

MAIN ORGANISER:



OFFICIAL COLLABORATORS:



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
بنيان المعرفة والقيم
Garden of Knowledge and Virtue

IKULLIYAH
EDUCATION



THE INTERNATIONAL COMPETITION ON SUSTAINABLE EDUCATION



20TH AUGUST 2025

TRANSFORMING EDUCATION, DRIVING INNOVATION AND
ADVANCING LIFELONG LEARNING FOR EMPOWERED WORLD

DIGI-FC-SML: ENHANCING SOIL MECHANICS LABORATORY LEARNING WITH INTERACTIVE FLASHCARDS

Asmidar Alias*, Kamisah Ariffin, Nur Asmaliza Mohd Noor

Faculty of Civil Engineering, Universiti Teknologi MARA Cawangan Pahang*

asmidar@uitm.edu.my*

ABSTRACT

The Soil Mechanics Laboratory course involves numerous technical terms and detailed explanations that demand both memorization and conceptual understanding. Understanding soil laboratory experiments is fundamental for civil and geotechnical engineering students, however, traditional learning methods often lack engagement and efficiency. The Digital Flash Card for Soil Mechanics Laboratory (DIGI-FC-SML) is an innovative educational tool which is interactive online flashcards designed specifically for soil laboratory experiments. The flashcards cover key aspects of each experiment: including the objective, required apparatus, procedure, and expected results. The tool leverages proven learning techniques such as spaced repetition, gamification, and microlearning to boost comprehension and retention. It is grounded in the learning theory that complex subjects are best mastered through intensive, consistent and structured study. With a user-friendly interface and game-based modes, students can learn anytime, anywhere, at their own pace. Students can self-assess their understanding through engaging and practical quizzes provided at the end of each topic, with the content freely accessible on quizlet.com. The flashcards aim to transform technical content into manageable, interactive sessions that support both exam preparation and conceptual understanding. This digital approach offers a scalable, cost-effective solution to enhance laboratory learning experiences, making soil laboratories more accessible, engaging, and effective for the next generation of engineers. Moreover, DIGI-FC is a versatile tool that can be easily adapted and expanded into a series of learning resources for other subject areas.

Keywords: Digital Flash Card, Learning Techniques, Soil Mechanics Laboratory

INTRODUCTION

The Soil Laboratory course is a core component of civil and geotechnical engineering education, introducing students to fundamental testing methods and interpretation of soil behavior. These experiments involve a wide range of technical terminologies and procedures that require both memorization and conceptual understanding. However, conventional teaching methods—such as printed manuals or static lecture notes—often fail to maintain student engagement and limit opportunities for active learning (Brame, 2016). Dunlosky et al. (2013) researched that rereading is of low utility compared to other techniques like active recall and spaced repetition.

To address this, DIGI-FC (Digital Flashcard) was developed as a digital learning innovation. Built on Quizlet, it presents soil laboratory topics in the form of interactive flashcards, incorporating objectives, apparatus, procedures, and expected outcomes for each experiment. By applying spaced repetition, gamification, and self-assessment techniques, DIGI-FC supports active recall and long-term retention as this method suggested by Karpicke & Roediger (2008). It aligns with the broader vision of transforming education through technology, driving innovation in teaching methods, and promoting lifelong learning (UNESCO, 2020).

METHODS

DIGI-FC introduces several innovative features that distinguish it from conventional educational tools:

Interactive Flashcard Design (Figure 1)

Each set of flashcards is structured around the core components of soil laboratory experiments: objectives, apparatus, procedures, and expected outcomes. This modular format simplifies complex content into manageable learning units. Compared with the laboratory manual which is written in detailed and crowded text.

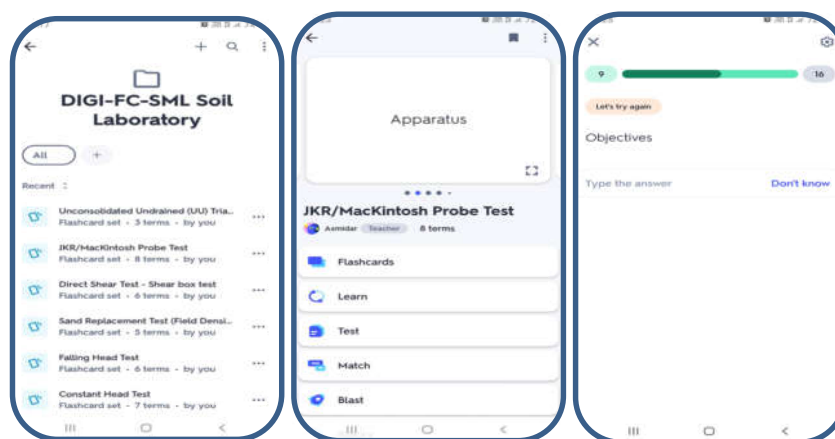


Figure 1.: Interactive Flashcard Design

Gamification

The integration of game-based elements such as 'Match', 'Blast' (Figure 2), and time-based challenges on Quizlet increases student engagement, motivation, and repeated exposure to key concepts.

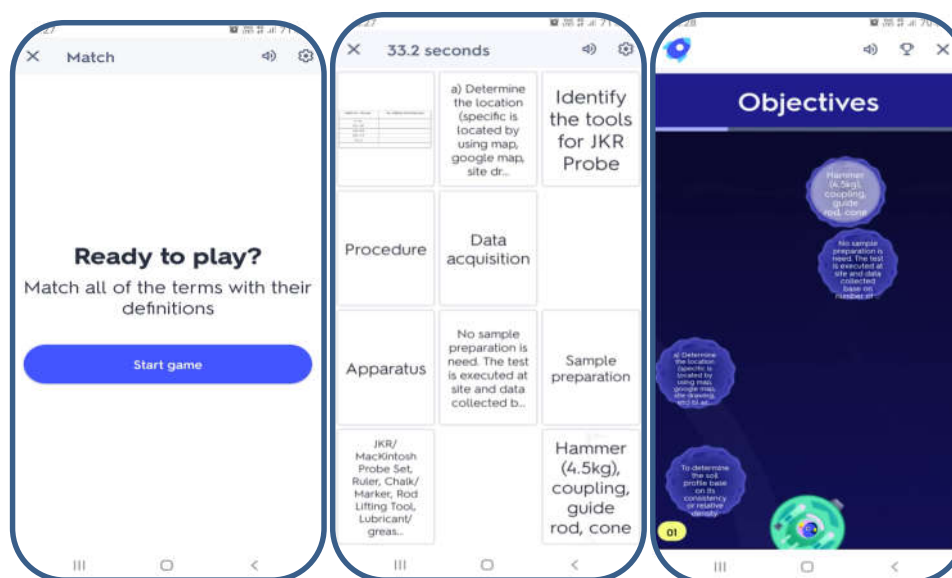


Figure 2. Game-based elements

Spaced Repetition and Retrieval Practice

By leveraging evidence-based techniques, DIGI-FC supports long-term memory retention and comprehension, allowing students to revisit flashcards over spaced intervals for more effective learning.

Self-Assessment and Feedback

Embedded quizzes and test modes at the end of each topic empower students to assess their own understanding and identify areas for improvement instantly.

RESULTS AND DISCUSSION

DIGI-FC has made a notable impact on student learning and engagement within the Soil Laboratory course. Feedback collected from initial users indicates that students are highly satisfied with the tool, citing its simple structure, ease of use, and visual clarity as major advantages. The streamlined design allows learners to focus on core concepts without being overwhelmed by excessive technical jargon or cluttered information.

Students reported that DIGI-FC made it easier to understand complex laboratory procedures and terminology, particularly when revising for assessments. The interactive and gamified features fostered

a sense of motivation and enjoyment, which are often lacking in traditional textbook-based learning. Many users appreciated the flexibility to study on their own time and pace, which supported both in-class and independent learning.

Beyond individual student benefits, DIGI-FC contributes to broader educational goals:

- Promotes digital literacy by integrating accessible technology into technical education.
- Supports inclusive learning by catering to different learning styles through visual, textual, and interactive modes.
- Encourages self-regulated learning, helping students take ownership of their study habits.
- Contributes to scalable innovation, as the approach can be replicated across disciplines and institutions.

Overall, DIGI-FC strengthens the bridge between theory and practice, making technical content in soil mechanics more approachable and memorable. It stands as a promising tool in the effort to modernize technical education and empower learners through innovation.

CONCLUSION

DIGI-FC demonstrates strong potential for commercialization due to its high usability, positive student feedback, and adaptable structure. Its design—centered around clarity, simplicity, and interactivity—has been well-received by students, especially those in technical fields who often struggle with dense, traditional materials. The positive learning experience, coupled with its intuitive interface, positions DIGI-FC as a market-ready educational tool that can be expanded beyond a single course or institution.

The modular nature of DIGI-FC allows for customization across various subjects, including civil engineering, mechanical engineering, biology, and vocational training programs. Institutions could license tailored flashcard sets aligned with specific curricula, or educators could subscribe to a premium version offering analytics, classroom integration, and progress tracking.

Potential future developments and commercialization strategies include:

- Self-learning tool – promoting sharing information in terms of academic content to a global audience.
- Use of technology – one-stop center to learn, re-learn, self-test and self-monitor individual progress.
- Self-evaluate – Students can self-evaluate their learning through the quiz provided at the end of session.

- Collaboration with textbook publishers or curriculum developers for bundled learning packages.

With the increasing shift toward digital and self-directed learning, DIGI-FC is well-positioned to meet the needs of modern learners and education providers. Its affordability, ease of deployment, and scalable format give it significant commercial appeal in both the public and private education sectors. Moreover, the emphasis on lifelong learning and flexibility ensures its relevance in continuous professional development programs and upskilling initiatives.

REFERENCES

- Brame, C. J. (2016). Active learning. Vanderbilt University Center for Teaching. <https://cft.vanderbilt.edu/guides-sub-pages/active-learning/>
- Dunlosky, J., et al. (2013). Improving Students' Learning with Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology. *Psychological Science in the Public Interest*
- UNESCO. (2020). *Education in a Post-COVID World: Nine Ideas for Public Action*. <https://unesdoc.unesco.org/ark:/48223/pf0000373717>