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Designing Interactive Mathematical Teaching Tools for Tablet-Based Learning: Enhancing Student Engagement and Tactile Exploration

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Abstract: The rapid advancement of digital technology has transformed mathematics education. This paper explores tablet-based tools using constructivist theory to enhance engagement and tactile exploration. A primary school case study confirmed their effectiveness in improving learning outcomes. The integration of Unity's Geometric Drawing Application with Moodle LMS offers a comprehensive educational experience. The paper emphasizes the need for further research, technological improvements, and cost-effective solutions to make education technology more accessible.

Keywords: Tablet-based learning, Interactive mathematical tools, Tactile exploration

1. Introduction

Digital technology has transformed education, especially in mathematics, where traditional methods often fall short (Prensky, 2001). This paper examines how tablet-based interactive tools enhance student engagement and tactile exploration.

Tablet learning supports interactive exploration, crucial for understanding abstract concepts, but requires more effective constructivist tools. A primary school case study shows improved engagement and outcomes, suggesting wider applications. This paper contributes to research on digital education, encouraging the development of tablet learning in mathematics.

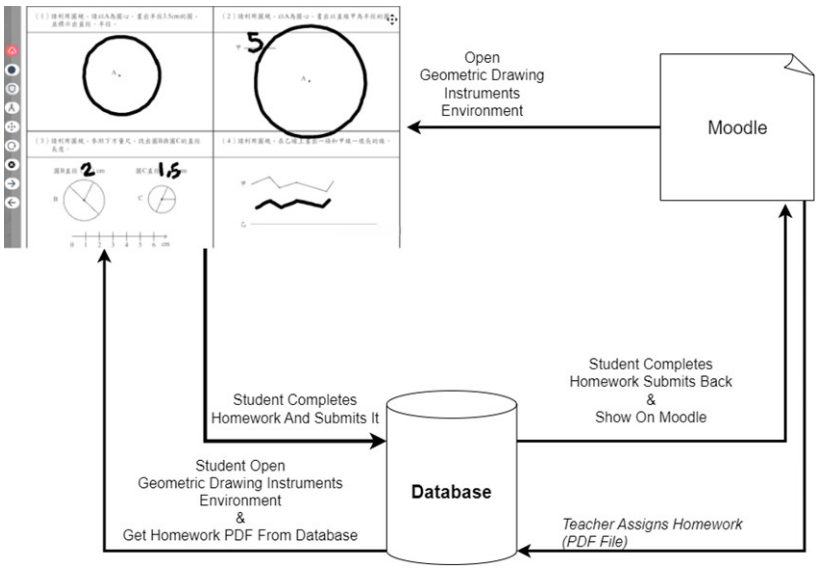
2. Related Work

The rise of tablets has transformed digital artistry and education by combining convenience with tactile experiences (Smith & Doe, 2020). Apps like Procreate and Photoshop enable touch-based creativity, though replicating tactile feedback remains a challenge (McCready, 2021).

In education, tablets enhance personalized learning, particularly in geometric drawing, but issues with precision and teacher training persist. While tactile exploration via tablets improves cognition and motivation, resource limitations and cost-effective solutions are needed (Lee, Messom & Yau, 2013). Further research is required to fully unlock the potential of tablets in education.

3. System Overview

The interactive teaching tools integrate Unity's Geometric Drawing Application with Moodle LMS, creating a seamless educational environment. Figure 1 shows Unity simulating traditional geometric instruments to enhance engagement and understanding, while Moodle



LMS manages course content, allowing educators to publish assignments, track progress, and assess performance (Schön, Ebner & Hornung-Prähauser, 2017)..

Figure 1. System Architecture with Moodle LMS & Geometric Drawing Instruments

In the tablet environment, students use digital tools like compasses and protractors, receiving real-time feedback to enhance their understanding of geometry (Smith & Doe, 2020; Johnson, 2018). Figure 2(a) shows students accessing assignments via Moodle, and Figure 2(b) illustrates how Unity guides them in drawing geometric figures. Students can then easily submit their work through Moodle.

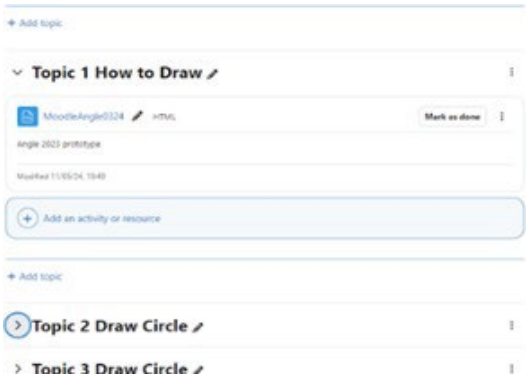


Figure 2. (a) Moodle LMS Environment

Figure 2. (b) Unity Geometric Drawing Application

Moodle's plugin architecture enables features like forums and quizzes, making it adaptable to diverse educational settings (Williams, 2023). Its digital approach also promotes sustainability by reducing paper usage (Denis, Donadio & Klein, 2016). Future updates will integrate adaptive learning algorithms and AI to personalize the learning experience (Adeilton, Pessoa & Oneide, 2023).

4. Pilot Study

This section describes the collaboration with two elementary schools and 18 math teachers using the "Double Diamond" design thinking model to refine digital teaching materials, leading to innovative solutions for tablet-based education (Design Council, 2019). The study focused on sustainability, evaluating if digital tools improved learning outcomes (Björk-Åman

& Harder, 2020), with field trials providing feedback for improvements (Smith & Kosslyn, 2015).

The pilot study assessed user experience through interviews, surveys, and observations (Earnshaw, Tawfik & Schmidt, 2018), identifying areas for improvement like navigation. These findings will guide further optimization to create a user-centered learning environment that enhances academic performance and fosters a positive attitude toward mathematics.

5. Conclusion and Future Work

This study developed tablet-based tools for elementary math by digitizing geometric instruments and integrating them with Unity Engine and Moodle LMS. Results show improved understanding of geometric concepts and increased participation, while also promoting sustainability.

Future research will validate these tools across broader subjects, incorporating AI and refining them through feedback from teachers and students.

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