

Math Learning Application on Mobile Devices Following the STEAM Educational Model

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Abstract: Building a math learning application on mobile devices following the STEAM educational model is a solution to help students see and grasp the role of mathematics in all aspects of their lives, have the mathematical skills to execute ideas correctly, be able to apply mathematical theories and skills to everyday life; create interest, curiosity, eagerness for learning in students. In addition, the application helps parents stay closer to their children and helps parents conveniently accompany their children in learning. This article summarizes the overview studies on applying the STEAM educational model in building math learning applications on mobile devices for grade 1 students.

Keywords: Math learning app, STEAM education model, Mobile device

1. Introduction

The explosion of technology 4.0 makes children today access technology very early. Therefore, some parents are concerned that it will affect their children. However, exposing children to programming and math games at preschool and primary school age will increase their thinking ability and ability to discover new things.

Each child is likened to a natural scientist, always curious to discover new and impressive things. Technology devices are a new horizon that brings learning and playing opportunities, from which children acquire rich knowledge and develop unlimited creativity. For children to develop, perfect, and develop natural skills, the right approach to technology and engineering should form STEAM education, which is no longer strange to many countries in the world. In Vietnam, STEAM education has also begun to be implemented through STEAM lessons or STEAM clubs in some schools, such as Science and Math classes, following the STEAM orientation.

STEAM education is essentially understood as equipping learners with the necessary knowledge and skills related to the fields of science, technology, engineering, and mathematics. These knowledge and skills are integrated and interwoven, complementing each other to help learners understand the principles, apply them to practice and create practical products, and promote creative thinking (Khine & Areepattamannil, 2019).

In addition, STEAM education promotes a new learning style for learners, which is the creative learning style and problem-solving ability. Putting learners in the role of an inventor, learners will have to understand the essence of the knowledge equipped; must know how to expand knowledge; must know how to repair and reprocess them to suit the problematic situation that learners have to solve. These skills are essential to work and develop in today's technological world.

Therefore, we have built a math learning application on mobile devices based on the STEAM model to serve teachers and parents and teach children to learn effectively and keep up with modern educational trends.

2. Research Object and Method

The research object of this study is a mobile-based math learning application designed for first graders, utilizing the STEAM educational approach. The research was conducted in Phu Tho province, Vietnam, from January 2022 to June 2022. This section outlines the research methods used in the development and evaluation of the application.

2.1 Research Method

Document Collection and Review: Research materials were sourced from publicly available documents, including official textbooks and guidelines from the Ministry of Education and Training. Additionally, input from experienced teachers who had undergone professional development in Phu Tho province was incorporated into the application design.

Database Development: The application's database follows a modular design, with content organized into chapters or "Groups." Each Group contains lessons on specific topics, ensuring a structured and manageable learning system. This modular setup allows easy management by application administrators, ensuring consistency and coherence throughout the learning process.

Development Tools: The application was built using React Native, a framework that allows cross-platform mobile application development. This choice of technology optimizes performance and minimizes development costs by enabling the use of a single codebase for both Android and iOS platforms, ensuring broad accessibility for users.

2.2 Implementation Method

Information Collection: The content for the app's lessons was drawn from publicly available documents provided by the Ministry of Education and Training, supplemented by expert opinions from professional teachers. This helped ensure that the material aligns with national educational standards.

Application Design: A user-friendly interface was prioritized in the app's design to make it accessible for young learners. Lessons are clearly structured, with each module divided into specific topics. Each topic includes both theoretical content and corresponding practice exercises to reinforce learning.

Pilot Testing: The app was piloted at primary schools in Phu Tho province, where it was tested by students, teachers, and parents. Feedback from these stakeholders was collected to assess the app's effectiveness and to identify areas for improvement.

2.3 Research Objectives

The primary objective of the study was to determine whether the STEAM-based math learning application for mobile devices would improve first graders' mastery of theoretical knowledge and enhance their logical and creative thinking skills. Based on user feedback, the application was found to have a user-friendly interface and an intuitive structure. Additionally, the lesson content was well-aligned with the current national educational program, suggesting that the application is an effective tool for supporting math learning in first-grade students.

3. Overview of the Research Situation

3.1 STEAM Education Model

STEAM is an abbreviation of English terms such as Science, Technology, Engineering, Art, and Math. Learners will link information from these fields, to understand deeply, understand clearly, and solve problems from many perspectives. It is worth mentioning that, in addition to

the knowledge received, this model also helps us develop thinking by maximizing the use of the mind.

STEAM education is mainly based on practical experiences and activities instead of simply being attached to knowledge. Thus, different from conventional education methods, the STEAM method encourages children to develop comprehensively in both knowledge and skills, ensuring a happy, comfortable spirit, without pressure (Jesionkowska et al., 2020).

Application of the STEAM Model in Education It can be simply understood that STEAM education reflects real life. Therefore, it encourages children not to memorize dry, discrete knowledge. Inspire children to love learning, and memorize knowledge by themselves instead of learning mechanically. To have the above skills, children need to learn systematically and build systematic lessons. Encourage children to ask questions, and actively explore the things around them. Parents can also learn about their children's passions to promote and help them pursue those passions. The four necessary skills of 21st-century citizens are Critical thinking skills, communication skills, cooperation skills, and creativity. STEAM education does not aim to train geniuses but mainly equips students with the necessary knowledge and skills in the digital age world (Quigley et al., 2017). From the preschool level, the STEAM education method will help children develop logical thinking skills and problem-solving skills. That is the necessary factor for every individual, especially in today's integrated world.

Advantages of STEAM Education According to some opinions (Wang et al., 2018, Ge et al., 2015, Martinez, 2017) the benefits of STEAM education follow:

- STEAM education is an educational method that integrates interdisciplinary knowledge through practice. From there, children both learn scientific knowledge and learn how to apply that knowledge in practice. The purpose of STEAM education is to create competent people in today's era.
- In each lesson on the STEAM topic, children are asked to solve related situations. To solve the problem, children must research and study through books, technology devices, etc. This helps children be proactive with their knowledge and remember the lesson longer.
- STEAM education promotes a new learning style for learners. The purpose is to help learners understand the essence of the knowledge they are solving. – Learning according to the method of "Learning through practice", and "learning while playing". The learning projects of STEAM education are through games, children can draw out related knowledge. At the same time, children see learning as a passion, and love, not a compulsion.

To strengthen the connection between the STEAM model and the design elements of the math learning application, we have integrated specific components from Science, Technology, Engineering, Arts, and Mathematics into its structure.

- **Science (S):** The app includes simulations of real-world scientific problems that require mathematical solutions, such as calculating distances, weights, or measurements. These scenarios allow students to apply their mathematical skills to scientific concepts, fostering a deeper understanding of the role of math in the natural world.
- **Technology (T):** React Native is at the core of the app's technology. The seamless integration of mobile technologies enables students to access the app on various devices, providing a modern, tech-based platform for learning. The application makes use of dynamic, real-time updates and interactive modules that encourage exploration, which aligns with technology's role in enhancing educational accessibility and engagement.
- **Engineering (E):** The engineering aspect is reflected in problem-solving activities where students use geometric principles to design basic structures or solve puzzles. These activities encourage logical thinking and spatial reasoning, key aspects of both engineering and mathematics.
- **Arts (A):** The app incorporates visual design elements and creativity exercises that enhance the learning experience. Through art-related challenges, such as using shapes and patterns to create aesthetically pleasing designs, students develop their creativity alongside mathematical reasoning. The use of colors, interactive

visualizations, and creative problem-solving makes math more engaging and accessible for young learners.

- **Mathematics (M):** At its core, the application builds mathematical skills through interactive exercises that cover fundamental topics, such as addition, subtraction, geometry, and measurements. The integration of other STEAM elements reinforces the practical applications of these mathematical concepts, helping students see how math is relevant across different disciplines.

These design elements ensure that each component of STEAM is represented in a way that enriches the student's learning journey. By linking math education with real-world applications across various fields, the app not only improves mathematical skills but also promotes critical thinking, creativity, and problem-solving abilities in a multidisciplinary context.

3.2 *React Native*

In developing a math learning application using React Native, we leverage its cross-platform capabilities, enabling us to create a single codebase that works efficiently on both iOS and Android platforms. React Native, an open-source framework developed by Facebook is built on JavaScript and React, allowing the use of native components compiled into the target platform's native code. This ensures high performance, comparable to native apps while maintaining a faster development cycle with features like real-time updates and hot reloading (Boduch, 2017, Eisenman, 2015).

The ability to develop cross-platform apps without separate codebases for each operating system significantly reduces both time and costs. React Native's ecosystem, with a wide array of libraries and pre-built modules, allows developers to streamline the addition of interactive features in the app. This is particularly important for math learning applications, where dynamic user interfaces are necessary to create engaging, interactive exercises for students. These benefits, combined with near-native performance and the vast support from the React Native community, make the framework ideal for developing educational applications.

In terms of integrating the STEAM model into the app, React Native's interactive capabilities allow the creation of features that immerse students in problem-solving activities, simulate real-world scenarios, and promote interdisciplinary learning. With its fast refresh capability, we can quickly implement and test new educational features to ensure that the application continuously adapts to student needs, making it a powerful tool for educators and parents alike.

Our app takes advantage of the strong React Native community and extensive resources to further enhance its features, enabling us to provide a cost-effective, performance-optimized learning platform. This adaptability is crucial in building an engaging and responsive user experience for both students and their families.

This connection between STEAM and our app is supported by a growing body of literature that emphasizes the importance of interdisciplinary learning in early education (Anderson et al., 2018; Johnson & Peterson, 2021). By leveraging technology through React Native, we ensure that our app is accessible across various mobile platforms, providing students and educators with a powerful tool to enhance the learning process.

4. Results and Discussions

4.1 *Components of the application*

Theoretical Foundation: The application is grounded in the first-grade math curriculum as outlined by the Ministry of Education, with digitized materials designed to align with students' learning progression. However, beyond this curriculum, the design also draws from educational theories such as constructivism and experiential learning. Constructivism, which posits that learners build their understanding through experiences, informs the app's

interactive lessons and problem-solving activities. Students engage actively with math concepts by solving practical problems related to everyday contexts, such as traffic or nature, making abstract concepts more tangible.

Active Learning through Interaction: The user interface is designed to promote active learning, with interactive lessons that encourage students to apply theoretical knowledge in real-time scenarios. For example, the app incorporates puzzles and multiple-choice questions that mirror real-life applications of math. This aligns with experiential learning principles, where students learn through doing. The app's design emphasizes problem-solving and immediate feedback, encouraging self-correction and a deeper understanding of mathematical concepts.

Application Features in STEAM Context: Incorporating the STEAM model, the app ensures that students develop cross-disciplinary skills. Beyond math, the app engages users with science-based problems, such as calculating distances in science-related topics, and integrates artistic elements through visual puzzles and creative designs. These features not only make the learning experience more engaging but also connect mathematics with broader STEAM concepts. The app's engineering focus is apparent in its problem-solving mechanics, where students apply math to build or solve geometry-related puzzles. Furthermore, the app's use of artistic visuals helps to stimulate creativity, as students are tasked with designing shapes and solving puzzles with aesthetically appealing elements.

4.2 Application function specifications

Support for Teachers and Parents: The app provides a valuable tool for teachers and parents to support students' learning. For educators, the app can complement classroom teaching by offering group activities and individualized tasks that align with traditional lessons. Teachers can integrate the app into lesson plans, using it for in-class problem-solving exercises or assigning it for homework to reinforce daily lessons. Teachers can also differentiate instruction using the app by tailoring exercises to the needs of advanced learners or students requiring additional support.

For parents, the app offers a direct way to be involved in their child's education. Parents can monitor progress and guide their children through interactive lessons at home, ensuring continuous learning beyond the classroom. The step-by-step solutions for problems help parents assist their children even if they are unfamiliar with the math concepts being taught.

User Feedback Integration: Feedback from pilot trials has been crucial in shaping the final design of the app. For instance, during initial testing, students expressed a need for more engaging visuals, which led to the incorporation of animated elements and familiar, child-friendly images. Parents and teachers also requested more detailed explanations for problem-solving, resulting in the inclusion of detailed step-by-step solutions and hints within the app.

With an intuitive, visually appealing user interface and clearly defined functions, the application provides an optimal environment for students to learn mathematics. The questions and puzzles are meticulously crafted using a scientifically systematic approach, guided by experts in primary education and STEAM education. These elements are enhanced with vivid visuals and familiar sounds, allowing students to engage with the content naturally, as illustrated in Figure 1. The questions are closely aligned with the student's curriculum, creating a sense of continuity with classroom lessons. Moreover, the animations and charming imagery are designed to be age-appropriate and relatable, making math learning more engaging. The content features everyday objects, animals, fruits, and other elements that children can easily recognize, bridging the gap between learning and real life.



Figure 1. The Main interface of the application

The application provides immediate feedback on student responses, indicating whether answers are correct or incorrect, with options to proceed. Additionally, users can access an explanation section that offers detailed examples of solutions, which can serve as models for similar exercises. Beyond traditional exercises and puzzles, the application includes a game section with a variety of games designed to enhance students' recognition speed and memory retention, as depicted in Figure 2.



Figure 2. Results Answer true or false

Figure 3 showcases an example of a game where students arrange numbers in increasing order from 1 to 50. This type of game incorporates prompts to guide the player toward the correct selections and provides feedback on incorrect choices, reinforcing learning in an interactive way. All exercises and games are developed to reflect the relevant knowledge areas within the mathematics curriculum, ensuring that students remain familiar with the concepts as they practice on the platform. These activities are not only intended to supplement the students' existing knowledge but also to strengthen their understanding with detailed, easy-to-follow solutions. Ultimately, our goal is to help students build a strong foundation in mathematics, supporting their learning journey with engaging and educational content.

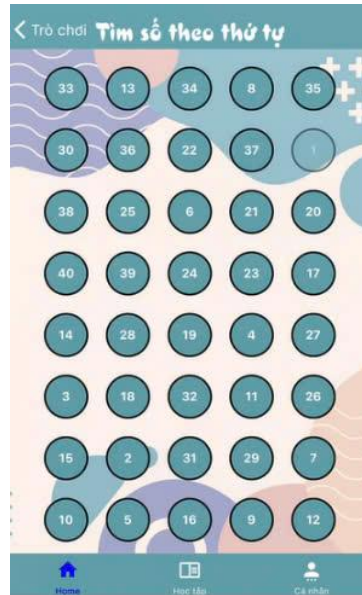


Figure 3. Number Sorting Game

4.3 Evaluation of User Experience and Effectiveness

To assess the effectiveness and user experience of the math learning application for first-grade students, we conducted a survey involving 100 participants, which included 50 students, 30 parents, and 20 teachers. The survey was designed to evaluate key factors such as the visual appeal of the app, its ability to engage students in learning, the enhancement of math knowledge, ease of use, and its compatibility with various devices. Below is the summary of the survey results.

Table 1. The table evaluates the effectiveness of the app

Criteria	Students(50)	Parents(30)	Teachers(20)	Percentage(%)
AG	48	27	18	93%
EL	47	28	19	94%
KE	46	29	20	95%
DC	45	26	18	89%
EU	47	27	19	93%
EPS	44	28	19	91%
PI	N/A	28	18	92%
				(Parents/Teachers)

4.4 Analysis of the Survey Results

The survey results clearly demonstrate in Table 1 that the math learning app is highly effective and well received by students, parents, and teachers:

- **Attractive Graphics (AG):** 93% of participants rated the app's graphics as visually engaging, with students being especially drawn to its colorful and interactive design. The aesthetically pleasing interface plays a crucial role in maintaining the attention of young learners, making learning math more enjoyable.
- **Engagement in Learning (EL):** A significant 94% of respondents found the app successful in keeping students engaged in their lessons. This high engagement level indicates that the app's interactive features, such as gamified exercises and vivid imagery, effectively capture students' interest. This aligns with the principles of STEAM education, which emphasize creativity and curiosity-driven learning.
- **Knowledge Enhancement (KE):** 95% of participants agreed that the app is useful in enhancing students' math skills. This high percentage suggests that the application not only reinforces theoretical knowledge but also helps students practice and apply

what they've learned in a variety of real-world scenarios. The variety of exercises and puzzles, ranging from simple to more complex, ensures that students of all levels can benefit from the app.

- **Device Compatibility (DC):** With 89% satisfaction in device compatibility, the application has proven to work well across a range of devices, making it accessible to students, parents, and teachers regardless of the technology they use. This is particularly important for broader adoption, ensuring that learning is not limited by technical barriers.
- **Ease of Use (EU):** 93% of participants reported that the app is easy to navigate, which is critical for both young students and parents. The intuitive user interface ensures that even first-time users can quickly understand how to use the app, reducing the learning curve and enhancing the overall user experience.
- **Encouraging Problem Solving (EPS):** 91% of respondents highlighted that the app supports independent problem-solving skills. This reflects the successful integration of educational theories such as constructivism, where students learn by actively solving problems and constructing their own understanding of math concepts.
- **Parental Involvement (PI):** 92% of parents and teachers noted that the app facilitates effective parental involvement in students' learning. By allowing parents to easily track their child's progress and participate in their learning journey, the app creates a collaborative environment that bridges the gap between school and home education.

The overwhelmingly positive feedback from students, parents, and teachers in the survey strongly indicates that the math learning application is not only effective in improving mathematical understanding but also highly engaging and accessible. The app's alignment with the STEAM model, its thoughtful design for young learners, and its compatibility with various devices make it a valuable tool for enhancing math education in first-grade students. The data demonstrates that the application successfully supports students' learning while providing useful resources for parents and teachers to guide and participate in the educational process.

5. Conclusions

Developing a math learning application based on the STEAM educational model offers a powerful means for first graders to engage with technology and math in an interactive and enjoyable way. The application helps students grasp theoretical knowledge, develop different problem-solving approaches, and recognize real-world objects and concepts like animals and everyday items. This research proves that such a tool is effective and feasible for enhancing students' mathematical learning experience.

Looking ahead, we envision further improvements by integrating AI and virtual technologies into the application. AI can provide personalized learning paths, adapt to each student's progress, and offer real-time feedback, creating a tailored learning experience. Virtual reality (VR) elements could immerse students in interactive learning environments, making abstract mathematical concepts more tangible and engaging. Additionally, we plan to expand the content with more advanced topics and practical knowledge, while also refining user interactions and features to enhance the overall usability of the app.

In the future, we aim to expand this research across other regions, with the goal of nationwide implementation. By continuously developing and incorporating emerging technologies, we hope this tool will become an even more effective solution for improving math education. Moreover, AI-driven analysis could help educators track students' performance and adapt teaching strategies accordingly, making the app a valuable resource for teachers and parents alike.

We extend our gratitude to everyone who has supported and recognized this research. In the coming phases, we are committed to enhancing our product and realizing its full potential to meet the growing expectations of both students and educators.

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