DEVELOPMENT OF SCIENCE TEACHING MATERIALS WITH THE MODEL OF SCIENCE, TECHNOLOGY, AND SOCIETY

Devy Aufia Abshor[1*], Murtono[2], Irfai Fathurohman[3], O.B. Kenzhaliyev[4]
[1,2,3]Muria Kudus University, 59327 Central Java, Indonesia
[4]Satbayev University, Almaty city, Kazakhstan
*e-mail: aufiadevy@gmail.com

Abstract. This study aims to determine the need for teaching materials with the model of science, technology, and society, describe the design of teaching materials and test the feasibility of these teaching materials. The form of this research is a combination of qualitative and quantitative research. Data collection techniques in this study were observation, interviews, documentation, and tests. The results of the study found that fifth-grade elementary school students in Kudus regency needed science teaching materials with models of science, technology, and society. This science teaching material is designed according to the steps of the science, technology, and society model. After being designed, validation is carried out to material and language experts. The validation results get an average of 65,3 "very good" categories so that science teaching materials with models of science, technology, and society are suitable for use during learning, but there are slight revisions.

Keywords: Teaching materials, science technology society, critical thinking, ecosystem.

Main provisions of the article. The purpose of product validation is to find out whether it can be used in the learning process, as well as to obtain suggestions and input for the improvement of teaching materials. The form of validation of science teaching materials is quantitative and qualitative data. Quantitative data is obtained from the Likert scale assessment, while qualitative data is an assessment of the validator's suggestions.

Introduction. Education is a place to develop the potential possessed by humans and change for the better. The education curriculum in Indonesia is always updated in accordance with technological developments. The 2013 curriculum is a student-centered curriculum by honing creativity and thinking skills during learning and in solving problems in everyday life. During student-centered learning, students play an active role in solving problems, while teachers do not lecture but play a role in helping students find facts and concepts or principles for themselves [1]. Therefore, learning innovation is needed for optimal learning.

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The subject of Natural Sciences (IPA) is one of the subjects in the 2013 curriculum which requires planting concepts during learning. Samawoto in Muakhirin [2] defines science as the science of events that occur in nature. Science is the science of processes that occur in everyday life, therefore, students must master these basic subjects [3]. According to Widiyatmoko [4] in Ardianti et al. [3], it is revealed that obtaining science can be done by collecting data according to investigation, observation, and deduction in order to obtain a reliable explanation.

So far, science subjects are considered difficult by students, from elementary school to high school. This is because the implementation of learning is less varied. One of the science learning innovations is the development of science teaching materials using the Science, Technology, and Society (STM) model [5]. This development was carried out in accordance with observation and interview data at the Mekarsari cluster elementary school. The result is that the teaching materials used by teachers and students are not in accordance with the development of students; the teaching materials use language that is too scientific and difficult to understand; the teaching materials use materials that do not relate to the actual problems of the student's environment; the pictures and colours in the teaching materials do not match reality; for students, the material on ecosystems, especially parts of the food web, is difficult; teachers do not understand about the steps of the learning model. This phenomenon encourages researchers to find solutions to develop science teaching materials with the Science Technology Society model [6].

Teaching materials are an important factor in the effectiveness of learning, especially in elementary schools. Lack of teaching materials can affect the quality of learning. The definition of teaching materials is a set of materials or learning materials that are arranged systematically [7]. A teacher in choosing teaching materials must pay attention to learning styles and adjust the age of students [8]. Paying attention to this, students will be able to understand the material better. There are four types of teaching materials, namely visual, audio, audio-visual, and interactive multimedia teaching materials [9].

When technology develops, it can provide opportunities for the emergence of new methods in learning [10]. With the new method, learning becomes more effective and efficient. The science, technology, and society model is very suitable to be applied to science material because it aims to form individuals who have scientific and technological literacy, and have concern for the environment [11]. Science, technology, and its application in society can be used to solve student problems and environmental problems. The emphasis on the science, technology, and society model lies in a realistic setting, namely the problems raised are really problems that exist in society [12]. In addition, according to Yager [13]; [14], Science, Technology, and Society are learning models that provide direct experience to students. One of the models of Science, Technology, and Society is based on constructivism theory. Constructivism theory explains that learning is not just memorizing. However, students must be accustomed to solving problems, finding something useful for themselves, and struggling with ideas in order to understand and apply the knowledge they have acquired [15].

The steps of the STM model (science, technology, and society) are, 1) introduction (Initiation/Invitation/Appreciation/ Exploration), 2) concept formation, 3) concept application, 4) concept consolidation, and 5) assessment [11]. This step connects the subject matter with the technology that students find in their lives [16]. This step will also be included in learning activities on science teaching materials with the Community Science Technology model developed by researchers.

Similar to the research of Kassiavera et al. [17], they conducted research on the development of physics modules using the science, technology, and society model with the aim of

increasing high school students' learning motivation and critical thinking skills. Similar to Yasa [18], developing a thematic module based on STM (Science, Technology, and Society) material on the theme of our friend's environment. The two studies produced teaching material products in the form of learning modules that have been validated and proven to be effective in learning.

Conceptual framework. Based on the explanation above, the teaching materials used by students are not in accordance with the characteristics and development of students. Therefore, researchers develop science teaching materials with models of science, technology, society that are adapted to the development of fifth grade elementary school students. Good teaching materials are teaching materials that are in accordance with the development of student characteristics. as stated by Fitria & Indriyeni [19], teachers compose teaching materials that must be adapted to the needs and characteristics of students. Fitria & Indriyani [19] also revealed that compiling teaching materials if adapted to the needs and characteristics of students, will later help teachers and students in the teaching and learning process.

Researchers use models of science, technology, society in the hope of making learning fun, contextual, and communicative, so that students are happy to learn.

Research objectives. This research was conducted to determine the need for teaching materials with models of science, technology, and society, describe the design of teaching materials, and to test the feasibility of these teaching materials.

Methodology

Research design. The design of this research is a combination of qualitative research and quantitative research.

Respondents of the study. There are three sources of data in this study, namely; teachers, students, and experts. Data from fifth grade elementary school teachers 1 and 2 Getasrabi is used to determine the need for developing science teaching materials. Data from fifth grade students of Primary School number 1 Getasrabi with a total of 13 students and Primary School number 2 Getasrabi with a total of 9 students were also used to determine the need for developing science teaching materials. Meanwhile, the expert data used to determine the effectiveness of science teaching materials. The experts consisted of experts in the field of science, namely Mrs. Yuni Ratnasari, S.Si, M.Pd as a Primary Teacher Education (PGSD) UMK lecturer, linguist Dr. Moh Kanzunnudin, M.Pd as PBSI UMK lecturer, and education Mrs. Safrida Khoirun Nisa', S.Pd.

Data collection techniques in this study were observation, interviews, documentation, and tests. The instruments used are interview guidelines and expert test questionnaires. The interview guide has a grid, namely; the needs of teaching materials, the needs of the content of teaching materials, and the needs of the graphics of teaching materials. Meanwhile, the expert test questionnaire has two aspects, namely; material and visual aspects. The expert test questionnaire will be assessed by the experts who have been determined.

Findings and discussion. Based on data collection, the researcher obtained several findings and then linked them with existing theories.

Results of Analysis of Teaching Material Needs. the results of the analysis of the needs of science teaching materials with the model of science, technology, society were carried out through observation and interviews.

Researchers conducted observations in the fifth grade of Primary School number 1 Getasrabi and Primary School number 2 Getasrabi. Based on the observations, the researchers found that it was difficult for students to understand the material because there was no face-to-face learning during the pandemic. This condition makes students passive and inhibits stu-

dents from thinking critically. This is evidenced by the low learning outcomes of fifth grade students at Primary School number 1 and 2 Getasrabi. In addition, when learning takes place, the teacher has used the learning model, but it has not been in accordance with the steps of the learning model. The teaching materials used are not in accordance with the characteristics and development of students. This is evidenced by the existence of language that is difficult to understand and too scientific.

Interviews were conducted to determine the need for the development of science teaching materials. The researcher conducted interviews with fifth grade students and teachers at Primary School number 1 and 2 Getasrabi. Based on the results of interviews with students, it was found that the student books used already contained interesting pictures and colors, but other teaching materials were still in black and white. The language used is too convoluted so that students have difficulty understanding it. Instructions for working on questions are not clear. Rarely are teaching materials that relate to the surrounding environment. The display section of teaching materials is already interesting, but needs to be developed.

Based on the results of interviews with teachers, it was found that teachers had used learning models, but had little difficulty in teaching ecosystem themes during the pandemic. The pictures and materials in the teaching materials are appropriate and interesting but do not include the environment around the students as the material. The teacher advises that it is necessary to develop science teaching materials, especially the ecosystem theme so that students can understand and apply them in everyday life.

Based on the results of observations and interviews, it can be concluded that the development of science teaching materials with models of science, technology, society is needed in learning. As the opinion of Nurjanah, Panjaitan, & Kurnia [20], the model of science, technology, society is a learning model with topics about problems that are happening in the community. By applying the model of science, technology, society, learning situations become fun and practice science process skills. In addition, students are interested in finding solutions to these problems.

Results of Analysis the Design Science Teaching Materials with Models of Science, Technology, Society. The design of teaching materials was analyzed using the steps of making teaching materials proposed by Prastowo [21], namely.

1. ANALYZING THE CURRICULUM.

This teaching material only takes Natural Science subjects on theme 5 ecosystem class V elementary schools with basic science competencies, 3.5 analyze the relationship between ecosystem components and food webs in the surrounding environment, and 4.5 create a work on the concept of food webs in an ecosystem. the results of the analysis are explained in the form of learning indicators. After analyzing the curriculum, the author also included the local potential of the Kudus Regency. These local potentials are BnP Garden Kampung Kuto Purwosari, Parijoto Plantation in the Gunung Muria Forest, local rice fields, and local rivers.

Determine Teaching Materials.

The material for science teaching materials refers to the student books and teacher books of the 2013 curriculum revised edition of theme 5 ecosystem in grade V elementary school. In addition, other sources of material were obtained from various master books, learning modules, magazines, and the internet.

Prepare a Map of Teaching Materials.

Theme 5 ecosystems in grade V elementary school consists of three sub-themes, namely sub-theme 1 ecosystem components, sub-theme 2 relationships between living things in the

ecosystem, and sub-theme 3 ecosystem balance. Science subjects are in three lessons for each sub-theme, namely learning 1, learning 2, and learning 5.

Understand the Component of Teaching Materials.

The components of this teaching material are cover page, preface, table of contents, background, instructions for using books, learning models, core competencies, concept maps, basic competencies and sub-theme learning activities. Each learning has five learning activities which are the steps of the science, technology, community learning model, namely preliminary activities, concept formation activities, concept application activities, concept strengthening activities, and assessment activities. The next component includes activities with parents, sub-theme practice questions, glossary, bibliography, answer keys, and author profiles. After determining the components of the teaching materials, the researcher determines the selection of letters, the use of images, and the selection of colors.

Good teaching materials are teaching materials that are in accordance with the characteristics of students as stated by Fitria & Indriyeni [19], teachers compose teaching materials that must be adapted to the needs and characteristics of students. Fitria also defines teaching materials as a teacher's tool for planning lessons that contain the subject matter to be achieved. Recent research showed that using the triple model (Industry, Education & Business) leads to effective work of society benefits [22, 23]. Researchers design science teaching materials with models of science, technology, society in accordance with the development and characteristics of students starting from the display of science teaching materials and the content of science teaching materials [24].

Results of Test the Validity Science Teaching Materials with Models of science, technology, society. The purpose of product validation is to find out whether it can be used in the learning process, as well as to obtain suggestions and input for the improvement of teaching materials. The form of validation of science teaching materials is quantitative and qualitative data. Quantitative data is obtained from the Likert scale assessment, while qualitative data is an assessment of the validator's suggestions. The results of the validation state that the average score for the validation of teaching materials based on local potential is 65.3 in the "very good" category. For the details of each validator, namely the number of assessment scores of the first validator, it obtained 67 with the "very good" category. The total score for the second validator was 61 in the "good" category, while the total score for the third validator was 68 in the "very good" category. The following is a summary of the results of the validation of science teaching materials.

Table 1 - Summary of the Results the Validation Science Teaching Materials.

No.	Validator Name	Score	Category
1	Yuni Ratnasari, S.Si, M.Pd.	67	Very Good
2	Dr. Moh Kanzunnudin, M.Pd.	61	Good
3	Safrida Khoirun Nisa', S.Pd.	68	Very Good
Average Score		65.3	Very Good

Table 2 - Assessment Indicators

Score.	Validator Name
66-80	Very Good.
51-56	Good
36-50	Enough
20-35	Less

So, it can be concluded that science teaching materials with models of science, technology, society can be tested in learning, but there are still few revisions.

Conclusions and Recommendations. Based on the findings and discussions, it can be concluded that science teaching materials with models of science, technology, society are needed by teachers and fifth grade students in Kudus Regency. The design of the developed science teaching materials is adapted to the steps of making teaching materials, namely; analyzing the curriculum, determining the source of teaching materials, compiling a map of teaching materials, and determining the components of teaching materials. The steps of this science, technology, community model are applied to the existing learning activities in science teaching materials, namely; preliminary activities, concept formation activities, concept application activities, concept strengthening activities, and assessment activities. Science teaching materials that have been validated by experts with an average score of 65.3 are very good categories, but there are still slight revisions.

Researchers provide suggestions so that science teaching materials can be developed more broadly in order to get perfect results.

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ҒЫЛЫМ, ТЕХНИКА ЖӘНЕ ҚОҒАМ МОДЕЛІ БОЙЫНША ОҚУ МАТЕРИАЛДАРЫН ӘЗІРЛЕУ

Деви Ауфия Абшор[1]*, Муртоно[1], Ирфаи Фатурохман[1], О.Б. Кенжалиев[2]
[1] *Мурия Кудус университеті, 59327 Орталық Ява, Индонезия*
[2] *Сәтбаев Универсситеті, Алматы қаласы, Қазақстан*

Аннотация. *Бұл зерттеу ғылым, техника және қоғам үлгісімен оқу материалдарының қажеттілігін анықтауға, оқу материалдарының дизайнын сипаттауға және осы оқу материалдарының орындылығын тексеруге бағытталған. Бұл зерттеу нысаны сапалық және сандық зерттеулердің жиынтығы болып табылады. Бұл зерттеудегі мәліметтерді жинау әдістері бақылау, сұхбат, құжаттама және сынақтар болды. Жобаланғаннан кейін материал және тіл мамандарына валидация жүргізіледі. Валидация нәтижелері орта есеппен 65,3 «өте жақсы» санатты алады, осылайша ғылым, технология және қоғам үлгілері бар жаратылыстану-әдістемелік материалдар оқу барысында қолдануға жарамды, бірақ біршама өзгерістер керек.*

Түйін сөздер: *Оқу материалдары, ғылыми-технологиялық қоғам, сыни тұрғыдан ойлау, экожүйе.*

РАЗРАБОТКА УЧЕБНЫХ МАТЕРИАЛОВ ПО МОДЕЛИ НАУКИ, ТЕХНОЛОГИИ И ОБЩЕСТВА

Деви Ауфия Абшор[1]*, Муртоно[2], Ирфаи Фатурохман[3], О.Б. Кенжалиев[4]
[1,2,3]*Университет Муриа Кудус, 59327 Центральная Ява, Индонезия*
[4]*Университет Сатпаева, Алматы, Казахстан*

Аннотация. *Это исследование направлено на определение потребности в учебных материалах с моделью науки, техники и общества, описание дизайна учебных материалов и проверку осуществимости этих учебных материалов. Форма этого исследования представляет собой сочетание качественного и количественного исследования. Методами сбора данных в этом исследовании были наблюдение, интервью, докумен-*

тирование и тесты. Этот учебный материал по естественным наукам разработан в соответствии с этапами модели науки, техники и общества. После разработки проводится проверка материалов и языковых экспертов. Результаты проверки получают в среднем 65,3 категории «очень хорошо», так что учебные материалы по естественным наукам с моделями науки, техники и общества подходят для использования во время обучения, но есть небольшие изменения.

Ключевые слова: Учебные материалы, научно-техническое общество, критическое мышление, экосистема.

Авторлар туралы ақпарат:
Деви Ауфия Абшор – аспирант, Мурия Кудус университеті, 59327 Орталық Ява, Индонезия
Муртоно – оқытушы, Мурия Кудус университеті, 59327 Орталық Ява, Индонезия
Ирфаи Фатурохман - преподаватель, Мурия Кудус университеті, 59327 Орталық Ява, Индонезия
О.Б. Кенжалиев – докторант, Сәтбаев Универсситеті, Алматы, Қазақстан

Сведения об авторах:
Деви Ауфия Абшор – аспирант, Университет Муриа Кудус, 59327 Центральная Ява, Индонезия
Муртоно – преподаватель, Университет Муриа Кудус, 59327 Центральная Ява, Индонезия
Ирфаи Фатурохман – преподаватель, Университет Муриа Кудус, 59327 Центральная Ява, Индонезия
О.Б. Кенжалиев – докторант, Университет Сатпаева, Алматы, Казахстан

Information about authors:
Devy Aufia Abshor – Postgraduate Student, Muria Kudus University, Indonesia, Email: 201903020@std.umk.ac.id
Murtono – Lecturer at Faculty of Teaching and Education, Muria Kudus University, Indonesia. Email: murtono@umk.ac.id
Irfai Fathurohman – Lecturer at Faculty of Teaching and Education, Muria Kudus University, Indonesia. Email: irfai.fathurohman@umk.ac.id
O.B. Kenzhaliyev – PhD student in Satbayev University, Almaty City, Kazakhstan. Email: andas89@gmail.com