HOW DO STUDENTS WITH LOW INTEREST IN MATHEMATICS REACT TO TASKS? AN INVESTIGATION OF TRIGGERING INTEREST

by

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A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education

Spring 2023

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ACKNOWLEDGMENTS

First and foremost, I want to thank Dr. Amanda Jansen, my advisor, for her patience, encouragement, empathy, and understanding throughout this process. Her unwillingness to give up on me helped me keep going through all the hurdles I faced. I also want to thank my other committee members, Dr. Charles Hohensee, Dr. Erica Litke, and Dr. K. Ann Renninger for their support and feedback in improving this document and pushing my thinking and perspective. I am thankful that I have gotten to be a part of the mathematics education community.

I also would not have succeeded in this journey without the help of my fellow graduate students and my current colleagues holding me accountable and keeping me motivated. I owe a special thanks to Dr. Faith Muirhead, Dr. Julien Colvin, Dr. Kelly Curtis, and Patty Brady for the integral parts they played in my success.

My five kids, Taylor, Xander, Carter, Nora, and Connor, have grown up watching me pursue my dream, and they have seen me achieve something difficult. I hope I have inspired them to keep reaching for what they want in their futures.

Finally, I could not have done this without my husband, Rob, by my side the whole time. It may have happened quicker if not for his cancer (and the Covid-19 pandemic), but he made sure it still happened for me. He did not let me quit when I thought I could not keep going. He knew it was important to me, and therefore it was important to him.

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ABSTRACT

The purpose of this study is to investigate the reactions students with low interest in mathematics have to multiple mathematics tasks. Interest has been shown to influence students' engagement, motivation, and achievement (Renninger & Bachrach, 2015; Hidi & Harackiewicz, 2000; Kang & Keinonen, 2018). Therefore, understanding what triggers the interest of students with low interest in a particular subject has been, and remains to be, an important goal for educators so students' experiences and achievement are improved.

My study focused on triggered situational interest, which is the first of the four phases of Hidi and Renninger's (2006) four-phase model of interest. One of the ways that may be used to initiate or trigger student interest in math is through the tasks students encounter in the classroom. To this end, I elicited students' in-the-moment reactions to math tasks that included three task features: realistic context, the opportunity to justify an answer, and a visual representation of data. Their responses informed my answers to the following research questions:

Research Question 1: *Among high school students who reported having low situational interest in mathematics, to which aspects of mathematical tasks did these students react? In what ways did the students react to the aspects and what explanations did they provide for their reactions? Which, if any, of the aspects were intended features of the focus tasks?*

Research Question 2: *What are the different cases that emerge when considering students who reported having low situational interest in mathematics that*

frequently and consistently reacted to a particular task aspect across most, or all, of the five different mathematical tasks? Within each case, how were the students' explanations for their reactions to that particular task aspect similar and different across the mathematical tasks? How do their explanations for their reactions support the concluding stances for that particular task aspect?

I used a Two Cycle coding process (Miles et al., 2018) to analyze the transcript data. Through this process, I developed codes to capture students' reactions to each of the three task features as well as their reactions to two task aspects that emerged from the data: mathematical topic, and perceived difficulty. I used the frequency of the assigned codes to answer research question one. I then used the assigned codes along with analytic memos (Miles et al., 2018) to select three student cases to answer my second research question.

Students generally reacted in ways that aligned with previous research for the task features, but their explanations were not always the same as those found in the research. For the emergent task aspects, students generally reacted positively to topics they had previous success with and reported having a general preference for ease. However, there were exceptions to these trends.

This study highlights the benefit of eliciting the students' voices to learn about their experiences. My results illustrate a range of ways that interest can be triggered by concurrent aspects of mathematics tasks among students who report having low interest in mathematics. My results suggest the importance of task selection and task launching in a classroom setting. I suggest future research that expands on the current study to include students with higher levels of interest in mathematics, or by using tasks that are included in current classroom curricula.

Chapter 1

INTRODUCTION

Students' experiences and outcomes in their academic classrooms are influenced by many factors, one of which is their interest in the subject. Interest has been defined as, "a psychological state of engaging or the predisposition to reengage with particular classes of objects, events, or ideas over time" (Hidi & Renninger, 2006, p.112). According to Renninger and Bachrach (2015), interest supports students' engagement and encourages behavior that increases opportunities to learn. Many previous studies have linked higher student interest to an increase in student learning in general (e.g., Harackiewicz et al., 2008; Jansen et al., 2016; Wade & Adams, 1990). Researchers have found this to be the case specifically for mathematics as a subject (e.g., Mitchell, 1993; Singh et al. 2002; Boaler & Staples, 2008).

Researchers have made distinctions between individual interest and situational interest (Hidi & Renninger, 2006; Ainley et al., 2002; Mitchell, 1993; Hidi & Baird, 1988). Ainley, Hidi, and Berndorff (2002) define situational interest as being "elicited by certain aspects of the environment" (p. 545) and individual interest as "an individual's predisposition to attend to certain stimuli, events, and objects" (p. 545). Situational interest must be present before students can develop individual interest in a subject, and it can be triggered by intentional external efforts by others (Hidi & Renninger, 2006).

Understanding why some high school students report having low situational interest in math is important because students with lower situational interest have been found to be less likely to pursue future courses in mathematics (Bong et al., 2015; Sansone et al. 2015; Köller et al., 2001), which may limit their prospects in higher education or STEM related career fields. Empirical evidence demonstrates that students' situational interest in mathematics tends to drop noticeably as students enter high school (Fredericks & Eccles, 2002; Gottfried et al., 2001; Kim et al., 2015). Furthermore, students in high school who express having low levels of interest in mathematics are likely to have begun to incorporate their low interest as part of their personal identities, and therefore may be less likely to seek out opportunities on their own to increase their interest (Cobb & Hodge, 2011). Students with lower reported levels of interest in mathematics than their classmates are a worthy demographic to study because those are the students who could most benefit by being impacted by external efforts to trigger situational interest (Hidi, 1990).

To disrupt trends of students' interest decreasing over time, educators can recognize that students' situational interest is not a fixed trait and can be externally influenced (Schiefele, 1991; Hidi & Renninger, 2006; Mitchell, 1993). It is important to find ways to positively influence these students' levels of interest. Renninger and Hidi (2015) note that educators can support students in "continued and meaningful engagement" (p.101) by drawing on knowledge, understandings, and experiences the students already have. They also say that educators can "incorporate design elements that explicitly support students to make connections to the content and develop their interest" (p. 101). Incorporating elements that connect to the students' existing interests may increase the students' willingness to engage or re-engage with the content in which they are less interested.

One way that teachers can design instruction to directly impact student interest is through the tasks they select for instruction (Hiebert & Wearne, 1993; Watson & Mason, 2007). Students with low situational interest in math may be more likely to be motivated to engage with selected tasks if it includes the presence of a feature that triggers their interest or attention, (Hidi & Harackiewicz, 2000). A single task can be composed of multiple features that may influence a student's interest. Some features that have been shown by research to positively influence student interest include the incorporation of a real-life context (e.g., Van den Heuval-Panhuizen, 2005), the opportunity to justify an answer (e.g., Boaler & Staples, 2008), and visual representations of quantitative data (e.g., Van Meter et al., 2020). There is a need to investigate how multiple features of a task concurrently influence student interest.

Given that interest is malleable, understanding the moments when it fluctuates can provide greater insight on how and when task features might impact interest. However, student interest is frequently studied through methods such as observation (e.g., Renninger & Bachrach, 2015), which requires external interpretation of another person's actions. Alternatively, we could investigate students' reports of their experience through questionnaires (e.g., Schukajlow et al., 2012, Frenzel et al., 2010) or interviews *after* the completion of an intervention (e.g., Ridlon, 2009). These retrospective measures have their strengths, but there is value in gaining insight into how student interest manifests and changes in-the-moment. Use of multiple measures would also strengthen the conclusions that can be made from the interpretation of collected data.

It is also valuable to listen to what students say about what aspects they report reacting to in the tasks they solve, instead of limiting investigations to the features that educators expect to trigger their interest. Listening to students use their voices to explain their reactions to tasks gives them the agency to be involved in the process of improving opportunities to learn and engage with math (Robinson & Taylor, 2006; Mitra, 2018) and avoids relying on assumptions made by adult educators that may not reflect the students' experience (Jenkins, 2006). This study aimed to emphasize voices of students to gain insight into how they react to tasks instead of relying on assumptions or expectations. One way this study achieved that aim was by having the students openly explore tasks that included features that educators presume positively affect students' situational interest and allowing the students to explain the reactions they had to those tasks. The students were not told that the tasks were intentionally selected with a focus on features intended to trigger their interest and additional triggers of situational interest emerged as a result.

I designed this exploratory study to increase our understanding of how high school students with low situational interest in math react to tasks that they encounter. I wanted to learn more about the ways in which these students reacted to features that are present in tasks, particularly when there were multiple features present. I also wanted to learn more about how these students reacted to other aspects of the task that were not intentionally included as features to trigger or increase interest. Finally, I wanted to explore the explanations the students provided for their reactions to the features and other aspects. To address my curiosities, I developed the following two research questions to guide my study:

Research Question 1: *Among high school students who reported having low situational interest in mathematics, to which aspects of mathematical tasks did these students react? In what ways did the students react to the aspects and what* *explanations did they provide for their reactions? Which, if any, of the aspects were intended features of the focus tasks?*

Research Question 2: *What are the different cases that emerge when considering students who reported having low situational interest in mathematics that frequently and consistently reacted to a particular task aspect across most, or all, of the five different mathematical tasks? Within each case, how were the students' explanations for their reactions to that particular task aspect similar and different across the mathematical tasks? How do their explanations for their reactions support the concluding stances for that particular task aspect?*

To answer these questions, I conducted a series of one-on-one interviews with 11 students who reported having a low level of situational interest in math. The students that I recruited to participate in the interviews all scored lower than a pre-determined cut-off score on a survey that measured their situational interest in mathematics as a subject. Each student completed a pre-interview, multiple task interviews and a final interview. The interview transcriptions were the data that I analyzed.

To investigate the aspects to which students reacted, and whether those aspects were intended features, I used five different multi-part mathematical tasks in my study. Four of the tasks were focus tasks that included three features that have been shown through research that they can positively influence student interest. The three features were the inclusion of a real-life context, the opportunity for the student to justify their answer, and the opportunity to interpret data from a graphical representation. I designed the comparison task to be devoid of those features.

To attain in-the-moment data, I provided the students with multiple opportunities throughout the interviews to tell me about the reactions they had to the tasks. During each task interview, the students completed one of the five math tasks. I asked them to explain any reactions they were having to the task before they solved any of the parts, after each part, and after completing the entire task. I also asked them to compare completed tasks to each other, providing them with another opportunity to reflect on the reasons for the reactions that they had to each task. The students were not aware of the specific features that I was investigating, so any mention they made of those features in their interview responses were unprompted and spontaneous reactions to the feature.

I answered the first research question by analyzing and tabulating the codes I developed and assigned to “monothematic chunks” (Miles et al, 2018, p. 74) of the interview transcripts. I coded the monothematic chunks using the “Two Cycle” coding process suggested in Miles et al. (2018, p. 64). The First Cycle codes that I used were three a priori codes related to the three featured task aspects of context, opportunity to justify, and interpretation of graphs and a fourth code to incorporate chunks that could not be assigned one of the other three codes. The Second Cycle codes I developed were a combination of revised subcodes for the three First Cycle codes that pertained to the featured aspects and two additional emergent aspect codes, mathematical topic, and perceived difficulty. This process informed the concluding stances I present for the three task features and two additional task aspects of the mathematical tasks to which the students explained having reactions.

I answered the second research question by selecting three representative cases when a single student had consistent and frequent reactions to a particular task feature or aspect. I selected these cases by analyzing the codes assigned to each student's transcripts and identifying the students that had consistent reactions to a particular feature or aspect during most of the tasks they had solved. After that, I wrote descriptive summaries and analytic memos for each of the selected students which led me to choose three cases to explore more deeply. These three cases were Diondre's preference for the inclusion of a real-life context, Arthur's positive reactions to the opportunity to justify his answers using his opinions and prior experiences, and Callie's preference for ease in mathematical tasks.

I designed this study to contribute to both research and practice in mathematics education. Regarding research, the methods I used made a contribution because they demonstrated a way in which data on students' situational interest in mathematics can be collected in-the-moment and in their own voices. My results also contributed a deeper understanding of how students react to multiple features of mathematical tasks when they are present concurrently. Regarding teaching practice, my study demonstrated how students' reactions to aspects in tasks can inform teachers' task selection. These findings also suggest the importance of launching a task in a way to increase the chances that all students are able to access the context of the task. Finally, my study highlighted the benefits of providing students with the opportunity to share their experiences in their own words and valuing their input when making decisions about the tasks they are provided.

Chapter 2

LITERATURE REVIEW

In 1913 John Dewey published his essay, *Interest and Effort in Education* which establishes that student interest has been a construct of significance to scholars of education for over a century. Dewey says that interests "mark an identification in action, and hence in desire, effort, and thought, of self with objects" (p.90) and that when interests are cultivated, students can meaningfully grapple with the subject at hand. Since Dewey's time, researchers in the field of student interest have shown the connections between interest and engagement (e.g., Renninger & Bachrach, 2015), motivation (e.g., Hidi & Harackiewicz, 2000), and achievement (e.g., Kang & Keinonen, 2018). These connections have also been shown specifically in math (e.g., Köller et al. 2001). Because of these connections, it is important to better understand the experiences of students with lower levels of interest and what they say influences their interest.

In a school setting, educators have influence over external factors that can affect student interest. Below I will describe the research that has been done into the effects of the external factors, or triggers, of interest that have been researched in educational settings. In math classrooms, one way in which interest can be triggered is through the intentional inclusion of elements that are designed to trigger interest in the tasks the students encounter (Renninger et al., 2019). In my study, I refer to these intentional elements as task *features*. There is less research available on the effects of how the presence of multiple features in the same task affects the students'