Development of STREAM integrated astronomy as an enrichment teaching material for elementary students

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Abstract. This study aims to develop STREAM (Science, Technology, Religion, Engineering, Art and Mathematics) integrated thematic learning material with the context of the ring solar eclipse material for elementary students. This type of research is Research and Development (RnD) using ADDIE research design. The experimental subjects used in this study were 40 students at third grade in one of the integrated Islamic elementary schools in Cirebon. Data were collected using interviews, questionnaires, and tests. The instruments used consisted of assessment sheets for students, observation of learning implementation, and interviews. The technique for the data analysis was qualitative and quantitative. The results showed that the average value of the expert validation test was 80.12 with the category of "very good", the results of the teacher's response were 94.34 with the category of "very good", and the results of the responses of the students were 90.12 with the category of "very good". From these results, the development of STREAM integrated astronomy teaching materials for elementary school students was declared "feasible" and "effective" to use during the instruction.

1. Introduction

Towards the end of 2019, precisely on December 26th, Indonesian had the opportunity to witness a rare and spectacular astronomical event, namely ring solar eclipse. This eclipse could be seen from parts of eastern Africa, almost all of Asia including all of Indonesia, parts of Russia, and parts of Australia. While in Indonesia, this eclipse center line crossed parts of Sumatra and Kalimantan. A solar eclipse is an event that occurs when the sun, moon, and earth are in line and are parallel to each other. As a result of such a position configuration, the moon will cover the disk of the sun and a solar eclipse will occur. Based on several factors such as the distance of the earth - moon, the distance of the earth - the sun, and the position of the sun and the moon in the sky, there are 3 types of solar eclipses that we can observe, namely total solar eclipse (TSE), ring solar eclipse (RSE), and partial solar eclipse (PSE). An additional one in the form of a hybrid eclipse, which is when in one day at some time there was a total eclipse and another part of a ring eclipse [1],[2].

As a very bright celestial object, the sun must not be observed carelessly, both directly with the naked eye and moreover by using tools such as binoculars, telescopes, and other optical devices. The energy emitted by the sun is very strong and not only in visible light, but also in ultraviolet and infrared light.
Mistakes in observing the sun will cause permanent eye damage namely blindness. The main principle for observing the sun, whether in an eclipse or not, is to reduce the light that enters our eyes [2],[3].

From this explanation, it is necessary to consider efforts to increase awareness and vigilance in observing the phenomenon of solar eclipses for elementary school students. Nowadays, teaching and learning activities of teachers in primary schools have gone through many changes. The teacher starts to make innovations in teaching, including the use of learning methods in class. However, the learning methods used are sometimes not appropriate with the material being taught, so the efforts made by educators in the development and science skills will be meaningless for students. Therefore, a teacher must be skilled in choosing methods that are appropriate to the material and learning objectives. For the study of natural sciences, it is not only to understand the knowledge of facts, concepts and understandings of science, but to develop skills that using scientific methods and scientific attitude to solve the problems they face in everyday life. Science education is directed to inquiry (to develop the ability to think, work and be scientific and communicate it as an aspect of life skills) and act so that it can help students to gain a deeper understanding of the natural surroundings. The aim of science learning in elementary schools is to foster thinking skills students, work and be scientific and gain knowledge, concepts and skills as a basis for continuing science education to a higher level. These goals can be achieved if the science learning emphasizes the science learning process, through learning that emphasizes the process, then students have firsthand experience of interacting with the environment.[4]

One learning approach that can be used to practice creative thinking skills is the STREAM learning approach [5]. STREAM education provides an opportunity for teachers to show students how the concepts, principles and techniques of science, technology, religion, engineering, art and mathematics are used in an integrated manner in the development of products, processes and systems used in their daily lives [6].

Current learning trends need to follow 21st century developments, one of which is by integrating (STREAM). Some of the benefits of the STREAM approach make students able to solve problems better, innovators, inventors, independent, logical thinkers, and technological literacy [7] STEM learning needs to emphasize several aspects in the learning process [8].

The research gap obtained and known from a number of STEM research references in basic education is that so far no research has developed integrated learning with STREAM specifically on the subject of ring solar eclipses. this research is meant to be able to produce thematic learning development products for elementary school students with the STREAM approach.

From the background that has been explained, it is necessary to conduct research activities to develop STREAM Method in natural science instruction with the context of solar eclipses for elementary school students as enrichment teaching materials. The results of this study are expected to be a medium for astronomical education in instilling an understanding of security awareness to elementary students in observing solar eclipses in one of the elementary schools in Cirebon.

2. Methods
This research is a type of model development research for learning or Research and Development (R&D) with the development design of ADDIE (Analysis, Design, Development, implementation, and Evaluation). Research and Development is a research method that serves to validate and develop products [9]. The development procedure that the author will do in developing the STREAM learning model for the thematic learning of elementary school students is carried out in 5 stages, i.e. the stages of analyze, design, development, implementation, and evaluation[9].

2.1. Analysis
The analysis phase is the stage where the writer analyzes the needs of the STREAM integrated learning model required by the school. Stages of analysis include three things, namely needs analysis, curriculum analysis, and student character analysis. The stages are carried out as follows:
2.1.1 Need analysis
Needs analysis is done by analyzing the main learning resources available at school. Because learning resources are very important in the continuity of learning. At this stage the authors will determine the STREAM learning method that is suitable for use in the learning process for students.

2.1.2 Curriculum analysis
Curriculum analysis is done by analyzing the curriculum used by the school. This is done so that the development is carried out in accordance with the applicable curriculum in the school.

2.1.3 Student analysis
Analysis of students is done to see the attitude of students in the implementation of learning. This is done so that the development carried out can be in accordance with the learning character of students in the learning process at school.

2.2. Design
This design phase begins with designing STREAM learning methods that are appropriate with the analysis phase that has been done before. At this stage, STREAM learning models will be designed for thematic learning of elementary school students. Next will be determined.

STREAM learning model framework for thematic learning of elementary school students to be developed. The author collects references that will be used to develop STREAM learning models for thematic learning of elementary school students. At this stage, the author also compiles an instrument that will be used to assess the STREAM learning model for the thematic learning of elementary school students developed. The instrument was prepared by taking into account several aspects such as the appropriateness of content, appropriateness of language, appropriateness of presentation, and appropriateness of the media used in development. The instruments were compiled into STREAM learning model assessment sheet for thematic learning of elementary school students and response questionnaires. Furthermore, the instruments that have been prepared will be validated to get a valid assessment.

2.3. Development
The development phase is the product manufacturing stage. At this stage, the STREAM learning model for the thematic learning of elementary school students is based on the design that has been done before. Then, the STREAM learning model for the thematic learning of elementary school students who have already made it will be validated by expert lecturers and teachers. The validation process is based on the instruments that were prepared in the previous stage.

Validation is done aiming to assess the contents of the product. Validators are asked to provide an assessment of the STREAM learning model for thematic learning of elementary school students that was developed based on assessment instruments, as well as provide suggestions relating to the STREAM learning model for thematic learning of elementary school students which will later be used as a reference for revision of improvements in improving the STREAM learning model for learning Thematic primary school students, so it is feasible to be implemented in learning. At this stage data analysis was also carried out on the results of the assessment of the STREAM learning model for the thematic learning of elementary school students obtained from the validator. This is done to get a valid value on the product's eligibility.

2.4. Implementation
Implementation of the product is carried out in selected schools. STREAM learning models for thematic learning of elementary school students that have been developed then is implemented by class teachers in learning. The author only serves as an observer who records everything, regarding the implementation of products that can be used as improvements to the STREAM learning model for thematic learning of elementary school students. After the instruction has been completed, students take tests using questions
provided by the author. The matter was compiled based on predetermined indicators that aim to see the effectiveness of the product.

At this stage, the author also distributes response questionnaires for teachers and students, which contain statements about the use of the STREAM learning model for the thematic learning of elementary school students in learning. This is done aiming to obtain valid data related to the use of the STREAM learning model for the thematic learning of elementary school students. In addition, the author asks teachers and students to provide criticism and suggestions as a reference for the second product revision in accordance with the responsiveness of teachers and students. After that the writer analyzes the data based on the results of the questionnaire response. It aims to determine the effectiveness of the STREAM learning model for the thematic learning of elementary school students. The effectiveness can be seen from the results of student learning tests.

Activity The implementation of the STREAM learning model for the thematic learning of elementary school involved 40 third grade. The results obtained from this study are the design of learning activities using the STREAM approach (Science Technology, Religion, Engineering, Art and Mathematics) for students in studying the phenomenon of solar eclipses through the thematic learning approach.

3. Result and Discussion
3.1. Designing and making STREAM learning methods for elementary school students
The results obtained from this study are the design of elementary school thematic learning activities with the STREAM approach in studying the theme of exploring outer space eclipse sub-themes.

![Figure 1. STREAM approach in as sunnah integrated Islamic Elementary School in Cirebon](image)
The more detailed activities of each approach will be explained as follows:

3.1.1 *Element of science.*
(1) Students can recognize and understand space objects such as planets, satellites, and stars, (2) students can understand the process of a solar eclipse, (3) students can understand the concepts of light and optics in the phenomenon of solar eclipse observation.

3.1.2 *Elements of technology.*
(1) Students can understand the use of the internet in obtaining information about meteorology, geophysics and space, (2) students can understand the techniques of using teaching aids for simulation of solar eclipses.

3.1.3 *Religious element.*
(1) Students can understand that the phenomenon of a solar eclipse is one of the great signs of HIS. This is related to the study of the Quranic verse that explains the phenomenon of the solar eclipse, (2) students can do and understand the procedures for carrying out solar eclipse prayers, (3) students can understand what needs to be done during a solar eclipse from a review of religious beliefs.

3.1.4 *Elements of engineering.*
Students are able to make sun eclipse observation glasses.

3.1.5 *Elements of art.*
(1) Students are able to menggnting pattern of solar eclipse observation glasses, (2) students are able to Color well and beautifully simulating the shadow of the sun shading Penumbra.

3.1.6 *Mathematical elements.*
(1) Students can understand the concept of time from the phenomena of Earth's rotation and revolution, (2) students can understand why the short time for the solar eclipse process, (3) students can understand the concept of time seconds, minutes, hours, days, weeks, months, and years.

3.2. **Validation of STREAM learning models for thematic learning of primary school students**

Before the STREAM learning model for thematic learning of elementary school students is tested in elementary learning activities, the STREAM Model is first assessed by four experts in the fields of media, material, learning and language to ensure the feasibility of its use in thematic learning activities in elementary schools. Table 1 summarizes the results of expert validation of the STREAM learning model for the thematic learning of elementary school students.

**Table 1. Recapitulation of expert validation results against STREAM learning models for thematic learning of elementary school students**

| Assessment Aspects       | Rating Indicator                                                                 | Rating Result                                                                 |
|--------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| STREAM assessment        | The existence of scientific elements in the model, the existence of technological elements in the model, the existence of religious elements in the model, the existence of art elements in the model, the existence of mathematical elements in the model, the relationship with life, the ability to think creatively and the ability to think critically | The validator's quarters stated that the stages in the STREAM learning model for the thematic learning of elementary school students had been fulfilled for low grade elementary school level learning. But it needs to be confirmed and strengthened again in the engineering and mathematics fields. |
| Design Validation        | Order of presentation, Completeness of STREAM information, use of fonts: type and size, layout, illustrations, graphics and images, display design | The four validators stated that the illustrations, graphics and drawings provided adequacy and provided support for the thematic learning process of elementary schools using the STREAM model. |
| Content Feasibility      | Compliance with learning outcomes, the accuracy of the material, conformity to the needs of students, suitability to the needs of teaching materials, the benefit of adding insight and presentation | The four validators stated that the phenomena presented were related to the sharpening of thematic integration of knowledge through the STREAM model for elementary school students |
| Language Validation      | Readability, Clarity of Information, Conformity with the rules of Indonesian language that is good and right and the use of language effectively and efficiently (clear and concise) | The four validators stated that the grammar used in the STREAM learning model for the thematic learning of elementary school students was in good criteria and could be used |
From Table 1 it can be seen that STREAM learning models for thematic learning of elementary school students have a good design for the integration of learning in elementary schools. Through this integrated STREAM design, students are able to reason and think critically, logically and systematically [10], [11]. It can be seen that the STEM integration model developed into STREAM is one of the learning approaches that is in accordance with the 2013 curriculum [12], [13].

Based on the description in the above table, it is estimated that Problem Based Learning, project based learning, and cooperative learning can support the application of STREAM in science learning for elementary school students. From this presentation it can be seen that all learning achievements that are accommodated by science subjects are expected to be actualized through the application of STEM which is supported by Problem Based Learning, project based learning and cooperative learning. Because the learning achievements overlap with scientific literacy and creativity, it can also be said that STEM-based learning supported by Problem Based Learning, project based learning, and cooperative learning are expected to actualize both competencies. Some research in Indonesia that has been done shows that STEM learning can improve scientific literacy, creativity, and problem solving skills [14].

4. Conclusion
STREAM is an integrated learning approach that encourages students to think more broadly about real-world problems that are integrated from a religious point of view. STREAM also supports meaningful learning experiences and problem solving, and believes that science, technology, engineering, art, religion and mathematics are interrelated. In STREAM, science and technology can be interpreted through art and engineering, including the mathematics component.

STREAM component consists of: Problem solving through innovation and design, the link between assessments, learning plans and learning standards, the combination of more than one subject in STREAM and their usefulness in the arts, a collaborative learning environment and process based learning, focus on things that are occur in life, In the STREAM approach, focus on processes that help lead to innovation, teach the power of observation, people and the environment in learning, help hone visual-spatial intelligence and mathematical concepts such as geometry and modelling.

The true foundation of STREAM lies in inquiry learning, critical thinking, and process-based. Process-based here means the process of asking questions, arousing curiosity, and being able to find solutions to a problem. The essence of STREAM learning is to make learners more creative in finding solutions to problems.

Based on the results of research and development of STREAM learning models for thematic learning of elementary school students in the form of assessments from media experts, material experts, learning experts, linguists, teacher responses, and students, as well as pretest and posttest results, it can be concluded that the STREAM learning model for Thematic learning of elementary school students, declared "feasible and effective" to be used in the learning process.

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