Development of integrated science teacher model sequenced with education approach for sustainable development for the theme of human body adaptation systems on temperature change

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Abstract. This research aimed at developing an integrated science teacher book model sequenced with the education for sustainable development approach to the theme of a valid, practical and effective human body adaptation system to temperature changes. This research was a research and development using the Plomp model, which has 3 phases: preliminary research, prototyping phase, and assessment phase. The analysis of the instrument at the initial stage was the need analysis observation sheet, the instruments were the initial analysis sheet, learning media, learning activities, assessment, and interviews. The teacher book assessment instruments were a sheet of validation, practicality and effectiveness. The research data analysis technique used percentage descriptions using the Likert scale. The results showed that integrated science teacher books model sequenced with the education for sustainable development approach for the theme of the human body's adaptation system to temperature changes developed by the category of valid with value 0.89, practical with percentage 86.89% and effective teacher used in learning with percentage 87.84%.

1. Introduction
National education is the main sector in realizing and educating the life of the nation which has a vision of the realization the education system as a strong and authoritative social institution to empower Indonesian citizens to become qualified human beings so as to be able to answer the challenges of the times. According to Law Number 20 of 2003, quality human meaning concerning the National Education System, namely educated human beings which are believe and fear the Almighty God, noble, healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens.

Japan UNESCO in 2015 gave an award for Indonesian national education in the field of sustainable development education or education for sustainable development through science lessons. In this case the government made a policy in the education system as a reference that regulates the teaching and learning process, namely the curriculum.
The curriculum is a very strategic component of education because it is a set of plans and arrangements regarding the objectives, content, and learning material and is used as a guideline for implementing learning activities to achieve certain educational goals. The current curriculum in Indonesia is the 2013 curriculum.

The changed of curriculum based on the level of needs of each education unit. The curriculum is intended so that the world of education can face various challenges and obstacles both internally and externally. The 2013 curriculum change emphasize mindset, strengthening curriculum governance, deepening and expanding material, strengthening the learning process, and adjusting the burden of learning in order to ensure compatibility between the desired and the results [1].

Integrated science learning is one of the 2013 curriculum implementation models where learning is packaged into one between chemistry, physics and biology. This learning is essentially a learning approach that allows students to actively seek, explore, and discover concepts and principles of learning in a holistic, meaningful, and active manner. The 2013 curriculum learning applies a scientific approach (scientific approach) on all subjects including one of them is integrated science [3]. Therefore, expected learning is created and directed conditions to encourage students to seek information from various sources or observations [4]. One supporter of achieving the goal of science learning is the availability of learning resources for students and teachers.

Learning resources are something that is available in the learning environment that functions to help the learning process for both teachers and students. Learning resources consist of materials that are used and needed in the learning process such as books, print media, electronic media, resource persons and the surrounding environment in order to increase student activity in the learning process. One of the learning resources used by teachers and students is books.

Student books and teacher books are guidebooks prepared by the government to make it easier for students and teachers to understand teaching materials, ways of learning, and ways of assessment. While the student book is a textbook for students prepared by the government as the implementation of the 2013 curriculum and facilitates the teaching and learning process [5].

The book for junior high school science teachers based on 2013 curriculum is an integrated / thematic science lesson teacher book. The integrated science lesson teacher book is a guidebook resulting from the integration of physics, chemistry and biology subjects in one book with the theme as the integrated binder. However, in reality the teacher's book used is not integrated and thematic. To solve existing problems, the development of thematic integrated science lesson teacher books was developed according to the characteristics of students. Characteristics of students are special characteristics that each student has. The conditions or circumstances of each student can influence how the student's learning process [6]. The teacher's book is used as a guide in the use of student books. Besides students using guidebooks, teachers also need to have guidelines for the implementation of learning. Then we need an integrated and thematic science teacher book development.

The development of a sequenced model of junior high school science teacher with the theme of the human body's adaptation to temperature change and the education for sustainable development approach, one of which needs to be done because teachers experience some difficulties in the teaching and learning process. The difficulties faced by teachers include the absence of instructions for using student books and unclear descriptions of things to do when learning activities take place. Therefore, the development of integrated books on junior high school science teachers with sequenced models with the theme of the human body's adaptation to temperature changes and the education for sustainable development approach has very important characteristics. This is in accordance with the Minister of Education and Culture of the Republic of Indonesia Number 13 Year 2015 which explains that in conducting learning activities teacher books are very useful because they are used as a guide to the use of student books.

The quality of books is one of the factors that determine the success of students in a learning process. Book quality measurement must pay attention to several important aspects, namely the validity, practicality, and effectiveness in its use. The results of observations made in the field of the teacher's book indicate that the teacher's book does not meet the criteria of a good teacher's book. This certainly
will have an impact on the success of students in the learning process if the quality of the teacher's book is not good.

The teacher's book was developed to support student books. In this regard, textbooks for students have been developed previously [7], namely the development of science textbooks with sequenced models with the theme of the human body's adaptation system to temperature change and the education for sustainable development approach. The development of student books can be used as a tool or means to achieve learning goals, increase creativity, activity, and the three attitudes, knowledge and skills competencies students have in learning integrated science material in junior high school.

2. Research Method
The type of research conducted was research and development with Model Plomp. Plomp model consisted of three stages, namely [8]: 1) recess preliminary stage, 2) prototyping or development stage, and 3) assessment stage. The object of the trial was SMPN 1 Tambusai. Data from the research results were obtained through analysis questionnaires, validation sheets, practicalities, and effectiveness. The data analysis technique used was descriptive analysis to explain the valid, practical, and effective books of Integrated Science teacher models sequenced with the approach of education for sustainable development for the theme of the human body adaptation system to temperature changes as follows:

2.1. Analysis of the Preliminary Research Phase
The preliminary research stage can be determined by equation:

\[
Score = \frac{Total\ Score}{Maximum\ Score} \times 100\%
\]

(1)

The results of the preliminary research stage for the needs analysis phase were categorized as good when obtaining results ≥ 61-100.

2.2. Analysis Validity
Validity analysis uses the Cohen's Kappa equation as follows:

\[
Kappa (k) = \frac{P - Pe}{1 - Pe}
\]

(2)

The validity decision criteria based on Cohen's Kappa in the development of teacher books were said to be valid if they get results of ≥ 0.61 - 1.00 [9]. The validation results that Validation Book of Science Teacher in Sequenced Model with Themes Adoption Human Body System to Temperature Change and Education Approach for Sustainable Development has been valid by validators. [10] state that the results of the development of revised textbook products were based on comments and validator suggestions for improving textbooks, so that the use of textbooks become more efficient, effective and communicative for users, while paying attention to the purpose of finding textbooks.

2.3. Analysis practicality
Practical analysis using equations:

\[
P = \frac{f}{N} \times 100\%
\]

(3)

Products developed in use are said to be practical, if they were in practical and very practical criteria with a percentage of 61-100.

2.4. Effectiveness analysis
Effectiveness analysis can use equations:

\[
E= \frac{f}{N} \times 100\%
\]

(4)

Products developed in use were said to be effective, if they were in effective and very effective criteria with a percentage of 61-100.
3. Results and Discussion
The results of the development research and discussion were described as follows based on the stages of development carried out.

3.1. Results of Preliminary Research Analysis Phase (Initial Investigation)

3.1.1. Preliminary Analysis. The initial analysis consists of performance analysis, SKL, learning objectives, learning difficulties, language feasibility, referral eligibility for referenced sources, and graphics. The results of the analysis can be seen in Figure 1.

Figure 1. Results of Final Analysis

Figure 1 explained that the final preliminary analysis with an overall average of 73.58% was categorized as good. However, in the performance analysis with an average of 64.23% the use of learning models and strategies were still not varied and in accordance with the 2013 curriculum, namely the Integrated model for Integrated Science and the appropriate approach.

3.1.2. Learning Media Analysis. Analysis of learning media consists of the quality of the content and the purpose and quality of learning. The results of the analysis were seen in Figure 2.

Figure 2. Results of Analysis of Learning Media

Figure 2 explained that in the analysis of learning media with an average of 51.03% was categorized quite well. This is because in the analysis of the quality of the content and objectives in the teacher's book was not appropriate between the learning material and the learning media used. The learning material that presented were integrated and themed according to the 2013 curriculum.

3.1.3. Learning Activity Analysis. The results of the analysis of learning activities consisted of analysis of activities opening up learning, core learning activities, and closing activities of learning can be seen in Figure 3.
3.1.4. Assessment Analysis
The results of the assessment analysis can be seen in Figure 4.

![Figure 4. Results of Assessment Analysis](image)

Figure 4 explained that in the teacher's book there were also assessment sections to assess each learning process carried out by the teacher towards students with an average of 61.72% categorized as good. The teacher has applied the assessment in accordance with the 2013 curriculum, but in self-assessment, between friends, enrichment need to be given guidance again.

3.2. Prototype or Development Phase
The prototype or development phase were carried out to determine the competencies achieved, indicators, objectives, forms and appearance of the teacher books developed, designing the material according to the theme described in the teacher's book. This stage emphasizes more valid and practical criteria.

The book developed based on the teacher book structure of Permendikbud No.8 Year 2016 concerning the components of the teacher's book that used as learning resources in the school consisting of covers, initial sections, content sections, and final sections. The design of the teacher's book started from designing a cover like Figure 5.
Figure 5. Sequenced Integrated IPA Teacher Book Cover

Figure 5 described the cover with a picture of someone using objects that can cause heat transfer. The human body was composed of bone, fat, muscle, skin, and can carry out metabolism, circulation, and respiration. The human body also experiences heat transfer such as solid, liquid; and gas by convection, conduction, radiation, and evaporation.

The next part of the book was the contents of the book consist of general instructions and specific instructions such as Figure 6.

Figure 6. Draft General and Special Instructions on Integrated Science Teacher’s Book

Figure 6 explained the contents of the teacher's book, there were general instructions that function as information about the scope and scope of integrated science presented in the book. In the general instructions section all models, media, how to use the teacher's book, and the scoring system were presented, so there were no errors in the use of the teacher's book. Specific instructions contain learning guidelines for each basic competency to improve students' attitudes, knowledge and skills. The theme of the teacher's book to be developed is the human body's adaptation system to temperature changes which consists of 3 sub-themes, namely the IPA object and measurement of body temperature, heat and changes in body temperature, the organization's adaptation system to temperature. Specific instructions to be explained were about the theme of the human body’s adaptation system to temperature changes.
The contents of the next book, were concept maps that contain material that has been combined with sequenced models according to the theme of the human body’s adaptation to temperature changes. Concept maps consist of facts, concepts, principles and procedures such as Figure 7.

![Figure 7. Concept Map on Integrated Science Teacher’s Book](image)

Figure 7 explained that the material in the three basic competencies is combined by one theme, namely the science and object measurement. The material shown in mind maps consists of material facts, concepts, principles, and procedures that are distinguished by color. The general description given by the concept map about the relevance of the material aims to make it easier for students to remember and connect every fact, concept, principle, and procedure in the learning teacher's book that was developed.

The last part of the teacher's book is the closing part of the book which consisted of a glossary and profiles of authors such as Figures 8 and 9. Figure 8 described the glossary contained in the book containing scientific words in an integrated science text book developed. The glossary was made alphabetically and the scientific words were given the meaning or intent of the word.

Figure 9 described the profile of the author of the book. In accordance with the structure of the book, that in the book is displayed the profile of the author consisting of the identity of the author, education history, work history and history of the work that has been produced.

The design of the teacher's book has been completed, and evaluated to produce a quality teacher book known as formative evaluation. The formative evaluation phase is self-evaluation, expert evaluation, one-on-one evaluation, small group evaluation, field test evaluation. Self-evaluation is done to find out writing errors, images, and layouts in the teacher's book that has been designed.

The results of the self-evaluation questionnaire obtained changes in the initial design form of the book, the self-evaluation stage was known as the prototype 1. Next, expert evaluation of the prototype 1; Expert evaluation was the validation stage by several validators or reviewers who were expert in integrated thematic science. Expert evaluation also obtained data from practitioner's evaluation. The expert validation used a validation questionnaire sheet filled by four experts in the field of integrated thematic science and language and one education practitioner. The results of an expert evaluation of the development of the Integrated Science teacher's book with the ESD-sequenced model for the theme of the human body's adaptation to temperature changes were obtained 0.89 categorized as valid. The results of expert evaluation were called prototype 2.
One-on-one evaluation of prototype 2 showed that the books developed were easy to understand, interesting, and efficient to use in learning by teachers known as prototypes 3. Prototype 3 then evaluated small groups of teacher books developed and obtained books that were easy to understand, draw, and efficient in learning. The results of the evaluation of the small group were known as prototypes 4. Prototype 4 was tested for practicality at the field test stage. Practicality was carried out with teacher response questionnaires in the use of teacher books. The practicality of the teacher response questionnaire of 86.89% is categorized as very practical.

3.3. Assessment stage

The effectiveness test was measured using a data collection instrument in the form of a questionnaire. This questionnaire is used to see whether the teacher's book developed is useful, useful, and makes it easier for the teacher to organize the learning process, and to see whether there is a change in the knowledge and skills of the teacher after using the developed teacher's book can be seen in Figure.

The picture explained that the results of the effectiveness of the teacher's book perceptions developed obtained an average value of 88.81% in the very effective category. It can be seen from the integrated science teacher's book model sequenced with the approach of education for sustainable development to the theme of the system of adaptation of the human body to changes in temperature to help teachers adjust perceptions about the Integrated Science material learned. The integrated science teacher book
model sequenced with the education for sustainable development approach to the theme of the human body’s adaptation system to temperature changes supports changes in the knowledge and skills of the teacher in explaining the material when there were students who do not understand the average score of 86.88%. So that the integrated science teacher book model sequenced with the approach of education for sustainable development for the theme of the system of adaptation of the human body to effective temperature changes is used by the teacher in teaching.

4. Conclusion
The development of integrated science teacher books model sequenced with the education for sustainable development approach to the theme of the human body adaptation system to temperature changes for VI grade science teachers in SMPN 1 Tambusai and SMPN 2 Tambusai can be categorized as valid with value, practical, and effectively applied in science learning integrated in school.

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