PRODUCTIVE STRUGGLE IN MATHEMATICS EDUCATION RESEARCH, TEACHING, AND LEARNING WORKING GROUP

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Facilitating productive struggle is an essential aspect of teaching that is responsive to students' thinking and develops deep and meaningful understandings of mathematics. Researchers, teacher educators, and teachers would all benefit from being able to draw on a common definition for the term "productive struggle" and a common understanding of the teaching practices needed to facilitate it. This working group will bring researchers and educators together to investigate what we know about facilitating productive struggle and draw on the expertise in the room to move our individual and collective understanding and practice forward.

Keywords: Research Methods, Instructional Activities and Practices, Preservice Teacher Education, Teacher Educators

Over the past 15 years, the term *productive struggle* has become commonplace in mathematics teaching and teacher education. Both the National Council of Teachers of Mathematics (NCTM, 2014) and the Association of Mathematics Teacher Educators (AMTE, 2017) identify providing students with opportunities to engage in productive struggle as a key component of effective mathematics teaching and learning. However, a preliminary systematic review of how researchers define the term productive struggle leaves many unanswered questions about what productive struggle actually entails (Kamlue & Van Zoest, 2024). This new working group seeks to develop a shared, consensus definition of productive struggle and a related conceptual framework that can be utilized to support research and opportunities for students to experience productive struggle in learning mathematics in the classroom.

Theoretical Background

Several seminal writings influence how we perceive and use the term productive struggle in our different contexts. Here, we highlight three seminal works. First, Hiebert and Grouws (2007) define *struggle* as follows, "students expend effort in order to make sense of mathematics, to figure something out that is not immediately apparent" (p. 387). Several researchers (e.g., DiNapoli & Miller, 2022; Warshauer, 2015) use Hiebert and Grouws' (2007) definition of struggle as their definition of productive struggle in their studies. Second, NCTM (2014) frames struggle as involving, "opportunities for delving more deeply into understanding the mathematical structure of problems and relationships among mathematical ideas, instead of simply seeking correct solutions" (p. 48). This framing continues to inform educators', teacher educators', and researchers' understandings of productive struggle (e.g., Edwards, 2018; Warshauer et al., 2021). Third, practitioners and researchers often invoke the first Standard for

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Mathematical Practice: *Make sense of problems and persevere in solving them* (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) when speaking of struggle.

As we seek to illustrate here, there is great variety regarding how the field has described and conceived of productive struggle (e.g., expend effort, delve deeply, perseverance). This lack of consensus and common language presents a challenge to those who research productive struggle, those who teach how to facilitate productive struggle, and those seeking to create opportunities for their students to experience productive struggle.

Structure of the Sessions

The purpose of this working group is to bring together researchers and teacher educators to examine existing and new conceptualizations of productive struggle. This work is crucial for the mathematics education community, as the current lack of consensus regarding the use of the term productive struggle presents a host of issues, including the inability to: (a) compare findings across studies and build on each other's work precisely, (b) determine when productive struggle occurs, and (c) effectively model how teachers can support productive struggle. Each session will be focused on a different aspect of productive struggle research and classroom practice.

Session 1: Developing a Consensus Understanding of Productive Struggle

Our goal for this session is to co-develop a shared definition of *productive struggle* and a theoretical underpinning of the term. We will first present how productive struggle has been defined by researchers, teacher educators, in-service teachers, and preservice teachers, and what theoretical frameworks they attended to in their contexts (Hiebert & Grouws, 2007; Jarry-Shore & Anantharajan, 2024; Warshauer, 2015). We will surface unanswered questions from working group participants and ask them to situate and relate their use and understandings of the term to existing literature in order to move our understanding of the term forward.

Session 2: Analyzing Classroom Videos

For this session, working group participants will be asked to apply the conceptualization of productive struggle developed in Session 1 to attend to and interpret instances of struggle in classroom video (Jacobs et al., 2010). Specifically, participants will view a collection of three 5-minute video-clips that display struggle of different forms. Video-clips will portray students solving problems individually and in collaborative groups so that we can assess the usability and applicability of our collective conceptualization of productive struggle to varied problem-solving contexts. The work during this session will be iterative, with participants revisiting and refining ideas between each video viewing, with the goal of drafting a more comprehensive and refined conceptualization of productive struggle.

Session 3: Facilitating Productive Struggle

In the third session we will shift to thinking about how to operationalize the co-constructed conceptual framework developed in sessions 1 and 2 for research, PK-16 classroom practice, and teacher education/professional development. We will attend to two questions. First, how can we use the framework(s) we have developed in our practice to (a) more effectively engage students in productive struggle and (b) teach educators to facilitate productive struggle? Second, how can we use the framework(s) we have developed in our research to more effectively study productive struggle and its facilitation. For both questions, we will focus on assessing the usability of the framework and the benefits and challenges of having such a framework.

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