

Preparation Model of Student Teacher Candidate in Developing Integrative Science Learning

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Preparation Model of Student Teacher Candidate in Developing Integrative Science Learning

Wiyanto¹ & Arif Widiyatmoko²

Abstract

According to 2013 Curriculum in Indonesia, science learning process in Junior High School is integrally held between physics, chemistry, biology, and earth science. To successfully implementing the 2013 Curriculum in school, the education institution which generates science teacher should prepare the student, so that they can develop integrative science learning. Based on that background, this research aims to find the model of student teacher candidate preparation in developing integrative science learning. To find the model, the design of this study used research and development design. The first stage of the research: curriculum analysis to identify good learning model or suitable with 2013 Curriculum and students expectation. Based on the result of this first stage, the preparation of science teacher candidate in developing integrative science learning will be developed. Moreover, this research will also test the validity, effectiveness, and practically through expert consideration and series of testing model.

Keywords: integrative science, student teacher candidate.

I. Introduction

Science is a field of study which studies the nature. This study is strongly and broadly related to human's life. Almost everyday in life, people encounter problems related to science. Hence, understanding of science becomes a need for every people, at least the understanding of the science literacy meaning. To fulfill the minimum requirement of natural science literacy for human's life, then science becomes one of the main subjects in general education level, from elementary school to junior high school.

Along with the advancement of era, people encounter problems that are more complicated. Many problems cannot be solved by only one branch of study, like physics or biology, however should be solved by some studies or interdisciplinary. The study of various knowledge in science, like physics, chemistry, biology, is called integrative science (Oludipe, 2011). In addition to integrated learning, some experts mention it with the other terms, such as interdisciplinary, multidisciplinary, trans-disciplinary, cross disciplinary, and thematic (Kurt1 & Pehlivan, 2013). The cross-disciplinary nature is intentional and explicit; each incorporates and integrates concepts drawn from earth and space science, environmental science, biology, chemistry, and physics (Plotnick et al., 2009).

As an effort to anticipate the needs required for students to solve problems that tend to be increasingly complex, it is necessary to develop an integrative science teaching and learning (Raimi & Adeoye, 2004; Merrill, 2001; Wicklein & Schell, 1995). In this case, the Indonesian government through Ministry of Education and Culture starts to implement the new curriculum, 2013 curriculum, which is strengthening thematic and integrated learning, including integrative science learning in junior high school/ Islamic junior high school. The implementation of 2013 in junior high school for science requires material development in alignment. Before 2013 curriculum is applied, learning process of biology and physics is conducted separately by the teachers.

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However, the learning process must be conducted simultaneously into integrative science. This policy is not supported by the availability of materials, so the teachers still teach biology and physics separately. Besides separating the studies, the teachers face an obstacle because the existing teachers only have qualification in term of biology and physics. Without sufficient effort, the teacher with biology qualification will hardly integrate physics or vice versa.

At first, the learning process of integrative science, as the mandate of Permendiknas No 22 Year 2006, states that science subject should be conducted by combining the studies of physics, chemistry, and biology. Integrated learning process may also be conducted by combining some subtopics (Beane, 1995). Through the learning process of Integrative science, the students can get direct experience in order to increase the strength for receiving, saving, and applying the concept that has been learned. Therefore, the students are trained to discover the concept by themselves holistically, meaningfully, authentically, and actively (Listyawati, 2012).

Teacher is the key of education quality, whereas curriculum is just a road map (Iskandar, 2014). Teacher's competence to implement curriculum can be maximized by tidying up all matters that become weaknesses of teacher candidate (Watterz and Diezmann, 2015). The ability of science teacher candidate to design materials of Integrative Science is not inherited generation by generation and it does not appear automatically. This ability requires the knowledge mastery/prerequisite understanding and regularly sufficient training in a programmed learning process. Therefore, preparation of student teacher candidate ability to develop the learning process of Science simultaneously needs to be conducted through research and development (Wiyanto, 2008).

Based on the background above, some general problems can be formulated: How is the preparation model of student teacher candidate to develop the learning process of Integrative Science? To solve the problem, the research and development is conducted by following questions:

- a. How is the appropriate learning process of Science in Junior High School based on 2013 Curriculum?
- b. How is the learning process of Science based on the expectation of Junior High School Students?
- c. How is the characteristic profile of students in Junior High School?
- d. How is the reality of learning process for Science that happens in Junior High School?

2. Research Method

The subjects of this research are: (1) the grade VIII students of three favorite Junior High Schools and three Junior High Schools from suburban area in Semarang, (2) the students of Science Education S1 Program and the students of Physics Education Program of Mathematics and Science Faculty, Semarang State University, and (3) Science Teachers of Teachers Forum in Semarang. The research is conducted in Semarang and the locations include Educational Laboratories in Mathematics and Science Faculty of Semarang State University and six Junior High Schools in Semarang.

The research is employed with research and development (R & D model) as the one has been developed by Walter Dick and Lou Carey (Gall et al., 2003). In the earlier year, the research has been initiated by some actions such as analyzing the applied curriculum theoretically or empirically about the appropriate learning process of Science based on 2013 Curriculum in Junior High School, analyzing the learning process of Science that has been expected by the students in Junior High School (step 1), analyzing some factors that influence the development of learning process for Integrative Science through analyzing the learning practice that happens in the schools (step 2), and discovering the characteristics or initial situation (with test and observation) of the students and the student teacher candidate that become the subjects of this research (step 3). Based on the suggestions of the results, some indicators of preparation model of student teacher candidate to develop the learning process of Integrative Science can be identified (step 4).

To develop the preparation model of student teacher candidate in the future, program and learning materials (step 5) and its learning strategies (step 6) and its instruments of evaluation (step 7) that has been maintained into unit of lecturing, lesson plan, student teacher candidate's worksheet and the students' worksheet that have been completed with authentic assessment sheet to discover the result of learning, will be developed in the next step.

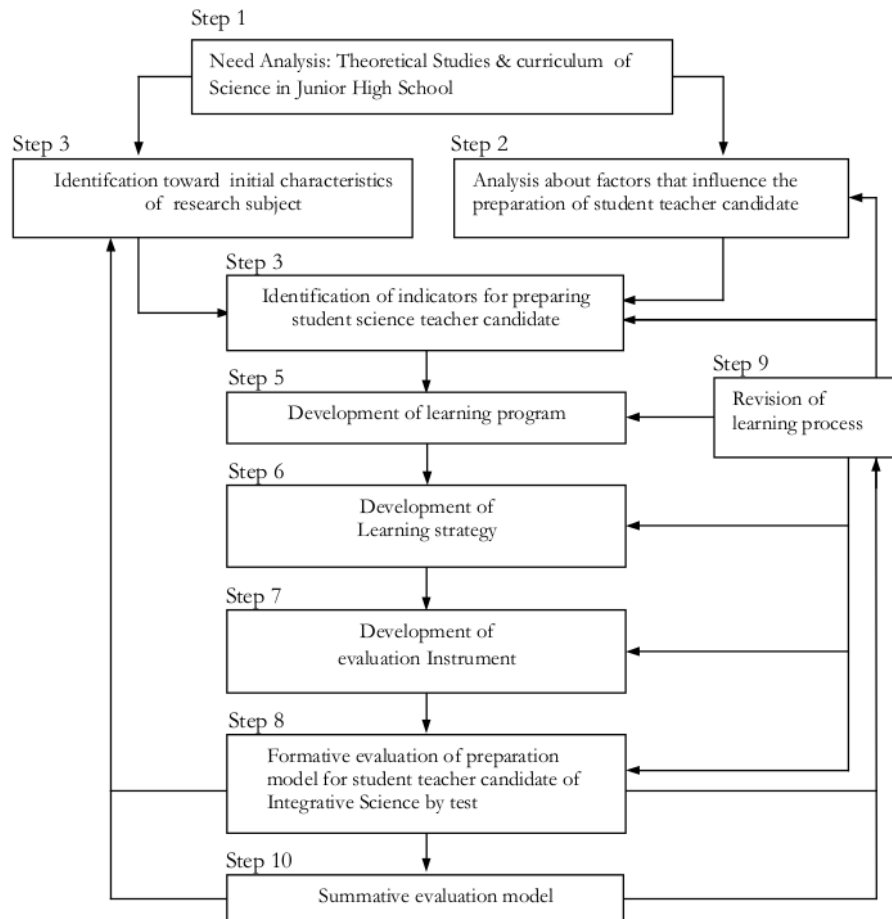


Figure 1. Scheme of Research Design

Learning materials are tested repetitively in order to do formative evaluation toward preparation model of student teacher candidate for developing the learning process of Integrative Science (step 8). Qualitative evaluation toward preparation model of student teacher candidate is going to be done on individual testing and small group level, in which the results is going to be used for revising the model before it is tested in class level (step 9). In class testing, evaluation toward model is going to be done by using quantitative method through validity test with expert's consideration, effectiveness test through pre-post experiment for discovering the gain of student teacher candidates' ability to develop the learning process of Integrative Science, and practicality test through questionnaire distribution to student teacher candidate for discovering their reasoning tendency toward model application. Summative evaluation (step 10) is going to be done by applying the model in experimental class and comparing it by applying the model in control class.

The used instruments of collecting data are; test, observation sheet, and questionnaire. The research instruments are related to linear research variable. There are some techniques used for analysing the data. To describe the appropriate learning process based on 2013 curriculum, the learning process of Science in Junior High School that has been expected by the students in Junior High School, the learning process based on the expectation of student teacher candidates, the reality of Science learning process that happens now in Junior High School, the characteristic profile of the students in Junior High School, and the characteristics profile of student teacher candidate are going to be analyzed by descriptive statistics.

3 The preparation model of student teacher candidate in developing the learning process of Integrative Science is developed through series of experiments and model, then all of their characteristics are finally described. The validity data based on expert's consideration is analyzed by descriptive statistics.

3. Results And Discussion

5 This research is constructed for : (1) describing the learning process of Science based on the expectation of Junior High School students, (2) describing the learning process of Science based on the expectation of student teacher candidate, (3) describing the characteristic profile of Junior High School students, (4) describing the characteristic profile of student teacher candidate, (5) describing the reality of learning process of Science that happens now in Junior High Schools.

a. Analysis of Learning Process of Science based on 2013 Curriculum

The analysis of learning process of Science is conducted by analyzing the teacher's manual for Science subject. The books consist of two parts. The first part contains the general guidance of learning process in Science, processing skill in learning process of Science, and assessment of learning process in Science. The second one deliberates the strategies of learning process in Science for each topic, based on 2013 Curriculum and the student's book.

2 Curriculum 2013 brings a mandate that Science in Junior High School is developed as integrative science, application oriented, thinking ability development, learning ability, and curiosity, caring and responsible of nature. The general aim of learning process is to improve the knowledge, skill and attitude equally. The learning process of Science should use discovery method, the learning method that emphasizes on basic pattern: doing observation, inferring, and communicating/ representing. This basic pattern can be identified by doing continual observation (collecting data), analyzing data and creating a conclusion. In the learning process of Science, the students are encouraged to discover by themselves and transform complex information, check new information based on existing regulation in their minds, and revise the regulation if it is no longer appropriate. This basic view about learning process indicates that the knowledge cannot be separated easily from the teachers into the students. The students must be encouraged to construct the knowledge in their minds. To completely understand and apply the knowledge, the students must be encouraged to solve the problems, find out everything for themselves, and engage themselves with their ideas.

Direct and indirect learning process occurs simultaneously and inseparably. The direct learning process deals with the process that related to Core Competence derived from Core Competence 3 and 4. Both core competences are developed simultaneously in a process of learning and become an arena for developing Basic Competence on Core Competence 1 and 2. The indirect learning process deals with the process related to Core Competence derived from Core Competence 1 and 2. The learning process consists of five main learning experiences as follow.

1. Observing
2. Questioning
3. Collecting information
4. Associating
5. Communicating

In the handout of the students, the integration of Science is conducted by formulating big themes into four integrated topics/subtopics of Science. The themes are: materials, system, changes, and interaction. Integration inter concepts in big theme is conducted connectedly. The concept or principle which is discussed continuously "side by side" principle, concept, or examples in other field. For example, when the students learn about temperature, the temperature is not only related to physical things, but also the behavior of animals related to the temperature.

Learning hours of Science is 5 hours/week and it is divided into 2 meeting/ week. There are 3 hours and 2 learning hours. The calculation also pays attention to the activity in each topic and the complexity of Basic Competence III and IV in each topic. The examples of integration of Science can be seen through this Table 1.

Table 1. Themes of Integrative Science in Junior High Textbook

No	Class	Themes
1.	VII	Object of Science dan Observation Classification of Things Classification of Human Beings Organization System of Living Changing of Things in Our Surroundings Energy in Living System Temperature and Its Changing Calor and Its Mobilization Interaction of Human Beings with Their Surroundings
2.	VIII	Movement of Human Beings and Things Skeleton, Muscle, and Simple Aircraft Structure and Function of Plant Tissue Characteristics of Materials and Their Usage in Life Food Digestion System Additive and Addictive Substance Transportation System Excretion System Hearing dan Sonar System of Human Beings Vision and Optic Tools Galaxy and Life on Earth

b. The Characteristic Profile of the Students of Junior High School

Students are human beings with all of their characteristics. They have feelings, thoughts, willingness or aspiration. They have basic necessity that must be fulfilled (food, cloth, and house), the necessity toward safety, the necessity toward acknowledgment, and the necessity to actualize themselves (becoming themselves based on their potentials). In their development, the students of Junior High School in formal operational phase (11/12-18 years old). The main characteristics of this phase are the children have been able to think abstractly and logically. The scientific thinking with hypothetic-deductive and inductive has been owned by the children with the capability to create conclusion, predict, and develop the hypothesis. As an effort to comprehend the mechanism of intellectual development, Piaget portrays intellectual functions into three different perspectives, they are: (1) the process that become the foundation how cognitive development happens (assimilation, accommodation, and equilibrium); (2) how the knowledge is formed; and (3) the steps of intellectual development.

The period is begun at the age of 12. It is for about the age of the students of Junior High School or known as "period of formal operation". At this age, the development of students happens on the ability to think symbolically and they can understand something meaningfully without the availability of concrete thing or even visual object. The students have comprehended imaginative objects. The implications on learning process are that the learning process will be meaningful if the input of lesson is linear with the interest and potential of the students. The learning process will be successful if the syllabus designer and the teachers can adapt the level of difficulty and input variety so the characteristics of the students can motivate their learning on the maximum level.

Generally, as higher the phase of cognitive development of someone, as more regular and more abstract their way of thinking. The teachers of Science must understand the phases of their students' cognitive development so when they design and conduct the process of learning can be appropriate with developmental phases that have been explained previously. Therefore, the meaningful learning process can be realized. The learning process of Science based on 2013 Curriculum requires the students to be encouraged to discover by themselves and transform the complex information, check new information based on the existing regulations in their minds, and revise the regulations if they are no longer appropriate (Puskur, 2013). The basic viewpoints about learning process believe that the knowledge cannot be transferred automatically from the teachers to the students.

In order to completely understand and apply the knowledge, the students need to be encouraged to solve the problems, find everything for themselves, and engage with their ideas. As developing human being, the students have been and will be experiencing four phases of intellectual development, such as motoric sensor, pre-operational, concrete operational and formal operational. The students of Junior High School are generally in the transformation phase from concrete operational into formal operational. It means that the students of Junior High School have been able think abstractly, for example doing analysis, inferring, concluding, and using deductive and inductive logic. However, they should be begun from real situation. Therefore, observing and experimenting play important role in the learning process of Science so the learning process of Science is not just memorizing activity.

Based on the concept of 2013 Curriculum, the learning process of Science is constructed based on integrative science so each knowledge that is taught, the learning process must be continued to make the students skillful in presenting the knowledge that they have mastered concretely and abstractly, and act as the human beings that are grateful about the nature that has been gifted to them through responsible usage.

c. Characteristic Profile of Student Teacher Candidate

The characteristics profile of student teacher candidate of Science is determined based on the necessity and the development of science and technology. The competence of graduation is resulted from the education that integrates the competence of Science field. Processing skill of Science of student teacher candidate of Science is classified into basic processing skills and integrated skills and the components are sometimes similar even different. The processing skills, either basic or integrated skills, must be trained to the student teacher candidates so they not only become information receiver, but also do searching the information related to the matters that are learned. Related to assessment system, the processing skills that are trained to the student teacher candidates must also be measured through consistent assessment or commonly known as authentic assessment. There are three key steps in doing scientific method. To discover the characteristics of student teacher candidates of Science toward the learning process of Integrative Science based 2013 Curriculum, questionnaire about comprehension toward the learning process of Science is used. The results of questionnaire about student teacher candidates' comprehension toward the learning process of Integrative Science can be seen through Table 2.

Table 2. Comprehension of Student Teacher Candidate toward the Learning Process of Integrated of Science

No	Learning Aspects of Integrative Science	Average Score	Detail
1	Mastering the curriculum related to the learning process of Integrative Science	3,15	Good
2	Mastering the materials of Integrative Science	3,35	Good
3	Utilizing the technology for conducting the learning process of Integrative Science	3,55	Very good
4	Being able to develop the instruments of the learning process of Integrative Science	3,25	Good
5	Having knowledge about the learning process of Integrative Science	3,60	Very good
6	Knowing some models to combine Science Concept into a theme in the learning process of Integrative Science	3,15	Good
7	Knowing the functions of the integration of Science in integrated learning process	3,60	Very good
8	Having the knowledge to make "theme" in the learning process of Integrative Science	3,50	Very good
	Average score	3,40	Good

d. Reality of the Learning Process of Integrative Science in Junior High School

To know the reality of the learning process of Science based on 2013 curriculum that implements the learning process of Integrative Science, the questionnaire is used to score the learning video. The assessment toward learning video includes: opening activity, main activity, closing activity, authentic assessment, and scientific approach. The results of learning video can be seen in Table 3.

Table 3. Results of Analysis toward Learning Video about Integrative Science

No	Aspects that are observed	Yes	No
1	Opening Activity		
	Apperception and Motivation	√	
	Competence of delivery and activity plan		√
2	Main Activity		
	Mastery of learning materials about Integrative Science	√	
	Application of educative learning strategy	√	
	Application of Scientific Approach		√
	Utilization of learning resource/media of learning	√	
	Existence of Learning Assessment	√	
	Involvement of students in learning	√	
	The use of appropriate and accurate language of learning	√	
3	Closing Activity		
	Facilitating and guiding the students to summarize the learning materials	√	
	Facilitating and guiding the students to reflect the process and learning materials	√	
	Giving spoken or written test		√
	Taking action by giving guidance for the next activity and enrichment activity	√	
	Amount	10 (77%)	3 (23%)

Discussion

2013 Curriculum started to be implemented in the school entirely in the academic year of 2014. The readiness of teacher to conduct the learning process is supported by the availability of students' textbook and teachers' manual as the main learning sources, so the learning process will be more effective. The teachers' manual is the main source containing materials and scenario of learning. Therefore, the teachers must use this book and other sources are just supplement. The creativity of students becomes important aspect that must be considered when the teacher designs the learning process. The creative teacher can present the learning materials using scientific approach that will facilitate the students to be creative (Kemendikbud, 2013).

Specifically, the learning process in Junior High School in 2013 Curriculum applies the learning process of Integrative Science. The thematic integrative learning approach has been specially used for gifted and talented students, genius, program of widening the study, and advanced students. In 2013 Curriculum, the students need additional opportunities so they can maximize their talent and potential, provide the time to get along with others to conceptualize and synthesize fast. In the integrative learning process of Science, it is expected that the students can achieve equal competences between attitude, skill and knowledge. All of them can be achieved through fun and holistic learning. The success of teachers to implement 2013 Curriculum can be listed such as being able to study, use, and complete the teachers' manual as the main source of learning (Khusniati & Pamelasari, 2014).

Based on the analysis, the teachers' manual and students' textbook of Science for grade VIII are the tools for implementing 2013 Curriculum in learning process. The teachers' manual and the students' textbook have been prepared by the government based on Permendikbud No. 71 year 2013 about Subject Textbook (Students' Textbook) and Guiding Book for Teachers (Teachers' Manual). The teachers' manual is the guidance for teachers to implement the learning process that covers preparation, execution, assessment and guidance how to use the students' textbook. The students' textbook is the main source of learning for the students that cover: Title of Topic, Information about Core Competences that are appropriate with the topic in each chapter. Each chapter is completed with conceptual map, the students' activities such as experimental, non-experimental, discussion, exercise, summary, evaluation, and assignment for the students

To know the characteristics of student teacher candidates of Science toward the learning process of Integrative Science which is appropriate with 2013 curriculum, the questionnaire about the comprehension toward the learning process of Integrative Science with the average score 3,40 and good category is used.

The student teacher candidates have been able to master the curriculum related to the subject of Integrative Science with the score 3,15 and good category, to master the materials of Integrative Science with the score 3,55 and very good category, to utilize technology for conducting the learning process of Integrative Science with score 3,50 and very good category, to develop the instrument of learning process of Integrative Science with score 3,25 and good category, to have knowledge about the learning process of Integrative Science with score 3,60 and very good category, to know the models to combine the concepts of Science into a theme in the learning process of Integrative Science with score 3,15 and good category, to know the function of the integration of Science in the learning process with score 3,60 and very good category, to have the knowledge to make "theme" in the learning process of Science with score 3,60 and very good category. The student teacher candidates of Science are expected to teach the Integrative Science in Junior High School by combing some materials into particular theme (Widiyatmoko & Nurmasitah, 2014).

The reality in the schools based on the review of learning video shows that the learning process of Science has not been conducted simultaneously yet. The appropriateness of learning practice is about 77% in which the teachers of Science conduct the learning process based on the mandate of 2013 Curriculum. That is implementing the learning process of Integrative Science. This situation can happen since the teachers have educational background from physics, and they are less capable of combining the some materials of Science into a theme. This fact is supported by the result of interview with some committee of teachers' forum for Science in Semarang who stated that some teachers had not mastered the materials yet. 50% of them understand and the rest do not. The difficulty is the graduation of physics teaches biology and vice versa. The difficulties faced during the process of teaching Integrative Science are highly complicated assessment of 2013 Curriculum, the mastery of IT (downloading PPT and just modifying it). Besides those difficulties, the teachers also must teach all levels of class (grade VII, VIII, and IX). Therefore, the depth of materials is still shallow. To solve these problems during the learning of Integrative Science, the teachers of Science shared the information about physics and biology when the lesson occurred in the class. It just occurred once in a while because of the time limitation and the busyness of teachers to teach).

To achieve the quality that has been constructed in the curriculum document, the learning activities need to use some principle that: (1) concerns on the students, (2) develops the creativity of the students, (3) creates fun and challenging condition, (4) contains value, ethics, aesthetics, logic, and kinesthetic, and (5) provides the diverse learning experiences through the application of some strategies and methods of learning that are fun, contextual, effective, efficient, and meaningful. In the learning process, the students are encouraged to find the information, check new information, relate the new information with the existing information in their minds, and do development on it into information or appropriate ability with the environment, place, and the time they are living.

4. Conclusion

Based on the data analysis and discussion, it can be concluded that: (1) The learning process of Science in Junior High School based on 2013 Curriculum is the learning process of Integrative Science which is application oriented, developing the thinking ability, the learning ability, curiosity, caring and responsible for nature, (2) The learning process of integrative science based on the expectation of the students in Junior High School is the meaningful learning that applies the integrative science learning, (3) The characteristic of student teacher candidates of integrative science based on 2013 curriculum got the average score 3,40 and a good category, (4) based on the review toward learning video, the appropriateness of the practice of integrative science learning process is about 77%.

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