The Influence of MGA Apps on Elementary School Students in Mathematics Learning:
The Example of an Informal Learning for Cube Nets

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EXECUTIVE SUMMARY

Numerous studies have explored the impact of game-based learning (GBL) on mathematics education. This teaching experiment endeavors to develop a mathematics grounding activity (MGA) mobile application focused on cube nets and to assess whether this MGA app enhances students' understanding of mathematical concepts and their attitude toward learning mathematics. To achieve this, a combination of quantitative and qualitative research methods was employed, involving a cohort of 506 students spanning grades four to six. Findings revealed that the MGA app effectively motivated students and added an element of intrigue to mathematics classes. Additionally, it was observed that students were able to facilitate their own

learning, rendering redundant exercises unnecessary. Furthermore, the application demonstrated the potential to bridge age and gender gaps, suggesting that its implementation in a coeducational and mixed-age classroom setting is viable and convenient.

INTRODUCTION

Numerous studies have explored the impact of game-based learning (GBL) on mathematics education. This chapter delved into whether students can learn mathematics concepts through digital games with or without any teacher guidance. To achieve this purpose, we developed a mobile app game based on the idea of Mathematics Grounding Activity (MGA) to assess students' scores in the digital game and measure their learning achievements. In addition, students' motivation and learning attitudes are also important in the study, which examines whether game-based learning helps students develop the affective domain. Finally, we also investigate teachers' perspectives on students learning through digital games to measure the possibilities for future instruction.

Background

Taiwanese elementary and junior high school students have shown relatively high average achievements in international mathematics assessments such as in TIMSS 2019 or PISA 2022. However, two issues have also emerged: First, despite the high average performances, there are often wide distributions in student performances, with significant gaps between low-achieving and high-achieving students. Second, students generally exhibit low interest and confidence in mathematics and do not perceive the usefulness of the mathematics they learn. To address and improve this widespread phenomenon, in the mid-2010s, the Department of International Cooperation and Science Education, Ministry of Science and Technology (MOST) of Taiwan cooperated with the-Ministry of Education (MOE) of Taiwan to launch the project "Just Do Math (JDM)", trying to help lower-achieving or underprivileged students in Taiwan.

Different from many earlier projects in Taiwan, which provided remedial teaching *after* students encountered learning difficulties, JDM posits that students struggle with many mathematical concepts because they lack sufficient practical experiences *before* formally learning these concepts. More practically, JDM sets "interesting, relatable, personally meaningful, and expressive" as principles for designing learning activities. JDM refers to this foundational experience as "grounds" or "cornerstones." Simply speaking, the JDM project helps students "build grounds", by which we