Developing Conceptual and Procedural Knowledge

Mental education needs more consistent integration of conceptual and procedural knowledge. The purpose of this study is to examine how the development and retention of conceptual and procedural knowledge influence our learning and performance in mathematics. It aims to determine how each type of knowledge interacts and how they can be improved. The relationship between the development of conceptual and procedural knowledge should be improved by focusing on both types of knowledge. This study explores the role of conceptual and procedural understanding and how these can be developed.

Introduction

Adding and subtracting decimals when posing restrictions in mental processes, different strategies are used. How can we develop a common understanding of conceptual and procedural knowledge? The role of the research on conceptual and procedural knowledge in mathematics education is crucial. The contribution of this study is to provide insights into how conceptual and procedural knowledge can be developed in mathematics education. The study examines the relationship between conceptual and procedural knowledge and how they interact to improve students' understanding of mathematical concepts.

We compiled the following instructional strategies for integrating conceptual and procedural knowledge.

- Conceptual Knowledge
  - Common fractions
  - Common decimals

- Procedural Knowledge
  - Ratio and proportion
  - Area and perimeter

These strategies were designed to improve students' understanding of mathematical concepts and their ability to apply these concepts in real-world situations.
Participants

Method

Mnemonic

Learning Context to Help Build Upon Prior Knowledge

Procedure

During the instructional sessions, students were randomly assigned to one of two conditions for the first three lessons.

Table 1: Lesson Order for the Two Conditions

|-----------|---------------------------------|--------------------------------------|----------------------------------------|--------------------------------------|----------------------------------------|

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Assessment

Students worked on the cognitive tier twice a week for four to eight weeks.

In the first condition, the second procedural lesson followed the second conceptual lesson. In the second condition, the second conceptual lesson was presented twice. Students practiced solving similar problems in a money context in the second lesson. Both orders began with the conceptual lessons. Additionally, the second lesson focused on money estimation.

Intervention

In the second condition, the second lesson was presented twice. Students practiced solving similar problems in a money context in the second lesson. Both orders began with the conceptual lessons. Additionally, the second lesson focused on money estimation.

The control group performed a problem-solving task with a similar context but without the procedural lessons.
Effects of Condition on Learning

Figure 2: Effect of condition on conceptual and procedural knowledge.

Table 2: Example Assessment Items

<table>
<thead>
<tr>
<th>Context</th>
<th>Learning</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money</td>
<td>2 items</td>
<td>3 items</td>
</tr>
<tr>
<td>4 items</td>
<td>3 items</td>
<td>1 item</td>
</tr>
</tbody>
</table>

Results

An alpha value of 0.05 was set as the criterion for all statistical analyses.

We conducted a repeated-measures ANOVA on percent correct at each time point.

= 1.44, t(14) = 2.14, p < .05, indicating that the procedural knowledge was higher in the 3-item context than in the 2-item context.

For each subject, we calculated the mean score of percent correct at each post-test time point.

No different context (Kind of Difficulty Factor) Assessment see Concrete vs. Noun stimuli.

The 3-item context was presented in a money context and without money. Results revealed no significant effect of context on procedural knowledge.
Discussion

Procedural knowledge and skill development are crucial in understanding the relationship between procedural and conceptual knowledge. The interaction between these two domains is evident in various educational contexts. When students are engaged in problem-solving tasks, they constantly shift their focus between procedural and conceptual aspects. This interplay is essential for effective learning and retention of knowledge.

In the classroom setting, the teacher's role is pivotal in facilitating this dynamic between procedural and conceptual knowledge. By providing meaningful examples, scaffolding, and opportunities for practice, teachers can help students bridge the gap between abstract concepts and practical applications. This reciprocal relationship not only enhances understanding but also fosters a deeper appreciation of the interconnected nature of mathematical ideas.

The learning environment plays a significant role in shaping this interaction. A supportive and engaging classroom culture encourages students to explore multiple strategies, reflect on their thought processes, and discuss their findings. Such an approach not only improves problem-solving skills but also builds a robust foundation for future learning.

In conclusion, the development of procedural and conceptual knowledge is a continuous and reciprocal process. By focusing on both domains, educators can create a learning environment that promotes deep understanding and application of mathematical concepts. This holistic approach prepares students for success in various academic and real-world contexts.