

TEACHING MULTIPLICATION USING REPRESENTATIONS: WHAT WORKS FOR PRIMARY PRE-SERVICE TEACHERS IN MALAWI?

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Abstract

This article addressed the question: How do pre-service teachers in Malawi understand the teaching tasks and the knowledge necessary to teach multiplication using multiple representations? A case study was conducted with one female pre-service teacher attending a teacher education college program. Teaching observation and a post-lesson interview were conducted over her teaching practice, focusing on two themes of analysis considering the theoretical framing of mathematical knowledge for teaching: (1) using representations to teach multiplication, and (2) reflections on the knowledge used to conduct the teaching tasks. These themes revealed an understanding of teaching knowledge consistent with theoretical constructs but limited with practical applications. The study has implications for initial teacher education and further research on the topic.

Keywords: Malawian teacher education; teaching tasks; representations.

Introduction

The 2030 agenda for Sustainable Development plays a central role in building sustainable, inclusive, and resilient societies by ensuring inclusion and equitable quality of education and promote lifelong learning opportunities for all (UNESCO, 2019). The Republic of Malawi, the first Sub-Saharan country to apply free primary education, has taken significant steps in providing accessible education to primary school children, but further actions need to be taken to improve the quality of education, especially the quality of teacher education.

A recent study conducted on teacher education colleges in Malawi (Jakobsen et al., 2018) reinforces this claim by showing that pre-service teachers possess a poor level of mathematics and develop little mathematical knowledge for teaching during teacher education. The current study sheds light on these issues in teacher education by addressing the question: *How do pre-service teachers in Malawi understand the teaching tasks and the knowledge necessary to teach mathematics using multiple representations?*

The Tasks and Knowledge Necessary to Teach Mathematics

Learning to teach involves not only the domain of content and pedagogical techniques, but it also requires an understanding of the teaching tasks and the knowledge necessary to carry out these tasks effectively (Mitchell et al., 2014). Although researchers such as Ball et al. (2008) attempted to understand the necessary knowledge for teaching mathematics, Mitchell et al. (2014) argued that the tasks and knowledge demands required for teachers to successfully teach mathematics with representations is still unclear, and further research is needed. These researchers recognized the relevance of studying the skills and knowledge necessary for teaching mathematics using different representations as a crucial component of effective teaching (Mitchell et al., 2014).

Recent reforms in the primary teacher education curriculum have taken into account those ideas about teacher knowledge by focusing on the knowledge and skills pre-service teachers will need to handle practical tasks in their future profession (Malawian Institute of Education, 2007). Although such a

proposal is promising, there is a clear need to understand how pre-service teachers acknowledge the teaching mathematics tasks and the knowledge necessary to effectively carry them out in primary classrooms.

Methodology and Data Analysis

The study is based on a qualitative case study (Stake, 2005) with one female pre-service teacher (Denise) from a teacher education college² in Malawi. Data were collected during Denise’s teaching practice in a rural primary school in the year 2019. The lesson was about numbers multiplication by 3, and it was recorded and later used in a post-lesson interview as a reference for Denise to discuss her views about teaching knowledge. The interview focused on the teaching tasks and aspects of the knowledge that Denise considered relevant to carry out multiplication teaching effectively. The data were analyzed using thematic analysis (Clarke & Braun, 2013) and based on two themes: (1) using representations to teach multiplication, and (2) reflections on the knowledge used to conduct the teaching tasks. While the first theme describes Denise’s actions and decisions in a teaching situation where she used representations to foster children learning, the second captures critical aspects of her views and understanding of the tasks and knowledge used to carry out multiplication teaching in a Malawian classroom.

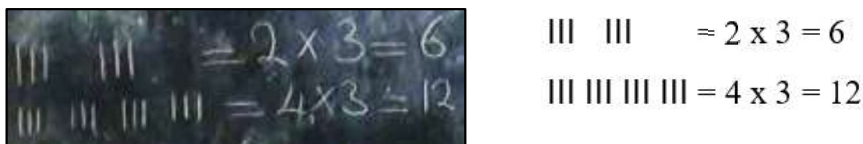
Findings and Discussion

Using representations to teach multiplication

The lesson was analyzed as part of Denise’s teaching plan for a Standard 2 classroom. Denise used three representations to teach multiplication of numbers by three (symbols, mathematical expression, concrete objects). She began the lesson by drawing a set of two lines and four-sets of sticks on the chalkboard; she asked the children to “imagine these lines as wood sticks” and explained that each stick set could be written as 2×3 and 4×3 . Then, Denise asked one child to stand up and answer the operations. The child responded 6 for the first expression and 12 for the second one (Figure 1).

Figure 1

Symbolic representations used to explain the concept of multiplication



In the sequence, Denise wrote on the chalkboard, three other mathematical expressions. Three children came to the chalkboard and answered 3, 6, and 33 respectively (Figure 2). Children had no difficulty in solving the expressions.

Figure 2

Mathematical expressions given to the children

² The college offers a two-year teacher education program for primary pre-service teachers. This program consists of coursework at the college and teaching practice in local schools. Denise was part of a group of pre-service teachers who started the program in 2017 and graduated at the beginning of 2020.



$$\begin{array}{r}
 \text{a) } 1 \\
 \times 3 \\
 \hline
 3 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \text{b) } 2 \\
 \times 3 \\
 \hline
 6 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \text{c) } 11 \\
 \times 3 \\
 \hline
 33 \\
 \hline
 \end{array}$$

Later, Denise organized the children into four groups and asked them to solve the three expressions using an abacus (see Figure 3). Most of the children could answer items *a* and *b* in Figure 2, but they struggled to solve item *c*, as the quantities in the abacus could not be arranged in more than eight sets of three sticks. Denise observed they were having difficulties but chose to let them think and discuss for a few minutes. Soon after, she told them to use one quantity to represent five sets of three sticks each. After she explained, still, only two of the groups could answer item *c*.

Figure 3

A child grouping three-stick set in the abacus



Reflections on the knowledge used to conduct the teaching tasks

In the post-lesson interview, Denise explained that she intended to make children familiar with the notion of grouping objects and symbolic representations of multiplication. She was aware it could be done differently, but it was more efficient articulating concrete and abstract representations. Also, Denise cogitated children could struggle to see where multiplication in the pictorial representations with sticks was as they were more familiar with addition than multiplication. She added, “The teacher needs to be careful to show this transition; (s)he needs to anticipate what children already know and the misconceptions they might have when learning a new topic,” an argument that is supported by Ball et al. (2008).

Regarding the employment of different representations for solving multiplication problems (Figure 2), Denise pointed out the importance of children being able to make generalizations of what they are learning with more complex content. Denise stated, “I wanted children to be familiar with this type of representation, as this is how it is used in Standard 3. However, Denise demonstrated a resistance (Taylor & Dyer, 2014) for using advanced representations that are not part of the curriculum for Standard 2 children. Denise argued that “it is also important for the teacher to be careful in using those types of representations because it [advanced representations] might confuse them [children].” Denise acknowledged that “the teacher should know when and how children can learn more complex ideas, but

of course this is very difficult here [referring to the Malawian context] because the teacher cannot predict what the problems.”

This argument was also part of Denise’s comments about children’s responses to solving mathematical problems using an abacus (Figure 3). Although her children had difficulties solving item *c* in Figure 2, Denise explained that “it is important for children to think about what they are doing [...]. It is not only about listening to the teacher explaining the content; they [the children] have to know how the content connects with real-life situations.” However, this line of thought was vaguely explained by Denise, giving a sense that she was mostly employing what she had learned during teacher education. “To me, the teacher has to make children think about the problems, so he or she needs to know what children know and what they can do [...] this is what I learned and what the curriculum tells us.” Although Denise was aware of what tasks and knowledge teachers need to teach mathematics, responses like this suggest that using different representations to support children’s mathematics learning when solving problems is a challenge for pre-service teachers in terms of meeting standards demands and children’s needs of learning.

Conclusion

This study explored the understanding that a female pre-service teacher in Malawi has of the tasks and knowledge needed to teach mathematics effectively in primary schools. Such a topic was analyzed from two analytical themes that helped identify and make sense of the pre-service teacher’s actions and response in a teaching situation involving representations to solve mathematical problems. The data indicates that the idea of the tasks and knowledge needed for teaching multiplication in primary classrooms can be unsettled for pre-service teachers during teacher education, even though they can express coherent views with the theoretical constructs of mathematical knowledge for teaching.

The case studied in this paper also illustrated how different, yet complementary, a pre-service teacher can think about teaching mathematics utilizing multiple representations. Although Denise conveyed a comprehensible view of other forms of teaching mathematics using representation, her understanding was limited for applying it to practical situations. This present study is a departing investigation for accomplishing how pre-service teachers develop teaching knowledge during teacher education, contributing to improving education quality. Drawing attention to these aspects in teacher education may also further research in education as it can explain how theoretical constructs can better serve pre-service teachers to understand and carry out the work of mathematics teaching.

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