guide the implementation of the Focus Group Discussion (FGD) was developed with several goals:

1. Guiding the discussion so that implementation can take place in accordance with the expected goals.
2. Obtain feedback from participants on the validity of Collaborative Creativity Model (CC) developed includes rationality, theoretical and empirical foundation, CC model development, the characteristics of CC models, syntax, social system, the principle of reaction, support systems, the impact of instructional and accompanist, learning plan, the learning environment and classroom management, and evaluation.

III. METHOD

This research is oriented to product development. The resulting product is an instructional model that is valid for teach skills of scientific creativity and scientific collaborative student. As described above, this study aims to: (1) know the content validity CC models were developed to teach students scientific creativity in learning, (2) knowing the construct validity CC models were developed to teach the scientific creativity of students in learning. The draft for the achievement of the objectives of research using descriptive qualitative approach, which describe the results of the validation have been done by an expert in FGD for the development of CC instructional models. The data needed to achieve the goal is the result of data validation experts. Analysis of the data to answer the problem and achieve the goal of the research was done by using descriptive.

IV. RESULTS AND DISCUSSION

Based on the background of the problems that comes on Curriculum 2013 and the framework of thinking which refers to the development of a collaborative creativity model, it can be validated models are performed by experts, with reference to the aspects of content validity and construct validity of the model. Validation of the instructional model CC performed to obtain a valid CC instructional model to teach skills of scientific creativity and scientific collaborative.
Results of the validation of the content validity shown in Table 1.

TABLE 1. Results of validation of the content validity

No	Rated aspect	The average score	K	R (%)
1	Needs of Development CC Instructional Model	3.50	VV	85.71
2	State-of-the art of knowledge	3.67	VV	90.48
3	Benefit	3.33	VV	85.71
Average		**3.50**	**VV**	**87.30**

Results of the validation of the construct validity shown in Table 2.

TABLE 2. Results of the validation of the construct validity

No	Rated aspect	The average score	K	R (%)
1	Rationality of CC Instructional Model	3.67	VV	92.86
2	Theoretical Support and Empirical Support of CC	2.89	V	95.00

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	Instructional Model			
3	Syntax of CC Instructional Model	3.67	VV	90.48
4	Social System of CC Instructional Model	3.93	VV	97.14
5	Principle Reaction of CC Instructional Model	3.33	VV	90.48
6	Learning Environment and Classroom Management	3.42	VV	76.19
7	Evaluation	3.33	VV	85.71
Average		**3.46**	**VV**	**89.69**

Description: K = Criterion, R = Reliability, V = Valid, VV = Very Valid

Based on the purpose and implementation of the FGD can be said that the FGD is one way that is effective and efficient validate in the hypothetical model and validate the learning tools that support the model.

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusion role in this research are:

a. The contents validity of the CC instructional model judged on aspects development needs of CC instructional model, advanced knowledge (State of the art of knowledge) and benefit and the results obtained are very valid.

b. The construct validity of the CC instructional model was evaluated based on rationality, theoretical and empirical support, syntax, social system, principle reaction, learning environment and classroom management, implementation of evaluation and the results obtained are very valid

B. Suggestions

a. Still needs to study the CC instructional model on the main learning on habituation in scientific creativity and scientific collaborative.

b. In addition to study the teachers' role as a facilitator as well as a motivator so that the teacher should be able to continue to motivate the students so that students can play an active role in the development of scientific creativity and scientific collaborative students.

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