MEMORIAL UNIVERSITY OF NEWFOUNDLAND AND LABRADOR

FACULTY OF EDUCATION

ED6630: CRITICAL ISSUES IN MATHEMATICS EDUCATION

LECTURER: DR. MARY STORDY

FEBRUARY 22, 2025

TOPIC: INTEGRATING REAL – LIFE CONTEXTS INTO MATHEMATICS INSTRUCTIONS.

BY: BENJAMIN DWOMOH

INTRODUCTION

Mathematics is often perceived by students as an abstract discipline, disconnected from their everyday experiences. This perception can lead to disengagement and a lack of motivation to learn mathematical concepts. Mathematics instruction should involve student participation and problem solving to encourage higher level thinking; it should not be based solely on the computation of algorithms and repetitive worksheets (Burns, 1999).

Teachers around the world have criticized the use of traditional, drill and skill, methods of teaching mathematics (Hong, 1996; O'Brien & Moss, 2004). Mathematics instruction should not be based solely on repetition, computation, and mathematical processes (NCTM, 1989).

According to a study conducted by the National Centre for Education Statistics (NCES), only 26% of high school students reported feeling confident in their math abilities (NCES, 2020). To counter this trend, educators are increasingly adopting pedagogical strategies that integrate real-world applications into mathematics instruction. By presenting mathematical concepts in contexts that students find relevant and intriguing, educators can foster a deeper understanding and appreciation of mathematics.

The integration of real-world applications into mathematics education is supported by various educational theories, including constructivism and experiential learning. Constructivist

theories suggest that learners build knowledge more effectively when they can relate new information to their existing experiences (Piaget, 1973). Similarly, experiential learning emphasizes the importance of engaging students in hands-on activities that allow them to apply theoretical knowledge to practical situations (Kolb, 1984). These frameworks provide a solid foundation for developing teaching strategies that connect mathematics to real-life scenarios, thereby enhancing student engagement and comprehension.

This project explores how real – world applications can make mathematics more meaningful for students, why this approach is essential, and how educators and stakeholders can be encouraged to embrace it. The project will take the form of a blog or website, providing an interactive and accessible platform to share insights, resources, and strategies.

INTEREST AND LEARNING POTENTIAL.

The integration of real – life contexts into mathematics instruction offers numerous educational benefits. For instance, a study by Boaler (2016) demonstrated that students who engaged in real – world mathematics projects showed significant improvements in both their problem-solving skills and their attitudes toward mathematics. The project - based approach allowed students to explore mathematical concepts through tasks that mirrored real – life challenges, such as budgeting for a community event or analysing data trends in sports statistics. This hands – on experience not only made mathematics more relevant but also encouraged collaboration and critical thinking among students.

Additionally, incorporating real-world examples fosters the development of critical thinking and analytical skills, equipping students for practical decision-making in their careers and everyday lives (Schoenfeld, 2019). This topic is particularly relevant in today's educational landscape, where there is an increasing emphasis on competency-based learning, STEM and Social Sciences education. For example, in engineering, mathematical principles are essential for designing structures and solving complex problems related to materials and forces. Similarly, in economics, mathematical models are used to analyse market trends and make predictions about consumer behaviour. By incorporating examples from these fields into the curriculum, educators can illustrate the

practical applications of mathematics, thus motivating students to engage more deeply with the subject matter.

WHY THIS TOPIC SHOULD BE OF GREAT CARE.

Mathematics is often cited as a subject students struggle with due to its perceived lack of relevance (National Research Council, 2012). This disconnection leads to decreased motivation, lower achievement levels, and increased math anxiety. Research shows that students perform better when they see the purpose behind what they are learning (Freudenthal, 1991). Thus, there is a need to address the underlying issue that school mathematics does not seem relevant to most of the students who study it (NRC, 1989; NRC 1990). One way to address this is to provide mathematics instruction that demonstrates how mathematics can be used as a tool to model the real world to solve problems and make better decisions. The eight Standards for Mathematical Practice (SMP) from the Common Core State Standards for Mathematics (CCSSM) stated that "Mathematically proficient students… continually ask themselves 'Does this make sense?'" (National Governors Association Centre for Best Practices & Council of Chief State School Officers [NGACBP & CCSSO], 2010, p. 6). The SMP Reason Abstractly and Quantitatively emphasizes students' ability to relate the mathematics they learn to the contexts of problem situations, as well as their ability to relate problem contexts to mathematical concepts. This bi-directional process of contextualization and decontextualization is a feature of the CCSSM position on mathematical problem solving in real-world situations. The CCSSM also emphasizes mathematical modelling. There are 61 content standards identified as modelling standards. Rather than being seen as isolated modelling standards, these are intended to be integrated into other topics.

Embracing this vision of routinely engaging students in genuine mathematical modelling activities could help students see the relevance of mathematics. It is not at all clear, however, whether teachers are prepared to teach school mathematics in this way. Doerr (2007) suggested that "one reason for the limited use of applications and modelling at the primary and secondary levels of schooling is the lack of knowledge by those who are expected to teach mathematics through applications and modelling" (p. 69). The mathematics textbook publishing industry provides teachers with their primary teaching

resources. Although textbooks do not constitute curricula, secondary mathematics teachers tend to rely heavily on textbooks (Reys et al, 2002; Rezat, 2012). Traditional massadopted mathematics textbook series have underemphasized true mathematical modelling in favour of drill and practice with rote skills and techniques (Schoenfeld, 2007; Sood & Jitendra, 2007; Usiskin, 2001). The story problems included in many of the sample sets within these textbooks bear little resemblance to the ways mathematics is actually used by professionals (K. R. Chelst, personal communication, May 1, 2015). The problems that are posed to students in mathematics classrooms typically have a right answer, which the teacher knows. Professionals who utilize mathematics frequently develop mathematical models of real-world systems. Thus, the result of authentic mathematical modelling work is not the one right answer to a problem, but "sharable, 9 manipulatable, modifiable, and reusable conceptual tools (e.g., models) for constructing, describing, explaining, manipulating, predicting, or controlling mathematically significant systems" (Lesh & Doerr, 2003, p. 3). Students who experience mathematics education as a year long series of homework assignments to practice the symbolic manipulations of solving equations and occasional contrived story problems can come to believe that mathematics is an uninspiring, tedious, and irrelevant discipline (Nardi & Stewart, 2003).

WHEN WILL I EVER USE THIS?

In 2007 work began on a National Science Foundation-funded curriculum development project (DRL-0733137). The project was a collaboration between educators, engineers, and mathematicians at three universities that sought to improve both students' abilities to model with mathematics and their attitude towards mathematics (Keene et al, 2011). A curriculum for a senior level mathematics course was developed to teach mathematical modelling tools from the fields of operations research and industrial engineering. The curriculum was made up of one semester each of algebraic and probabilistic modelling techniques. A professional development program to train teachers to implement the curriculum was also developed as part of the project (Chelst et al, 2008). The curriculum and supporting professional development program eventually came to be called "When Will I Ever Use This?" (WWIEUT). The curriculum features a variety of decisionmaking tools all centred on teaching students how to model with mathematics. Mathematical modelling was not emphasized in undergraduate mathematics teacher education

programs (Doerr, 2007). Neither did it play a prominent role in the majority of high school mathematics curricula. To address the need for teachers to learn new content knowledge and pedagogical knowledge, a professional development program was created to train teachers to effectively implement the curricular materials.

TEACHING STRATEGIES.

To effectively integrate real-world applications into mathematics education, various teaching strategies can be employed. One prominent approach is project-based learning (PBL), which encourages students to engage in extended projects that require them to apply mathematical concepts to solve authentic problems. According to a meta-analysis by Thomas (2000), PBL not only enhances students' understanding of mathematical concepts but also promotes skills such as collaboration, communication, and critical thinking. For example, students might work on a project that involves designing a sustainable garden, where they must calculate area, volume, and budget constraints, thereby applying geometry and arithmetic in a meaningful context. Another effective strategy is the use of technology to simulate real-world scenarios. Tools such as graphing calculators, spreadsheets, and mathematical software can provide students with opportunities to explore complex problems and visualize mathematical relationships. A study by Kershner (2018) found that students who used technology to engage with real-world data sets demonstrated higher levels of mathematical reasoning and problem-solving skills compared to their peers who relied solely on traditional methods. For instance, students can analyse real time data from stock markets or weather patterns, allowing them to apply statistical concepts in a context that resonates with their interests. 21 Additionally, interdisciplinary approaches can enhance the integration of real-world applications in mathematics education. By collaborating with teachers from other subjects, mathematics educators can create lessons that draw connections between mathematics and other fields, such as science, history, or art. For example, a lesson on the Fibonacci sequence can be enriched by exploring its occurrences in nature and art, thereby illustrating the interconnectedness of mathematics with the world around us. Research by Beers (2011) suggests that interdisciplinary teaching not only improves student engagement but also fosters a deeper understanding of the material, as students learn to apply mathematical concepts across various domains. Professional development for educators is also crucial in effectively implementing these strategies. Training programs that focus on real-world applications can equip teachers with the necessary skills and

resources to create engaging lessons. According to a report by the National Council of Teachers of Mathematics (NCTM), teachers who participate in ongoing professional development are more likely to adopt innovative teaching practices that enhance student learning (NCTM, 2014). This investment in teacher training ultimately leads to more effective integration of real-world applications in the mathematics curriculum. In summary, a variety of teaching strategies can be employed to integrate real-world applications into mathematics education. Project based learning, the use of technology, interdisciplinary approaches, and professional development for educators are all essential components of this integrative process. By adopting these strategies, educators can create a more engaging and relevant mathematics curriculum that resonates with students and enhances their understanding of mathematical concepts

CONCLUSION

In conclusion, the integration of real – world applications into mathematics education is a powerful approach that can significantly enhance student engagement, comprehension, and academic performance. By employing diverse teaching strategies, such as project based 24 learning, technology integration, and interdisciplinary collaboration, educators can create a mathematics curriculum that resonates with students and reflects the relevance of mathematics in their lives. The positive outcomes of this integration, as demonstrated through various studies and case examples, highlight the importance of making mathematics education more applicable to real - world contexts. As the educational landscape continues to evolve, it is essential for educators and policymakers to prioritize the incorporation of real – world applications in mathematics instruction. This shift not only addresses the challenges of student disengagement but also prepares students for the complexities of the modern world, where mathematical literacy is increasingly vital. By fostering a culture of relevance and application in mathematics education, we can inspire future generations to embrace mathematics as a valuable tool for understanding and navigating their environments. Ultimately, the integration of real - world applications into mathematics education represents a promising pathway toward creating a more engaging, effective, and relevant learning experience for students. As educators continue to explore innovative approaches to teaching mathematics, the focus on real – world connections will undoubtedly play a crucial role in shaping the future of mathematics education.

REFERENCES

Burns, M. (1999). *About teaching mathematics: A K-8 resource.* Sausalito, CA: Math Solutions.

Hong, H. (1996). Effects of mathematics learning through children's literature on math achievement and dispositional outcomes. *Early Childhood Research Quarterly, 11(4), 477-494.* Retrieved April 22, 2007, from ERIC database.

O'Brien, T. C., & Moss, A. (2004). Real math? *Phi Delta Kappan, 86(4)*, 292-303. Retrieved June 8, 2007, from Academic Search Premier database.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Centre for Education Statistics (NCES). (2020). The condition of education 2020. U.S. Department of Education.

Piaget, J. (1973). To understand is to invent: The future of education. Viking Press.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice Hall.

Boaler, J. (2016). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching. Jossey-Bass.

Schoenfeld, A. H. (2019). How we think: A theory of goal-oriented decision making and its educational applications. Routledge.

National Research Council. (2012). Education for life and work: Developing transferable knowledge and skills in the 21st century. The National Academies Press.

Freudenthal, H. (1991). Revisiting mathematics education: China lectures. Kluwer Academic Publishers.

National Research Council. (1989). *Everybody counts. A report to the nation on the future of mathematics education.* National Academy Press.

National Research Council. (1990). *Reshaping school mathematics: A philosophy and framework for curriculum.* National Academy Press.

National Governors Association Centre for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards for mathematics.* Authors.

Doerr, H. M. (2007). What knowledge do teachers need for teaching mathematics through applications and modelling? In W. Blum, P. Galbraith, H.-W. Henn, & M. Niss (Eds.), *Modelling and applications in mathematics education (Vol. 10, pp. 69-78).* Springer.

Reys, B. J., Reys, R. E., & Chavez, O. (2004). Why mathematics textbooks matter. Educational Leadership, 61(5), 61-66. http://www.ascd.org/publications/educational-leadership/feb04/vol61/num05/Why-Mathematics-Textbooks-Matter.aspx

Rezat, S. (2012). Interactions of teachers' and students' use of mathematics textbooks. In G. Gueudet, B. Pepin, & L. Trouche (Eds.), From text to 'lived' resources (Vol. 7, pp. 231-245). Springer

Schoenfeld, A. H. (2007). Problem solving in the United States, 1970–2008: Research and theory, practice and politics. Zentralblatt für Didaktik der Mathematik, 39(5), 537-551. https://doi.org/10.1007/s11858-007-0038-z

Sood, S., & Jitendra, A. K. (2007). A comparative analysis of number sense instruction in reform-based and traditional mathematics textbooks. The Journal of Special Education, 41(3), 145-157. https://doi.org/10.1177/00224669070410030101

Usiskin, Z. (2001). Quantitative literacy for the next generation. In L. A. Steen (Ed.), *Mathematics and democracy: The case for quantitative literacy* (pp. 79-86). National Council on Education and the Disciplines.

Nardi, E., & Steward, S. (2003). Is mathematics T.I.R.E.D? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal, 29(3), 345-367.*