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Virtual Manipulative-Aided Instruction (VMAI): Its Effects on Seventh-Grade Students' Conceptual Understanding in Fractions

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Abstract

Technology enhances education and addresses students' academic challenges. Excessive use of mobile phones and internet applications may contribute to students' poor academic performance. But, technology can also be an aid in improving learning outcomes. This study aimed to examine the influence of Virtual Manipulative Aided Instruction (VMAI) on Grade 7 students' conceptual understanding in solving fraction-related problems. A one-group experimental research design was employed, involving 55 Grade 7 students from three intact classes in selected national high schools in Lanao del Sur. Findings revealed significant improvements in conceptual understanding skills. Results further showed that VMAI influenced conceptual understanding in the representation of fractions, conversion of improper fractions to mixed numbers and vice versa, and simplification of equivalent fractions. Overall, the findings suggest that VMAI serves as an effective instructional approach, fostering active engagement, motivation, and enhanced mathematical skills among students. The study underscores the potential of technology-assisted learning to enhance conceptual understanding in mathematics.

1. INTRODUCTION

In basic mathematics education, conceptual understanding is necessary in developing students' analytical and problem-solving skills, with fractions being a crucial component of the curriculum. Fractions are foundational for understanding more advanced mathematical concepts, yet many students struggle with both conceptual understanding and problem-solving. Many students struggle with understanding and applying fractions, which can hinder their overall mathematical development. Studies have shown that most students at lower grade levels did not learn the conceptual understanding of a particular object before reaching the next higher grade level of education necessary for their computational and problem-solving skills (Solaiman, 2013; TIMSS 2003 & 2007). On the other hand, virtual manipulatives can be used as tools for students while actively

engaging in learning mathematics (Shin & Bryant, 2016). It can be incorporated in the teaching – learning process to motivate the interest of learners while providing the opportunity to explore, discover, connect, construct, criticize, or experience the concepts.

2. METHOD

This study aimed to address the challenges in teaching fractions to 7th-grade students. It seeks to provide evidence-based insights into how VMAI can enhance conceptual understanding to improve mathematics instruction and student success. It is a one-shot pretest – posttest study design consisting of 55 participants from 3 intact classes of Grade – 7 students who were handled by 3 different mathematics teachers for 6 weeks. The participants were enrolled in 3 different public high schools in Lanao del Sur province in the school year 2023 to 2024. The instruments used to collect the data are conceptual understanding tests (CUT) containing fractions concepts, weekly journals and interview as triangulation to allow students to justify their answers in CUT posttest.

3. RESULTS AND DISCUSSION

There were three statements of the problem utilized in the study. The first question was about the conceptual understanding mean score of grade - 7 students in fractions before and after the Virtual Manipulative -Aided Instruction (VMAI) intervention within each experimental group. Table 1 presents the conceptual understanding mean score of grade - 7 students conceptual understanding mean score of grade - 7 students in schools A, B, and C. In the pretest, school A had the highest mean scores in the representation of fractions and conversion of improper fractions while school B scored highest in Simplification of equivalent fractions. In the post-test, school C scored highest in representation of fractions and simplification of equivalent fractions, whereas school A excelled in conversion of improper fractions. The second statement of the problem asked about the significant difference of the grade - 7 students' conceptual understanding mean scores in fractions before and after the VMAI intervention within each experimental group. After analyzing, only Simplification of Equivalent Fractions showed significant improvement in School B while in school C, significant differences were observed in representation of fractions and simplification of Equivalent Fractions. The last statement of the problem of the study asked about the challenges and benefits do the Grade 7 students and mathematics teachers perceived when integrating virtual manipulatives into fraction instruction across experimental groups. This question was collected from the journals and answers in an open – ended interview from both mathematics teachers and 30 selected Grade – 7 participants. Some of their responses were the poor internet connection was the problem while the study was encouraging classroom collaboration engagement and enhanced visualization of conceptual understanding. The study confirms the effectiveness of VMAI in enhancing students' conceptual understanding in fraction-related topics, with the strongest impact observed in school C.

Table 1.Mean Scores of the Grade 7th Students on the CUT in Fraction Before and After the Intervention

Fraction Topic	Schools		
	A	B	C
	mean	Mean	mean
Before			
Representation	7.5	7.1	5.7
Conversion of IF to MN	6.8	6.2	6.0
Simplification of EF	6.1	6.5	4.2
After			
Representation	7.2	6.8	9.3
Conversion of IF to MN	7.2	6.1	6.0
Simplification of EF	6.2	5.458	9.6

4. CONCLUSION

This study explored the impact of Virtual Manipulative App Instruction (VMAI) on 7th-grade students' conceptual understanding (CU)) in fractions. School C showed significant gains in fraction representation, while Schools A and C improved in converting improper fractions to mixed numbers. Schools B and C demonstrated progresses in simplifying equivalent fractions. While this study highlights the effectiveness of VMAI in improving fraction learning, its scope is limited to 55 grade 7

students from public schools in BARMM, Lanao del Sur. Results may vary in other contexts.

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