

Title: Interactive flashcard App for Teaching STEM concept to children

Researcher: UWASE Jeanne gentile

Registration Number: 23/22298

Supervisor: Mr.Eraste Rukundo

Department: Software Engineering

Institution: INES Ruhengeri

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INTRODUCTION

BACKGROUND OF THE STUDY

In recent years, advancements in software engineering have revolutionized education by introducing interactive learning applications that enhance student engagement and understanding. Interactive flashcard applications have emerged as one of the most effective tools in digital learning, particularly in STEM (Science, Technology, Engineering, and Mathematics) education. These applications leverage multimedia elements such as animations, audio, and gamification to make learning more interactive and engaging. The evolution of educational technology has facilitated a shift from traditional learning methods to digital platforms, which are more adaptable to individual learning needs.

The significance of interactive flashcard applications in STEM education lies in their ability to simplify complex concepts and improve knowledge retention. Studies have shown that students retain more information when they engage with interactive content rather than passive reading or listening (Mayer, 2021). Flashcards have long been recognized as an effective memorization tool, but digital interactive flashcards extend their benefits by incorporating features like real-time feedback, quizzes, and adaptive learning pathways. According to Brown et al. (2020), gamification elements in educational apps significantly increase students' motivation and learning efficiency.

Despite these advancements, many children in African schools, including Rwanda, face challenges in learning STEM subjects due to a lack of engaging and culturally relevant digital tools. Traditional teaching methods often fail to cater to different learning styles, leading to decreased student interest and lower retention of STEM concepts. The integration of interactive flashcard applications can bridge this gap by providing a personalized and immersive learning experience.

The case study for this research, Kalisimbi Valley Academy in Musanze, Northern Province, Rwanda, presents an opportunity to assess the impact of an interactive flashcard app on STEM education. This academy has adopted technology-enhanced learning strategies but still faces challenges in making STEM education engaging for young learners. The proposed interactive flashcard application will address these issues by providing visual, auditory, and kinesthetic learning experiences, catering to children aged 6-12.

Current trends in software engineering emphasize user-centered design, artificial intelligence (AI), and adaptive learning technologies in educational applications (Nguyen & Johnson, 2022).

However, many existing applications lack customizations for local contexts and do not fully utilize gamification strategies for STEM subjects (Smith & Lee, 2021). Additionally, studies indicate that culturally relevant educational tools enhance comprehension and relatability among learners (Chowdhury et al., 2019).

This study aims to contribute to the field of software engineering by designing and developing an interactive flashcard application tailored to the learning needs of young Rwandan students. By leveraging modern software development methodologies, such as Agile and UI/UX design principles, the application will provide an innovative solution to improve STEM learning engagement and outcomes. The research will fill the gap in digital STEM education tools and demonstrate how interactive technology can be effectively integrated into the Rwandan educational system.

PROBLEM STATEMENT

Despite the increasing use of digital tools in education, many existing interactive learning applications for STEM subjects fail to provide personalized, engaging, and adaptive learning experiences. Traditional flashcard applications primarily focus on memorization rather than fostering deeper conceptual understanding. Moreover, many existing platforms lack essential gamification elements, real-time feedback mechanisms, and adaptive learning technologies, which are critical in enhancing engagement and knowledge retention (Mayer, 2021).

At Kalisimbi Valley Academy in Musanze, Northern Province, Rwanda, students often struggle with STEM subjects due to the limitations of traditional teaching methods and the absence of engaging digital learning tools. While some educational applications exist, they frequently lack customization for the local curriculum and do not support interactive features tailored to young learners' needs. This results in reduced motivation, poor retention of STEM concepts, and limited teacher-student interaction (Brown et al., 2020).

This research seeks to address these challenges by designing an interactive flashcard application that incorporates adaptive learning techniques, real-time assessments, gamification, and multimedia content. By developing a user-friendly, engaging, and contextually relevant digital learning tool, this study aims to enhance the effectiveness of STEM education for children in Rwanda. The findings will contribute to the field of software engineering by demonstrating how modern digital learning technologies can be optimized to improve educational outcomes.

OBJECTIVES.

The general objective of this study is to develop an interactive flashcard application that enhances STEM education for children by integrating gamification, adaptive learning, and real-time feedback to improve engagement, retention, and conceptual understanding.

RESEARCH QUESTION

1. What challenges do children face when learning STEM subjects using traditional methods?
2. How can an interactive flashcard application integrate gamification and multimedia elements to enhance STEM learning?

3. What design principles and features can make a digital flashcard application more engaging and user-friendly for children aged 6-12?
4. How does real-time feedback and adaptive learning improve students' retention and understanding of STEM concepts?
5. What is the impact of the developed interactive flashcard application on STEM education outcomes in Rwanda?

CHOICE OF THE PROJECT

This study was chosen due to the increasing need for engaging and interactive digital learning tools to enhance STEM education in Rwanda. As a software engineering student at INES-Ruhengeri, I am particularly interested in developing innovative solutions that improve children's learning experiences through technology. The case study of Kalisimbi Valley Academy provides a suitable environment to evaluate the effectiveness of an interactive flashcard application in improving STEM education. This research will contribute both academically and practically by advancing digital learning methodologies and addressing the challenges faced by young learners in understanding STEM concepts.

DELIMITATION OF THE PROJECT

This study is focused on the design, development, and evaluation of an interactive flashcard application for teaching STEM concepts to children aged 6-12 at Kalisimbi Valley Academy in Musanze, Northern Province, Rwanda. The study will be limited to schools with access to digital devices, excluding institutions without technology infrastructure. It will assess short-term learning outcomes rather than long-term impacts. The research will not cover other digital education tools or broader curriculum enhancements beyond STEM subjects. The scope is defined by available time, resources, and the feasibility of implementing and testing the application within the study area.

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