# DEVELOPING MATHEMATICS LEARNING MEDIA USING THE STEAM APPROACH : EFFORTS TO IMPROVE THE QUALITY OF DEEP LEARNING

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**Abstract**

Development of mathematics learning media using the STEAM approach as a strategic effort in the process of adapting 21st century learning. The purpose of this study is to determine the process of developing mathematics learning media in an effort to improve the quality of deep learning. The research method used is the 4D development method consisting of Define, Design, Develop, and Disseminate. The subjects of this study were prospective mathematics teachers who were taking a mathematics animation multimedia course. In the define stage, prospective teachers analyzed materials that were considered difficult by students from teaching field practice or from previous learning experiences. Data containing materials that were difficult for students to learn were then analyzed to develop relevant media to reduce students' difficulties in understanding certain materials. Information collection related to student difficulties was obtained through the process of observation, direct interviews, and documentation of student learning outcomes to determine the causes of difficulties and from the difficult material identified for product design that could help students overcome their difficulties. The design was then followed up with the development of mathematical animation multimedia. In accessing mathematics learning so that it could be accessed by many parties, prospective teachers developed it in web form using Coding entered in Visual Studio Code which leads to HTML. The website containing mathematical animation multimedia was taught to teachers from Cambodia. Based on the animated multimedia created, Cambodian teachers gave positive appreciation and stated that the animated media created was appropriate.

**Keywords :** Media, STEAM, Deep Learning

## INTRODUCTION

Technology-based learning media is currently one way to foster more collaborative learning between teachers and students. This initiative also serves as an effort to reduce the current conventional learning process. Conventional learning tends to make students less active and less engaged in the learning process. A good learning process seeks to encourage students to be more active in the learning process and position them as the subjects of education (Wulandari et al., 2022).

The learning process that positions students as the subject of education can be carried out using active learning strategies where students contribute significantly to the learning process and the teacher acts as a facilitator (Rohyana et al., 2023) (Yudi Hari Rayanto & Daryono, 2022) (Rahmayumita et al., 2024). Through active learning, students can construct their knowledge. The construction of knowledge possessed by students can help in the process of understanding the material and the learning carried out can be meaningful (Leung et al., 2024). Meaningful learning has an important

meaning for students where students can elaborate on their abilities to overcome problems in everyday life. The construction of knowledge that can be carried out by students can be stimulated through active learning by utilizing technology-based learning media.

Technology-based learning is highly relevant for implementation in the 21st-century learning process, where technological developments have already penetrated the educational realm (Firmansyah et al., 2024). Most students, especially those living in urban areas or areas in the 3T Zone, are now comfortable using technology, especially in the learning process. This is one of the assets that can be utilized to strengthen the technology-based learning process. There are positive impacts through the use of technology-based learning media, ICT (Information and Communication Technology). Success in the ICT learning process lies in preparing competent human resources or prospective teachers who not only use but also produce learning media that is suitable for use in the learning process.

To prepare qualified and competent human resources or prospective teachers in the learning process, massive and impactful efforts are needed for prospective teachers to improve the quality of technology-based learning (Nurunisa & Shodiq, 2024). One effort that can be made is to equip prospective teachers with courses on animated multimedia. One of the materials that students find difficult, according to data and research, is mathematics. Efforts are needed to develop mathematics learning media that can help students learn difficult material through a fun learning process.

The concept of ICT-based mathematics learning can encourage students to be more active in the learning process (D. I. Pratiwi et al., 2023). Student activity in the learning process can encourage students to be motivated in the learning process to find out things that have not been obtained to answer difficult material. Difficulties in the process of understanding the material can be a reference for developing a fun learning process. Through a fun learning process, students indirectly have high enthusiasm in the learning process until

they find the correct answer with the right solution through mathematical animation learning media facilitated by the teacher. There are several LPTK (Education Personnel Education Institutions) that have developed ICT-based learning and there are also those that are still not optimal in the use of ICT in the learning process.

Learning mathematics using ICT-based media has a positive impact on the learning process and student learning outcomes. This is relevant to the STEAM approach, which prioritizes meaningful learning. The STEAM approach used in mathematics learning activities plays a significant role in helping students understand mathematical concepts. Some abstract mathematical concepts can be taught easily and visually so that students can understand the concepts well, some examples of which are geometry. The application of the STEAM approach in mathematics learning is not limited to variations in learning approaches, but begins with problems that occur and find solutions in the learning process. Learning based on solving problems in everyday life is a form of contextual and meaningful learning. Contextual learning can be implemented, one of which is by using interactive and integrative learning media that support the achievement of the learning process.

Furthermore, there has been no research on the development of animated mathematics learning media implemented by teachers in Cambodia. The results of this study provide insights into the responses and perspectives of mathematics learning media created by prospective mathematics teachers and implemented by teachers in Cambodia. This research can add to the scientific knowledge of animated mathematics media, the implementation of which can be felt by the global community. Therefore, the focus of this research is to develop learning media with a STEAM approach from the perspective of improving the quality of Deep Learning.

## METHOD

The research method used in this study is the 4D method consisting of Define, Design, Develop, and Disseminate. The first step is Define, where prospective teachers before producing

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mathematical animation multimedia are analyzed to determine the difficulties experienced by students. Information related to the difficulties experienced by students is very important related to the media created. Through accurate information related to student difficulties, prospective teachers can create animated media with appropriate materials. The second step is Design or designing the media. Animated media requires a design process before being created, this is to ensure that the animated media created is in accordance with the needs of students and is inseparable from the purpose of creating the media, which is to help students who experience learning difficulties. The third step is Develop, through the design process is then followed by the process of creating or developing the media. This step is a strategic step where the media can be produced and utilized. If there was a previous design step, then the media can be produced for use. The fourth step is Disseminate, where prospective teachers who create mathematical animation multimedia can disseminate this utilization for use by students.

This 4D development method was implemented over five weeks to produce a robust media. A robust media platform is demonstrated by the completeness of the materials presented. A small-scale trial was also conducted during initial use to identify its strengths and weaknesses, which can then be further developed into a usable platform with improved quality.

There are 27 learning animation media created by prospective teachers, then three media were selected as research subjects. The selection of these three subjects was based on the best media with the criteria of material complexity, informativeness, and interactivity. The development of STEAM-based mathematical animation multimedia, where in general prospective teachers already understand the context of Science, Technology, Engineering, Arts, and Mathematics in every step of its creation. This is to support the creation of media that leads to Deep Learning learning. Media that, according to the researcher's perspective, can support Deep Learning aspects is also an additional consideration in selecting

categories to take three interesting media. Furthermore, the three media are reviewed from a STEAM perspective in their use.

## RESULTS

Researchers have identified three best media based on the completeness or complexity of the material, the information conveyed, and the interactive aspects of the animation. Another consideration is the ability of the developed media to support the Deep Learning process. Researchers also administered a questionnaire to the research subjects to determine the primary purpose of the media development, key points in the development steps, and efforts to disseminate the created media to maximize its use by a wide range of users. The following presents questions and answers from each research subject.

Results of Research Subject 1

Q: "Explain the problem analysis behind the creation of your media! Describe it in one paragraph of approximately five sentences!"

S1: "Based on the main challenges in learning geometry, namely students' difficulty understanding abstract concepts and limited spatial visualization abilities, learning media is needed that can overcome these obstacles. Therefore, the development of animated geometry web media is designed to convey abstract concepts through relevant visuals and animations, thereby improving students' understanding and visualization abilities. In addition to its visualization function, this media also integrates ethnomathematics, making the learning material more contextual and meaningful, which will ultimately simplify and streamline the students' learning process."

Q: "Explain your media planning in the form of a storyboard presented in a table!"

The following is the storyboard designed by S1, which can be seen in Table 1.

**Table 1** Storyboard for Media Creation

| Plan | Picture |
|---|---|
| Determine the theme, characters, |  The video's theme is a discussion of translation material integrated with ethnomathematics. The character is a junior high school student, and its duration is 3 minutes. Canva was used for video editing, Capcut for sound effects, and Studio Code for website creation. |
| Create a narrative for each scene |  |
| *Story Board* |  |

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Q: "What efforts are being made to disseminate the created media?"

S1: "The videos are disseminated by uploading them to YouTube so they can be accessed by everyone. YouTube was chosen as the uploading medium for ease of viewing, such as selecting video quality or searching for videos. However, the website itself cannot be uploaded due to budget constraints for domain names or media hosting."

Research Subject 2 Results

Q: "What motivated you to create animated mathematics media?"

S2: "Based on the research findings, the creation of learning media in the form of learning videos on fractions was motivated by high levels of student learning difficulties, particularly in conceptual understanding (83.33%) and arithmetic skills (59.52%). This difficulty was compounded by several factors, such as a lack of understanding of the context of story problems related to factual knowledge and a lack of skill in calculating fractions. Therefore, this learning video was created to help students understand abstract concepts more easily and to practice fraction calculation skills in a more engaging and visual way, thereby addressing the main problems identified in the research."
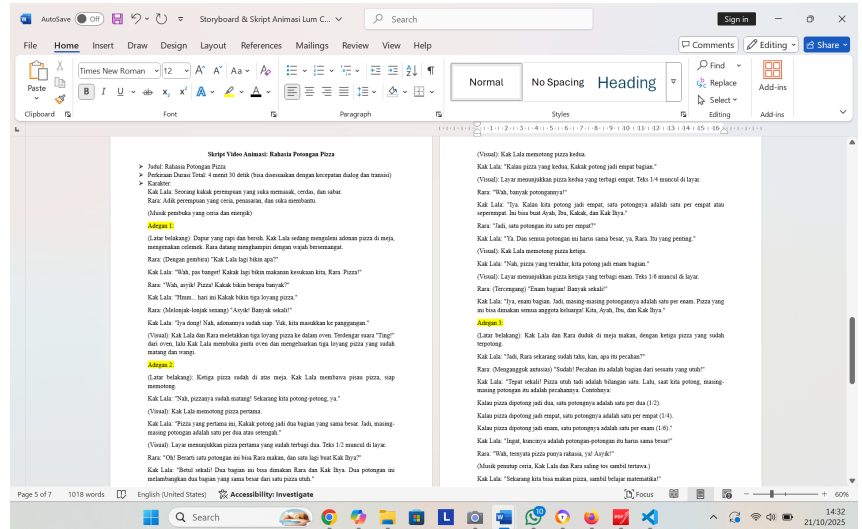
Q: "Explain the steps in your media planning in the form of a storyboard presented in a table!"

S2: The following are the steps in creating a storyboard, as shown in Table 2.

**Table 2.** Media Creation Story by S2

| Plan | Picture |
| --- | --- |
| Determining the Material Concept Map |  |
| Story Board |  |

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Video Script



Q: "How are you disseminating the media you've created so that it can be maximized by a wider audience?"

S2: "This fraction learning video media is disseminated through a website platform. After the video is uploaded to YouTube, it will be integrated directly into the website. This strategy allows the media website to become a central learning resource center."

Subject 3 Research Results

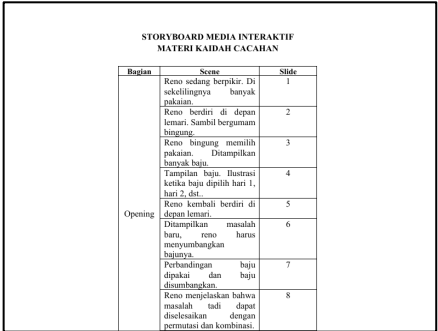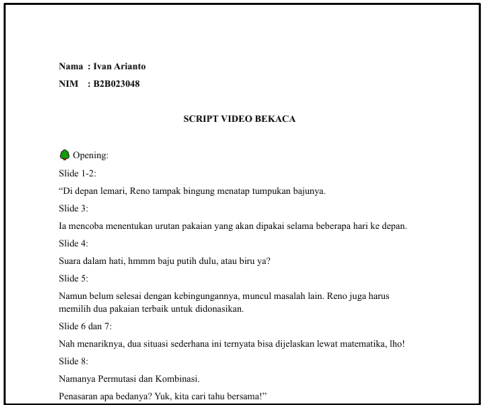P: "Explain the problem analysis behind the creation of your media!"

S3: "The topic of permutations and combinations is part of the counting rules that often confuses 12th-grade students, especially in distinguishing between the two. This problem can impact the understanding of more complex mathematical concepts and suboptimal learning outcomes. Therefore, engaging and easy-to-understand learning media are needed to help students understand the differences and applications of permutations and combinations more concretely. One solution offered is animated multimedia that can present the material visually and interactively. The animated video BEKACA (Learning Counting Rules) was developed as an alternative media to support a more enjoyable and effective learning process."

Q: Explain the steps in your media planning in the form of a storyboard presented in a table!

S3: The following are the steps in the form of a storyboard and can be observed in Table 3.

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**Table 3.** Steps for Creating Media by S3

| Plan | Picture |
|---|---|
| Concept |  **Link:** **https://drive.google.com/file/d/1Cioz3lpP2mQ8e4_Ca8mRNKjG8FyT-Pne/view?usp=drivesdk** |
| Storyboard |  **Link:** **https://drive.google.com/file/d/1spw40eaggNI2eOHKMXQ8gSvPp7w-4aaC/view?usp=drivesdk** |
| Video Script |  **Link:** **https://drive.google.com/file/d/1FivJXNHJuLfQbsfAyzAU74kMO19QhSbR/view?usp=drivesdk** |

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Q: "How do you disseminate the media you create?"

S3: "For dissemination, I use web support. So, the animated videos I create are included on a website. The website includes a media presentation, animated video, creator profile, and description."

## DISCUSSION

There are several scientific reasons behind the development of learning media by prospective mathematics teachers. One of them was conveyed by Subject 1, who stated that learning media needs to be created to help students who have difficulty understanding abstract concepts. The process of transitioning thinking from concrete to abstract is not easy for some students, especially without guidance in the learning process. In the process of student cognitive development and the transition of thinking processes to something more complex, it is necessary for students to provide direction to guide the thinking process. One effort made by prospective teacher Subject 1 is through the development of media that can be utilized by students to help them overcome difficulties in abstract thinking (Asmara et al., 2022) (Adawiyah et al., 2024).

The prospective teacher of subject 1 explained that there are still students who have difficulty in carrying out the visual thinking process. In geometry, there are many objects, both 2-dimensional and 3-dimensional, that require a good visualization process. Students can know the angles, edges, sides and diagonal parts of a space in addition to the explanations given, objects can also be shown concretely for 2- or 3-dimensional objects. One of the advantages of learning media is helping students to know objects that were initially difficult to visualize into objects that can be observed and studied (Riwayati et al., 2025). In this section, the role of animation-based learning media becomes something important

in efforts to support a meaningful learning process. The prospective teacher of subject 1 described the development of media that is carried out not only for students who have difficulty in the visual aspect but can be used for students who already understand the aspect of strengthening concepts.

In line with the purpose of creating technology-based learning media, prospective subject 2 teachers explained that the level of difficulty for students in learning concepts was quite high (Riwayati et al., 2025) (Firdaus, 2025). If this is not immediately followed up properly, students may experience difficulties in learning subsequent materials, because in principle mathematics is a continuous science, if the initial part of the explanation that has been delivered by the teacher cannot be understood well, then students may experience difficulties for the next material. Especially if there is a mid-term exam or final exam, where the material presented is a combination of materials that have been studied previously.

In addition to difficulties in understanding concepts, students are still found to have difficulty in performing arithmetic operations (Ragil et al., 2025) (Putri et al., 2023). According to prospective teachers in subject 2, students are still identified who have difficulty in multiplication with many digits, mixed fraction arithmetic operations, and difficulties in performing arithmetic operations for decimal numbers, including other forms of arithmetic operations. One of the causes of this problem is conventional learning and the active role of students has not been optimal, including the teacher's efforts to convey all the material in a relatively short time, so that students have not been able to contribute to the learning process.

The prospective teacher of subject 3 confirmed the opinions expressed by subjects 1 and 2, stating that observations during the

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permutation and combination lesson revealed that some students still had difficulty solving permutation and combination problems. Some students used the concept of combination in the given problem, but the answer was a permutation problem, and vice versa. In this context, students did not fully understand the material related to permutation and combination.

Through the media created, it is hoped that students will have the concept of permutations and combinations in a fun and impressive way. Related to the learning process, if students feel happy and comfortable in the learning process, students can easily understand and consistently remember the material that has been learned (Muhammad et al., 2025). This is the background for the prospective teachers of the third subject to create learning media that are fun and material that is easy to understand and concepts that are taught correctly can always be remembered by students (June & Chusna, 2024).

Regarding the implementation of the STEAM method in creating mathematics learning media, both prospective teachers in subjects 1, 2, and 3 have the same characteristics in their implementation. In the Science aspect, all three subjects have knowledge related to the use of learning media to help overcome student learning difficulties (K. A. M. Pratiwi et al., 2024). In the Technology aspect, in the process of creating media, all three subjects use the Canva application so that the media created can run attractively and interactively. In the Engineering aspect, all three subjects use media displays through websites so that they can be accessed anywhere and anytime. The Arts aspect is related to culture in the mathematical concept known as ethnomathematics. In the Mathematics aspect, in the creation process, mathematical concepts are used in the

proportional time or duration estimation section of the media. Careful mathematical calculations are needed so that animated multimedia can run well.

In the dissemination phase, the three subjects shared a common characteristic: utilizing a platform that can display videos over the internet. This aims to make it easier for students to learn the material presented anywhere and anytime (Alhamdani, 2022). This effort is part of a flexibility effort in the learning process (Mahrani et al., 2022). Students can review material they find difficult. Technology-based learning media is a crucial tool in improving the quality of learning.

The media developed by the three subjects were then demonstrated to other teachers and received positive feedback. Some teachers expressed their desire to use the media they created for implementation in their schools. Positive feedback and teachers' willingness to use the media are key to the success of the Deep Learning program, which includes creating meaningful and enjoyable learning (Alhamdani, 2022). Students can utilize these media to support a comprehensive learning process.

**CONCLUSION**

Creating mathematics learning media using the STEAM method can encourage prospective teachers or teachers to produce learning products that are useful for students. This is because the STEAM principle begins with a problem-solving context. Both prospective teachers and teachers can identify problems in the learning process, one of which is student difficulties, so they can design and create media that can overcome these student difficulties. Mathematics learning media using the STEAM method tends to be more systematic and structured according to learning needs, so that the products created receive a

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positive response from the educational community in the field of mathematics teaching. Further research can be directed at the influence of learning media produced using the STEAM method on student learning outcomes as an effort to increase the treasury of mathematical knowledge in the field of media development using the STEAM method.

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