Reimagining Tutoring Practices: Supporting Learners and Empowering Tutors in Mathematics

Purpose

This ongoing research project examines an after-school math tutoring program at a university-associated learning lab that provides one-on-one support to struggling K-8 learners. The learning lab also aims to aid tutors in building their confidence and understanding of mathematics and addressing diverse needs through differentiated instruction. Training and support are based on a digital repository of resources developed by the learning lab's staff, which supports tutors in planning lessons, while onsite supervisors offer guidance on addressing challenges learners may face. This approach aligns with principles of mathematical education, specifically in the context of the role of assessment (Bryant & Pedrotty Rivera, 1997), anticipating student responses (Cavalcante et al., 2019), mathematical modelling (Lesh et al., 1987), and fostering a growth mindset (Kroeper et al., 2022). Aligning with the conference theme, this study explores how tutoring connects to interdisciplinary learning and the practical applications of mathematics. The program utilizes an individualized approach where tutors integrate real-world examples with mathematical concepts while supporting tutors in developing flexible, responsive teaching skills and implementing creative problem-solving opportunities that move away from 'traditional' questions (Offen, 2020). For example, tutors are encouraged to draw from multiple disciplines when developing engaging lessons for their learner(s) (e.g., analyzing sports statistics [physical education], using symmetry in visual compositions [the arts], investigating measurement with science concepts, or journaling to monitor their growth over the semester).

Background Literature

Mathematics has been a core subject in schools for decades; however, challenges in preparing beginning teachers for the complexities of mathematics instruction have led to a need for improved teacher training (Alfageh et al., 2024). Consequently, there has been an emphasis on utilizing responsive teaching approaches, such as those often associated with tutoring to more effectively support learners. As Stevens et al. (2018) suggest, learners who face challenges in mathematics may benefit from one-on-one instruction that is responsive to their specific learning needs (Powell et al., 2021). Research also emphasizes the positive impact tutoring programs have

on learners (e.g., Nickow et al., 2023). These impacts can be magnified when lessons and activities include interdisciplinary tasks that reflect their learners' interests and lived experiences, increasing both their engagement and understanding (Benson-O'Connor et al., 2019).

Theoretical Framework

Effective teaching practices are often associated with providing learners with targeted support aimed at improving their independence and growth (Kim et al., 2019). In the current study, Vygotsky's (1978) concept of scaffolding emulates the support tutors provide learners and that tutors receive from learning lab staff. The scaffolding provided by tutors is closely aligned with the learner's zone of proximal development (ZPD; Vygotsky, 1978) and level of optimal instruction, ensuring that support is tailored to the learners' level of mathematical understanding. The application of scaffolded support at learners' instructional level is complemented by the relevancy of the support they receive. As Dewey (1916) highlighted, meaningful learning can occur when the learning resources are relevant and connected to the learners' everyday lives. Thus, tutors are encouraged to situate the mathematical learning in both real-world and interdisciplinary contexts for their learners (e.g, communicating their observations of mathematics in the learning space, budgeting for personal expenses, designing artwork based on tessellations, analyzing nutrition labels, etc.). It is important for tutors and learners to understand, value, appreciate, and discern the importance of the mathematical concepts they engage with.

Methodology

The authors collaborated to revise and improve the learning lab's existing digital repository of resources, drawing on feedback gathered from tutors and supervisors that indicated that tutors lacked confidence in teaching mathematics to K-8 learners and did not feel they fully understood learners' needs. In response, the authors revised the digital repository to include strategies aimed at empowering tutors and developed diagnostic assessments for tutors to garner learners' understanding at the beginning of the tutoring program.

Findings

This program emphasizes an interdisciplinary approach, utilizing mathematical modelling to support adaptable tutoring strategies. Tutors receive training and support using Lesh's Translation Model (Lesh et al., 1987) to foster a deeper understanding of mathematical concepts. By providing a variety of representations, tutors are better equipped to meet learners at their level and address areas of need effectively. This is strengthened through "circles of resonance," as

tutors work to re-engage learners with familiar classroom concepts in new ways - transforming their understanding through individualized, one-on-one instruction, interactive tools, and tasks and activities that draw on interdisciplinary learning and the notion of developing connections between concepts.

Given that tutors typically lack experience tutoring math, diagnostic assessments were designed to assist tutors in identifying specific areas where learners require support based on each strand of the curriculum (Ontario Ministry of Education [OME], 2020) rather than determining an overall grade level of understanding. Unlike traditional diagnostic assessments, this provides flexibility to transition from grade-specific questions. By analyzing learners' responses, tutors can quickly identify areas that require additional attention and refer to specific expectations from the Ontario mathematics curriculum (OME, 2020). This alignment supports tutors in identifying learning gaps and tailoring instruction accordingly.

Encouraging tutors to use open-ended tasks ensures that questions are being targeted at the appropriate level to provide challenge (Small, 2024). For example, this could include questions that require learners to analyze climate data to make predictions (science) or design visually appealing packaging that maximizes volume while minimizing material waste (the arts). While open-ended tasks encourage learners' critical thinking, it is equally important to ensure consistency in the structure of the tutoring sessions. Teaching routines provide structure and enable educators and learners with a predictable approach to address concepts (Thanheiser & Melhuish, 2023). As Anthony and Walshaw (2009) highlight, these routines serve as an important component for the development of learners' mathematical thinking. This predictability ensures consistent expectations and stability while allowing tutors to focus on their goal of student growth.

Discussion and Future Directions

The research is ongoing with initial findings suggesting positive developments in tutor and learner experiences. In this bi-directional learning process, tutors gain confidence and hone their skills to assess and support diverse learners, while learners benefit from individualized support addressing their specific mathematical needs. The program remains open to refinement, with improvements planned for the summer of each academic year. Preliminary feedback from learners, tutors, and on-site supervisors coupled with evidence-based practices and strategies will be used to revise the program and ensure its continued relevance, appropriateness, and

effectiveness. Future research will also explore the most effective ways to train tutors and assess the impact of the program on learner engagement and motivation. As well, the authors plan to investigate how mathematical modelling can further enhance the program and evaluate the benefits of incorporating new strategies for tutors and learners. Moving forward, the researchers aim to develop new interdisciplinary modules that combine mathematics with other disciplines to highlight some of the connections tutors can use in their programming with their learners, and what these activities might look like during a tutoring session. These modules will serve as reference points for tutors over the duration of the semester and the tutoring program.

Conclusion

The authors are committed to enhancing the programming by incorporating feedback from learners, tutors, and supervisors. The digital repository of resources will be updated to address challenges that tutors face and reflect the evolving needs of learners. This will include the integration of resources that explore mathematics in relation to the arts (visual arts, music, and dance), sciences (including sustainability), and technology (e.g., coding, online software). Future efforts will focus on enhancing the training provided to tutors and supervisors. The authors will offer a range of workshops, diving deeper into the content provided in the digital repository of resources and training sessions while fostering a collaborative environment that enhances tutoring sessions. These efforts seek to empower tutors while contributing to the success of each learner.

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