



## The Development Process of Islamic STEAM Activity Storybooks for Early Childhood

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### Abstract

This study aims to design and develop an Islamic Science, Technology, Engineering, Art, and Mathematics (STEAM) Activity Storybook prototype, which is a storybook with STEAM learning activity content in it, and there is an integration between the concept of science and Islamic content. The Design Research with the Plomp Model went through the preliminary investigation, design, and construction phases. The preliminary investigation results showed that Kindergarten teachers did not understand the essential elements in the implementation of STEAM learning and still did not have adequate references and media for STEAM learning implementation. In the design phase, principles in developing the Islamic STEAM Activity Storybook for Early Childhood and criteria for STEM/STEAM learning-based storybooks were formulated before entering the construction phase. The storyboard is developed to determine the narrative, activity sheet, context, or description of the image on the specified book page in the construction phase. The whole process was put forward as a reference for developing the Islamic STEAM Activity Storybook for Early Childhood on other STEAM learning content. The results of this study can help teachers and parents to plan and implement STEAM learning with Islamic content for early childhood.

### Kata Kunci

Anak usia dini, islam,  
*project-based learnin*,  
steam, *storybook*

### Abstrak

Penelitian ini bertujuan untuk mendesain dan mengembangkan prototipe *Islamic STEAM Activity Storybook* untuk Anak Usia Dini yakni buku cerita dengan muatan aktivitas pembelajaran STEAM di dalamnya dan terdapat integrasi antara konsep sains dengan muatan islami. Penelitian Desain dengan Model Plomp ini melalui fase investigasi awal, fase desain, fase konstruksi. Hasil Investigasi awal menunjukkan bahwa Guru PAUD belum memahami unsur-unsur yang penting dalam pelaksanaan pembelajaran STEAM serta masih belum memiliki referensi dan media yang memadai untuk pelaksanaan pembelajaran STEAM. Pada fase desain, prinsip-prinsip dalam mengembangkan Buku Cerita Aktivitas STEAM Islami dan kriteria buku cerita berbasis pembelajaran STEM/STEAM dirumuskan sebagai dasar sebelum memasuki tahap konstruksi. Pada fase konstruksi, *storyboard* dikembangkan untuk menentukan narasi, lembar aktivitas, konteks atau keterangan gambar pada halaman buku yang ditentukan. Keseluruhan proses desain dan pengembangan buku cerita yang berjudul "Asyiknya Berkemah Bersama Keluarga Arsyah" dikemukakan sebagai acuan pengembangan *Islamic STEAM Activity Storybook* pada muatan pembelajaran

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STEAM lainnya. Hasil penelitian ini dapat membantu guru dan orang tua untuk merencanakan dan melaksanakan pembelajaran STEAM dengan muatan Islami untuk anak usia dini.

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## A. Introduction

Nowadays, Early Childhood (EC) is an alpha generation that lives in the rapid development of information technology. The way they learn is influenced by the speed of information they get through cyberspace, so the world of education needs to adapt to how children learn in the information technology era. Expressing their thoughts and giving them autonomy in learning is an inevitable need (Koh & Dresang, 2009).

Apart from the characteristics of children's current behavior in receiving information, a successful individual in the 21st century can think critically and creatively, collaborate, communicate, and utilize information technology to solve problems (Binkley et al., 2012). These various skills can be developed through discovery-based learning, inquiry, and critical thinking (F. K. Fitriyah et al., 2022; Häkkinen et al., 2017).

By noticing the current characteristics of Early Childhood and future human resource needs, Early Childhood's High Order Thinking Skills (HOTS) thinking skills need to be developed. It should provide many opportunities for children to work together to solve problems, ask questions, investigate, explore, and communicate the results of their thoughts and work from an early age. STEM (Science, Technology, Engineering, and Mathematics) learning which has developed into STEAM (Science, Technology, Engineering, Art, and Mathematics) integrated with a Project-Based Learning (PjBL) approach, can be an alternative to train EC to adapt to inductive learning to meet learning needs alpha generation.

STEAM PjBL is learning that links the fields of Science, Technology, Engineering, Arts, and Mathematics through a project-based learning activity (Ng & Adnan, 2018; Safiee et al., 2018; Ubben, 2019). PjBL provides opportunities for children to analyze problems, make plans regarding tools and materials and the time required to complete the project, implement the project, and finally evaluate the resulting product (Jannah et al., 2021; Mills et al., 2003). It is known that currently, 80% of PjBL is related to STEM learning (Angelle, 2018).

In Indonesia, the development of HOTS in Early Childhood Education (ECE) classrooms is a new issue, so most ECE teachers are not used to implementing learning that emphasizes HOTS, such as STEAM PjBL. The problem in implementing PjBL in ECE is the limitation of teachers who are not accustomed to implementing inductive learning in the classroom. Afifah et al. (2019) analyzed the kindergarten teacher's ability to teach Project Based Learning (PjBL) science in the classroom. It is known that teachers still do not understand they implement PjBL, so learning is not carried out optimally.

The involvement of cultural elements is very important in supporting the success of learning (Fitriyah et al., 2022), especially when facing the implementation of an independent curriculum (Pendidikan et al., 2022). In addition, linking Islamic religious knowledge in STEAM in Indonesia has not been consistently developed. Previous research stated that the cultural approach through Islam is very relevant in the implementation of learning, especially for Islamic societies (Fitriyah et al., 2021; Fitriyah & Djazilan, 2020). The only publication related to STEAM PjBL Early Childhood with Islamic nuances was found in 2017 (Imaduddin,

2017). Thus, it is necessary to have media that makes it easier for teachers to implement STEAM PjBL in the classroom and can be used independently at home by children and parents.

In STEAM learning for Early Childhood, reading stories is an initial step to identifying problems (DeJarnette, 2018), so storybooks are the right media for ECE's STEAM learning. Islamic STEAM Activity Storybook for Early Childhood is a media that can be used directly by parents at home and teachers for Early Childhood Islamic STEAM learning in the classroom. Grolig et al. (2019) argue that storybooks can be predictors of vocabulary, grammar, comprehension monitoring, and narrative comprehension as part of reading comprehension with the help of the shared reading method. Various forms of storybook media have been researched to develop literacy, namely in printed books and in the form of e-books (Kusumaning Ayu et al., 2019; Neumann, 2020; Raynaudo & Peralta, 2019).

STEAM books for Early Childhood that are widely developed in Indonesia are tutorial books for teachers (Kusumaning Ayu et al., 2019; Siantajani, 2020; Supriadi & Farhati, 2020) and storybooks with the theme of STEAM for EC in Indonesia are still very limited. Research on storybooks for Early Childhood in various forms has been found (Ariyanto & Tanto, 2021; Harsiwi & Yunarni, 2021; Kusumaningrum & Wahyono, 2019); the STEM storybook in Indonesia has also been published (Siantajani, 2019). However, by linking the different characteristics of storybook development, STEAM PjBL activity sheets, and Islamic value with science content, it is hoped that it can provide new treasures for the development of learning media to develop Early Childhood storybooks.

Thus, this article aims to depict the design process of developing the prototype "Islamic STEAM Activity Storybook for Early Childhood" as part of design research and development. This development process includes a preliminary investigation phase, a design phase, and a construction phase.

## B. Methodology

This research held with a design research approach referring to the Plomp model. The Plomp model consists of a preliminary investigation phase; a design phase; a construction phase; a test, evaluation, and revision phase; and finally, the implementation phase (Rochmad, 2012) as follows :

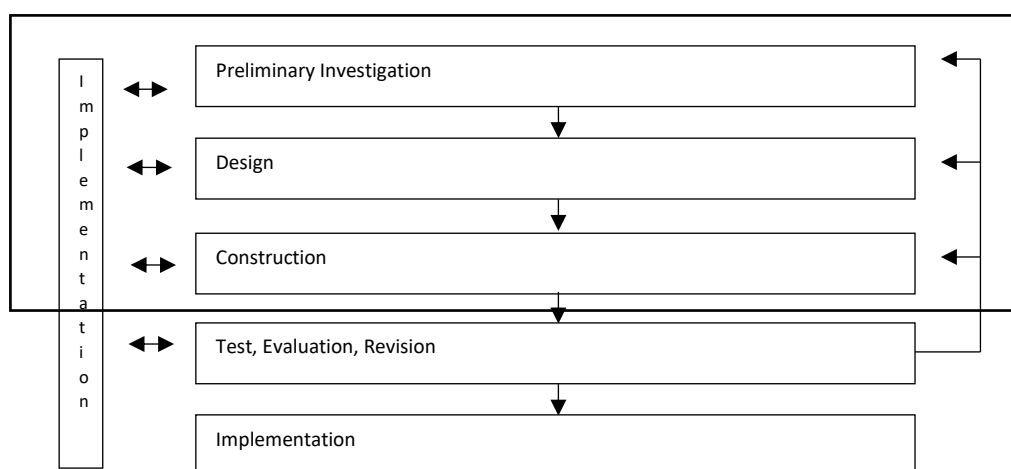


Figure 1. Design Research with the Plomp Model (Rochmad, 2012)

1. Preliminary Investigation Phase: This phase is a study to ascertain the gap between needs and actual conditions as a basis for the product being developed.
2. Design Phase: The design phase is analyzing problem-solving to provide the answer to the problem
3. Construction Stage: Creation of blueprints and product prototypes
4. Stages of testing, evaluation, and revision: the stage of collecting information systematically to find out what to do with the product
5. Implementation Phase: Gathering information on a broad scale to determine the effectiveness of the resulting product.

The context raised in this research is suitable to be applied through design research. It has problems that cannot be solved through solutions that have been implemented and have a large enough impact that leads to change (Plomp & Nieveen, 2013:137). From all the research steps, this article will discuss the product development process starting from the preliminary investigation phase, the design phase, to the construction phase. The preliminary investigation phase was applied on April 2021 by analyzing 20 ECE teachers' understanding of the implementation of STEAM learning using a quantitative descriptive method. The participants were ECE teachers who were studying in ECE undergraduate program at a private university. The data collection technique was conducted through a questionnaire using a Guttman scale, appropriate and inappropriate via Google Form. The item validity test was performed using the Pearson bivariate formula, and the data were analyzed by calculating the percentage of correct answers. The following are statements related to the understanding of STEAM learning on the questionnaire and the validity value of each item:

**Table 1. List of Statements According to the Category of Understanding about STEAM Learning**

Category	Statements	Answers	Validity Value
Integrated STEAM Learning	1. In my opinion, STEAM learning is the same as a science demonstration	Inappropriate	0,730
Implementation	2. In my opinion, coloring the rainbow image on the activity sheet is not a STEAM learning.	Appropriate	0,627
Student Center Learning	3. I have given STEAM lessons to students because I have demonstrated hands-on activities (for example, mixing colors) and children participated in the demonstrations.	Inappropriate	0,590
	4. I think STEAM learning needs to be teacher-centered because STEAM material is still too tricky for Early Child	Inappropriate	0,612
	5. One of the goals of STEAM learning is to develop thinking skills from the teacher's demonstration	Inappropriate	0,395
	6. In my opinion, I once gave STEAM lessons online only by giving assignments to make crafts from youtube links during this pandemic.	Inappropriate	0,782
Authentic Assessment	7. Conversation activities are not so crucial in STEAM learning; what is essential is doing assignments.	Inappropriate	0,697
	8. Assessment in STEAM learning is enough to see the results of students' work.	Inappropriate	0,814

Referring to the rtable value at a significance of 0.05 is 0.444 for 20 participants, then the results of the item validity test show that item number 5 was not valid. Measurement of reliability using Cronbach Alpha and the resulting value is 0.835 out of 8 items, indicating that these items have a good consistency. If item number 5 is omitted, then the value is 0.810, which means the consistency of each item remains good.

Before the Islamic STEAM Activity Storybook for Early Childhood prototype entered the construction phase, the design phase that mapped the STEAM elements to the book was implemented. Furthermore, the construction phase of the Islamic STEAM Activity Storybook for Early Childhood consists of a brainstorming process in the design of the construction phase, storyboard development, illustrations, and graphic design for the construction phase to the completion of the initial prototype design. It was analyzed and implemented based on a literature review method from the design phase to the construction phase.

## C. Result and Discussion

### 1. Preliminary Investigation Phase

This study aims to provide a development process overview of the Islamic STEAM Activity Storybook for Early Childhood, including the investigation phase, design phase, and construction phase. The preliminary investigation process adapts to the steps proposed by Plomp & Nieveen (2013), including context and needs analysis from the field, literature analysis, and theory development for research needs.

**Table 2. Result of Needs Analysis**

Participants	Experienced in STEAM learning training	Score (%)
R1	Inexperienced	37,5
R2	Experienced	25
R3	Experienced	50
R4	Inexperienced	25
R5	Experienced	37,5
R6	Experienced	25
R7	Experienced	12,5
R8	Experienced	87,5
R9	Experienced	0
R10	Experienced	0
R11	Experienced	87,5
R12	Inexperienced	62,5
R13	Experienced	25
R14	Experienced	50
R15	Experienced	0
R16	Experienced	0
R17	Experienced	62,5
R18	Experienced	87,5
R19	Experienced	0
R20	Experienced	0

A field study analysis was conducted on 20 ECE teachers who teach at various ECE institutions in Surabaya to study their understanding of STEAM learning in April 2021. Based on the literature study results, STEAM learning needs to fulfill multiple aspects, such as

learning that connects all STEAM in an integrated manner, learning that refers to real-world problems centered on students, and using an assessment that refers to the process.

Of the 20 participants, 16 people have experience in STEAM learning training for Early Childhood. However, only four experienced participants scored above 50, so it can be concluded that only 25% of experienced STEAM learning training teachers understand the principles of implementing STEAM learning.

## 2. The Design Phase

Based on the results of the interviews, it is known that many of them still do not understand the criteria for STEAM learning, even though 16 from 20 of them were experienced Tiered Education and Training organized by the Ministry of Education and Culture for ECE teachers. In addition, teachers have not received adequate references and media as examples for STEAM learning, so STEAM learning activity books are needed to be applied in the classroom.

As part of the product development process, it is necessary to conduct a literature study as the basis for developing the Islamic STEAM Activity Storybook. The following are the principles for developing the Islamic STEAM Activity Storybook:

- 1) Referring to the STEAM learning criteria.
- 2) ADJUST to the book criteria for Early Childhood,
- 3) Linking the concept of science with the arguments in the Qur'an and Hadith, and
- 4) Adjust to the available resources.

The development of the Islamic STEAM Activity Storybook for Early Childhood follows the STEAM learning initiated by DeJarnette (2018) and Rahardjo (2019) by reading stories at the beginning of learning as a medium to help children formulate problems. Thus, this PjBL Islamic STEAM activity book is applied in the form of a story. In addition, with reference to the development of Early Childhood, storybooks that can increase Early Childhood attention and involvement are by using illustrated and colorful storybooks (Machado, 2015).

In determining the content of the PjBL Islamic STEAM activity book, the criteria for STEM/STEAM learning-based storybooks are:

- 1) It shows the character's experience interacting with the environment or solving problems in the environment.
- 2) Characters show a disposition of curiosity, investigator, dare to ask questions, analytical, creative, and so on by the dispositions to be developed through STEM/STEAM learning (F. K. Fitriyah et al., 2022; Sharapan, 2012; Simoncini, 2017).
- 3) Activities that appear in storybooks are activities related to STEAM learning.
- 4) There are activities related to case-based, problem-based, or project-based learning steps through hands-on activities according to the stages of Early Childhood Development.
- 5) The arguments of the Al-Qur'an were reviewed, related to the concept of science discussed in the PJBL Islamic STEAM activity book.

## 3. The Construction Phase

The design in the construction phase is a brainstorming phase to determine story ideas based on the criteria for the STEAM Islamic activity book for early childhood. At the design stage, brainstorming is an essential step in the design thinking process (Bonnardel & Didier,

2020). This brainstorming process provides ideas on how the product developed becomes a standard in storybook development with STEAM learning. The brainstorming process is divided into systems one and two (Kannengiesser & Gero, 2019). System one is more focused on speed in developing ideas without considering various factors, while system two prioritizes the factors involved in decision making. In the application of brainstorming for product development, researchers consider the type two system so that this STEAM learning media provides the STEAM label and considers the results of studies that have developed regarding STEAM learning and the integration of science with Islamic value.

The results of the brainstorming developed from the results of the literature analysis are:

- 1) The activity book was developed in an illustrated storyline because it refers to STEAM learning for Early Childhood. The problem formulation process is set in the form of a story (DeJarnette, 2018; Rahardjo, 2019).
- 2) Elements of Science, Technology, Engineering, Art, and Mathematics are each spread out in the storyline in activity sheets. Each problem solving will provide answers to other STEAM elements. For example: on an activity sheet with questions containing aspects of Technology, readers are asked to collect the tools needed for camping, while in an activity sheet containing engineering questions, readers are requested to use the tools they managed previously to build a tent.
- 3) There are hands-on activities as one of the challenges with steps referring to the Engineering Design Process (EDP) according to the steps initiated by Engineering is Elementary (EiE) (Halim et al., 2020).
- 4) Determining the characters that appear in the story characters is an important part of the STEAM learning process because the goal of STEAM learning is to gain knowledge and skills and develop characters that support the learning process (MacDonald & John, 2015). The dispositions that are instilled in the characters of this storybook are curiosity, love of new things, courage, and creativity.
- 5) Integration of science with Islamic content, connecting the concept of science with the arguments of the Qur'an, and then taking the value of that integration into the context of STEAM learning (Fitriyah & Djazilan, 2020).

After the story is roughly developed through brainstorming, it enters the stage of developing the storyline or storyboard. Storyboard mapping in story development facilitates communication between story writers and illustrators, and graphic designers to create illustrations and organize storybook graphics.

The elements in the storyboard consist of book pages, narration, activity sheets, context, or picture descriptions. The book page shows the page where the narrative, context, activity sheets, and STEAM elements are developed are applied. The narrative is a conversation between characters in the story; the STEAM learning activity sheet is mapped page by page, accompanied by context as a guide for developing illustrations.

STEAM (Science, Technology, Engineering, Art, and Mathematics) learning is learning that combines all STEAM fields through the context or problem to be solved. In the developed book, the element of science appears as a theoretical footing in solving problems and explaining the phenomena around. Technology is used as a problem-solving tool and product; Engineering plays a role in the problem-solving process. Art provides aesthetic elements to the product



being developed, and mathematical elements play an essential part in considering product completion.

The book that was developed entitled “Asyiknya berkemah bersama keluarga Arsyah” talks about Arsyah's experience camping with his parents. The things Arsyah prepared for camping, what Arsyah saw during the trip, and Arsyah's experiences while camping were part of the STEAM learning process.

The Technology element was raised in the form of an activity sheet when Arsyah was asked by his father to prepare camping equipment in the story. This context follows the function of the technology element in STEAM learning for Early Childhood. The technology element plays a role in introducing tools for manufacturing STEAM products or the utility of STEAM products themselves (Sharapan, 2012).

Science is applied to things that Arsyah observes around. The question of why Arsyah raised her mother and father about the mountains and terraces she saw during the trip to the camping site became part of the element of science. In this discussion of the mountain concept, the author combines elements of scientific ideas, propositions in the Qur'an, and analogies to the developed STEAM project.

The Engineering element was raised in the hands-on activity of making tents. Readers are invited to participate in solving problems in building a tent to stand tall and strong. The steps of this engineering element adapting to the EDP include Ask, Imagine, Plan, Create, Test in the form of activities (Lin et al., 2021).

Elements of Art is honing the aesthetic ability of children to decorate products that have been designed. As for the Mathematics element, it is applied to the process of solving STEAM problems and developing children's HOTS through activities.

In applying the integration of science with Islamic content, the author connects the concept of a mountain scientifically with QS An-Naba 'verse 7. According to science, the earth's surface consists of tectonic plates that continue to move and collide to form folds that stick out above the earth's surface to form mountains. To maintain the stability of the geothermal core of the earth, it must routinely release hot gas through active volcanoes.

In the Qur'an, the translation of QS An-Naba 'verse 7 is as follows:

*"And the mountains as pegs?"*

This integration is implemented in the form of a discussion between Arsyah and her father as a concept guide in STEAM learning, namely, building a tent as follows:

Arsyah: "Father, why did Allah create mountains? And how are mountains established?"

Father: "Mountains were created as earth pegs so that the earth becomes stable and does not make humans shake on this earth."

Father: "Arsyah knows the tent? Just imagine the tent can stand strong because of what?"

Arsyah: "The stake, father."

Father: "What happens if the tent is not pegged?"

Arsyah: "The tent will collapse."

Father: "Right, the same as the earth if there are no mountains."

After design fixation, the following process is the application of illustrations and graphic designs to the developed product. Figure 1 shows several pages of the prototype Islamic STEAM Activity Storybook for Early Childhood entitled “Asyiknya Berkemah bersama Keluarga Arsyah”:





Figure 2. Product Prototype Showing Elements of Science Integration with Islamic Content

In the United States, STEM activity books and storybooks for ECE have been developed in accordance with the applicable curriculum, such as the Smart Start STEM book for pre-K (Rivera & Allman, 2018) and the STEM storybook storytime: Folk and Fairytales with hands-on investigations (Rhodes, 2019). These two books were developed based on the study of STEM and STEAM learning by involving the Project-Based Learning Approach and Engineering Design Process (EDP), which frees children to create their work to solve the problems described in the book. There have been circulating storybooks containing STEAM for ECE in Indonesia, namely the Serial STEAM: Buku dan Bambu (Siantajani, 2019). However, the EDP content does not appear in the storybook, so teachers need to design their STEAM activity challenges from the book.

This Islamic STEAM Activity Storybook for Early Childhood, in addition to containing stories with the EDP challenges in STEAM, Islamic content linked to science is an advantage. Future Indonesian education aims is Profil Pelajar Pancasila to cultivate specific great dispositions and skills (Kemendikbud, 2021). Islamic STEAM Activity Storybook for Early Childhood could foster indicators to practice motor skills and ECE's critical and creative thinking while developing Gratitude for God's creations from children understanding about linking science with Islamic content. This research continues with the field trials for Early Child, content validation test phase to experts and ECE teachers; practices to ECE teachers, parents, and Early Child evaluation; revision phase to improve prototype one into a revised version; and last is the implementation phase.

The product of this research will be beneficial to the implementation of STEAM learning in the thematic curriculum and the development of the prototype curriculum, which will provide more space for STEAM learning at various levels of education, including Early Childhood Education (Kemendikbud, 2021). In addition, it is necessary to develop an Islamic STEAM Activity Storybook for Early Childhood with other material content as the application of this research.

#### **D. Conclusion and Recommendation**

Based on the preliminary investigation results, it is known that only 25% of ECE teachers have undergone STEAM learning training. They have not understood the principle of STEAM learning, including Integrated STEAM Learning Implementation, student center learning, and authentic assessment. In addition, teachers have not received adequate references as examples for STEAM learning so that the Islamic STEAM Activity Storybook for Early Childhood can be applied in the classroom. The characteristics of the Islamic STEAM Activity Storybook for Early Childhood were developed in the form of a storybook. There are activity sheets related to STEAM elements that are integrated into the story and PjBL activities with Engineering Design Process (EDP) steps. The storybooks are made with colorful illustrations and conform to the book criteria for Early Childhood. In the narrative, there is a relationship between the concept of science and Islamic content.

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