Modern definitions emphasize different component of giftedness they see giftedness as emergent after interaction with the environment and a dynamic process (Gagné, 2005; Subotnik, Olszewski-Kubilius, & Worrell, 2011; Ziegler, 2005). If giftedness is a developmental and dynamic process, then their development should be supported by a suitable educational environment. Without this kind of support, gifted children's mental abilities will get wasted and they will never realize their true potential. According to this dynamic and developmental understanding in order to reach full capacity, a gifted mind needs continuously challenging environmental factors (Rogers, 2007). Despite the dynamic and d

DEVELOPMENT OF A SCALE TO MEASURE TEACHERS' BELIEFS TOWARD STRUGGLES IN MATHEMATICS

Mehmet Kirmizi, Prof. Dr. Kamuran Tarim
Department of Mathematics, College Science and Engineering, Texas State University
Department of Mathematics Education, Colloge of Education, Cukurova University

Introduction

Traditionally, struggling in mathematics is considered undesirable. However, recent research frames struggle as important learning opportunities to gain deeper understanding in mathematics. The idea that mistakes and errors are necessary for the deep understanding is well supported by evidence from different fields.

A growing number of scholars have begun to think struggles are essential for gaining conceptual understanding (Hiebert & Grouws, 2007; Warshauer, 2015). We have empirical evidence suggests that student can transform their struggles into productive ones from unproductive frustration. However, the key component in the transformation process is support of the teacher (Granberg, 2016).

If teachers resist supporting students to productively struggle, students cannot take full advantage of the cognitive benefits struggles in mathematics offer. Teachers' positive beliefs and attitudes toward struggles in mathematics is essential to harness the power of struggles. For this poster, we plan to share our work developing a scale to measure teachers' beliefs towards struggle.

Need for the scale

In this work we developed a valid scale to assess teachers' beliefs toward students' struggles in mathematics that differs from the existing scales on similar construct:

- Belief in the Efficacy of Struggle Questionnaire (Vazquez, Ermeling, & Ramirez, 2020) was developed for parents,
- Mathematical Resilience Scale (Kooken et al., 2016) was developed to assess students' beliefs toward studying mathematics, and
- Attitudes Toward Struggles (Russo et al., 2020) was not developed via factor analysis.

Theoretical Background of Productive Struggle

In order to develop a valid and reliable scale to assess teachers' belief toward struggles, we first identified the theoretical background of productive struggles. In the literature, productive struggle is usually tied with four components:

- Understanding (Hiebert & Grouws, 2007; Kapur, 2010, 2014; Warshauer, 2015)
- Persistence (Kooken, 2016; Sengupta-Irving & Agarwal, 2017)
- Tasks and times ((Livy, Muir, & Sullivan, 2018; Russo et al., 2020)
- Joy of Teaching (Russo et al., 2020)

After identifying these four components, we consulted with one of the leading scholars related to productive struggle to determine that these four components were aligned our vision with her vision (Warshauer, personal communication, Aug 8, 2021).

Items

- We developed an initial item pool based on the components identified above. The initial pools contained 52 items and we evaluated each item based on wording and relevance with the theoretical background, as well as similarity with other items.
- Then we reduced the number of items to the 21
- After reduction, the initial scale was sent to four scholars in mathematics education to assess the content validity.
- Based on the feedback from each scholar, we modified items and the initial scale is ready and we are collecting data for the pilot testing.

Data

To date 206 future teachers and graduate teaching assistant have taken the scale. Next, we plan to do a factor analyses to check internal reliability measures of our scale.

Pilot Scale

U.1 I believe struggle is essential to become good at mathematics.
U.2 I believe mistakes are part of the process of gaining for a deep understanding of mathematics.
U.3 When it comes to making sense of mathematics, I believe in working on demanding problems and struggling over these problems is essential for any learners.
U.4 I believe there is value for my students in attempting to solve challenging mathematical problems even if they did not solve them correctly.
U.5 When it comes to making sense of mathematics I believe "less is more" which means a few carefully selected problems are more beneficial than many skill building problems.
U.6 I believe that if I have my students focus heavily on procedures and rules, they will learn more. *
P.1 I encourage my students to stick with a problem even if they are having a hard time figuring out a way to solve it.
P.2 I believe mathematics is challenging; however, if one perseveres even if they are struggling it can make a difference.
P.3 I believe that most of my students will quit when they are facing a challenging problem*.
P.4 I believe mathematics is challenging to everyone; however, mathematicians keep trying despite the struggle
T.1 I believe that class time is wasted when students struggle with a challenging problem*.
T.2 I believe the teacher needs to explain challenging tasks before students are able to make sense of the problems *.
T.3 I believe mathematical tasks should be challenging enough to encourage students to think harder. (Mehmet)
T.4 I give my students enough time to make sense of a challenging problem. (Mehmet)
T.5 I believe there is value in discussing students' common mistakes when I explain the solution to a challenging problem.
T.6 I believe making sense of mathematics is a process that requires sustained effort over time.
T.7 I usually give necessary explanations to my students before they work on a challenging problem. *
J.1 I enjoy classes when my students are engaged in a challenging problem that requires creative solutions.
J.2 I believe the joy of teaching mathematics lies in engaging my students in a problem that challenges them.
J.3 I enjoy mathematics because it is challenging yet doable.
J. 4 I enjoy classes when most of my students solve the problems at hand quickly*.

References

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. *Second handbook of research on mathematics teaching and learning*, 1(1), 371-404.
Kapur, M. (2010). Productive failure in mathematical problem solving. *Instructional science*, 38(6), 523-550.
Kapur, M. (2014). Productive failure in learning math. *Cognitive science*, 38(5), 1008-1022.
Kooken, J., Welsh, M. E., McCoach, D. B., Johnston-Wilder, S., & Lee, C. (2016). Development and validation of the mathematical resilience scale. *Measurement and Evaluation in Counseling and Development*, 49(3), 217-242.
Livy, S., Muir, T., & Sullivan, P. (2018). Challenging tasks lead to productive struggle! *Australian Primary Mathematics Classroom*, 23(1), 19-24
Russo, J., Bobis, J., Sullivan, P., Downton, A., Livy, S., McCormick, M., & Hughes, S. (2020). Exploring the relationship between teacher enjoyment of mathematics, their attitudes towards student struggle and instructional time amongst early years primary teachers. *Teaching and Teacher Education*, 88, 102983
Sengupta-Irving, T., & Agarwal, P. (2017). Conceptualizing perseverance in problem solving as collective enterprise. *Mathematical Thinking and Learning*, 19(2), 115-138.
Vazquez, S. R., Ermeling, B. A., & Ramirez, G. (2020). Parental Beliefs on the Efficacy of Productive Struggle and Their Relation to Homework-Helping Behavior. *Journal for Research in Mathematics Education*, 51(2), 179-203.
Warshauer, H. K. (2015). Productive struggle in middle school mathematics classrooms. *Journal of Mathematics Teacher Education*, 18(4), 375-400. doi:10.1007/s10857-014-9286-3

TEXAS STATE UNIVERSITY
The rising STAR of Texas
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM

The video introduction link:
https://youtu.be/iKEbwXqW_yI