Development of an integrated science teaching material oriented ability to argue for junior high school student

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Abstract. The 21st Century Education focuses on the development of the competence in creativity, critical-thinking, collaboration and communication [1]. Based on that reason, the argumentation can be one of the solutions to answer this issue since it facilitates the critical-thinking and communication competences. The argumentation is improved by the lesson that has the socio-scientific issue inside the teaching materials. Based on the observation, the teaching materials in Science lesson is still incomplete which has only the material collection from Physics, Chemistry and Biology. Therefore, holistically, those teaching materials has no the socio-scientific issue. This research has the purpose to develop the teaching materials for science through the plastic theme based on the argumentative skill orientation.

1. Introduction

The 21st Century Education focuses on the development of the competence in creativity, critical-thinking, collaboration and communication [1]. It challenges educational institutions, specially the school, to find a way so their students could master the 4 competencies. The argumentation can be one of the solutions to answer this issue since it facilitates the 21st Century competencies. Argumentation could facilitate critical thinking competencies [2-5] and communication competencies [4, 5]. Argumentation according Toulmin’s Argument Pattern (TAP) has 6 components, namely (1) claims are opinions or conclusions submitted, (2) data is an objective fact or condition that occurs, (3) warrant is explanation that contains the relationship between claims and data, (4) backing is a commonly agreed upon assumption and supports warrant, (5) qualifier is a specific proof that claims are true, and (6) rebuttal is a statement that defies claims [6, 7].

Students will possess the ability to argue if they have deep extensive knowledge, so an integrated science learning of Physics, Chemistry, and Biology is required. Through integrated science learning, students gain hand-on experience, so they acquire the ability to search, store, and apply the concepts they have learned. Students are skilled to be able to find their own concept holistically, meaningful, authentic, and active.

Based on the researcher observation, science learning in Junior High School has not been implemented in an integrated manner. Physics, Chemistry, and Biology, although within the scope of
science, are as yet taught separately. By research it is found some obstacle that caused integrated science learning has not conducted in Junior High School, namely (1) Teachers are from different majors of science such as Physics, Chemistry, and Biology, there are even some non-science teachers who have to teach science; (2) The resources used by the teachers as teaching materials as the books published by the government, worksheet, as well as some relevant books from certain publishers are mostly the compilation of Physics, Chemistry, and Biology materials; 3) Teachers skill are limited to develop integrated science teaching material [8].

The teaching materials used in science teaching in Junior High School did not provide integrated science, they are only a collection of Physics, Chemistry, and Biology material combined. In term of content lacked palpable linkage between the concepts of Physics, Chemistry, and Biology. Some research related the integrated teaching material show a positive effect on student learning outcomes. Integrated science teaching material could improve student learning outcomes [9]. Other research show that the use of integrated science teaching material could improve the students’ critical thinking skills [10]. Thinking ability of students who use integrated science teaching material is better than whose use partial science teaching material [11].

There are a lot of ways to combine Physics, Chemistry, and Biology. One of them by using webbed model. Webbed is an integrated learning model that uses themes as the basis of learning. This learning model combines various subject that are bound by a theme [12].

2. Method
Research development was conducted in this study. Four Step Teaching Material Development (4S-TMD) was administered as a development procedure. The integrated science teaching material process consisted of 4 steps, namely (1) selection, (2) structuring, (3) characterizing, and (4) reduction. In the selection, some basic competencies are selected according the current curriculum, indicator development, the selection of material concepts according to indicator, and development of appropriate argumentation of material concepts. The next step is structuring the integrated science teaching material. In this step, development of conceptual learning maps and macro structures in accordance with the structure of integrated science teaching material are also carried out. The development of multiple representation is also conducted so that the integrated science teaching material are easier to understand. In characterizing, the concept of integrated science teaching material that has been structured is tested by it is understanding to the students, so that will be obtained any paragraph which is considered difficult to understand. At the reduction stage, the difficulty level of the paragraph is reduced [13]. To improve the quality, integrated science teaching material are also tested for their feasibility which includes the aspects of content, language, presentation, and graphic [14].

The integrated science teaching material development instrument covers the validation sheet of indicator conformity with the basic competencies, the material concepts with indicators, argumentation with material concepts, conceptual learning map with integrated teaching material structure, and macro structure with teaching material structure. Aside from that, the integrated teaching material development instrument also includes validation form of multiple representation and comprehension test. In the feasibility test phase, there is validation sheet of content, language, presentation, and graphic.

3. Results and discussion
The development of integrated science teaching material uses integration model of webbed with theme of plastic. The theme of plastic was chosen because it is closest to student life. Theme close to life can be more easily due to their commonness. Besides, plastic contain socio-scientific issues so it is suitable to be developed to practice argumentation. Integrated science teaching material delivered through real and contextual situation could ease the practice of science learning [15]. The integrated science teaching material developed through Four Step Teaching Material Development (4S-TMD) development model.

At the selection stage, basic competencies analysis is conducted to find out the content needed based on the curriculum and can be developed into integrated science teaching material through plastic theme. Selection of basic competencies is a challenge because not all basic competencies in one level can be
facilitated by a plastic theme. Based on the analysis, there are 10 basic competencies from the 22 basic competencies in grade 7 that can be developed into integrated science teaching material through plastic theme. The 10 selected basic competencies were then developed into 30 indicators. The resulting indicator becomes the reference for the collection of material concepts from several textbooks as a reference. At this stage also made the selection of argumentation in accordance with the concept of the material presented.

| Table 1. Validation of the selection stage. |
|--------------------------------------------|
| Indicator | Material Concept | Argumentation   |
|-----------|------------------|----------------|
| 97.78%    | 97.43%           | 97.22%         |

Table 1 show data validation. Based on the result of validation, indicators that have been compiled largely declared valid by the validator. The description of the material concept developed based on the indicator and argumentation are also largely declared valid by the validator.

At the structuring stage, material concept of the selection stage is structured based on the scientific and cognitive structure of the student into the integrated science teaching material structure. At this stage, conceptual learning maps, macro structure and multiple representation declared valid by the validator with little revision. Some revisions made to structuring stage can be seen in Table 2.

| Table 2. Revision of integrated science teaching material at structuring stage. |
|-----------------------------------------------|
| Part                           | Revision from Validation | Follow up Revision |
|-----------------------------------------------|
| Conceptual learning maps                | Incomplete integrated science teaching material, additional material concepts about climate change are needed | Conceptual learning maps added material concepts about climate change |
| Macro structure                      | Macro structure need more detail | Macro structure is more detailed |
| Multiple representation                | Multiple representation need more symbolic | Multiple representation is added symbolically |

At the characterizing stage, the concept of integrated science teaching material that has been structured is tested by it is understanding to the 32 students. If the understanding paragraph score below 75 then the paragraph is quite difficult and must be reduced level of difficulty. A score of 75 is chosen as the limit because the score is the minimum completeness criteria in the school that became the
research site. The last test conducted in this research is feasibility test which includes the aspects of content, language, presentation, and graphic.

4. Conclusion
The development of integrated science teaching material is required because of the challenges 21st century education and the needs of school. The integrated science teaching material developed through Four Step Teaching Material Development (4S-TMD) development model with inserted Toulmin’s Argument Pattern (TAP).

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