

Mathematics Engagement in College Precalculus: Understanding Students' Experiences Through a Graphing Elicitation Tool

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In recent years, we have witnessed great efforts to improve college-level mathematics courses by shifting to student-centered instruction and providing better supports for all learners (e.g., Apkarian et al., 2021; Rasmussen et al., 2019). The implementation of pedagogies like active learning, inquiry-based learning, or flipped classroom instruction in gateway mathematics courses highlights the importance of student engagement in improving learning outcomes (Uhing et al., 2021). To increase student engagement, it is critically important that we understand how students experience this phenomenon.

Despite its importance in learning, educational researchers have not come to a clear consensus on a conceptualization of student engagement (e.g., Appleton et al., 2008; Wong & Liem, 2022). Our colleagues in K-12 mathematics education have been inquiring into students' mathematics engagement since the 1990's (Middleton et al., 2017) and a commonly adopted conceptualization comes from Fredricks et al. (2004) of engagement as a multi-dimensional meta-construct capturing students' affect, behavior, and cognition (Middleton et al., 2017).

This poster proposal aims to highlight a part of the methods of a larger study exploring undergraduate students' experiences of mathematics engagement in a college Precalculus course. This study considers students' mathematics engagement holistically, drawing on engagement research in K-12 mathematics education for its conceptual framework and acknowledging that the various dimensions of engagement are interwoven with each other and are extremely dynamic. The overarching research question is: "What is the story of college students' mathematical engagement in Precalculus?" The theoretico-methodological framework of the study is foundationally based in the socio-cultural tradition (Vygotsky, 1978) and built with hermeneutic phenomenology (van Manen, 2014), which means that the experience of the phenomenon of engagement is studied against the backdrop of socio-cultural learning theory.

The focus of the proposed poster is on the use of a graphing elicitation tool as part of the research design, wherein study participants will be asked to sketch a graph of their engagement in their Precalculus course across the semester over the course of 4 interviews. The sketches drawn by the participants will provide the participant and interviewer a common representation to discuss during the conversation and can allow the researcher's questions to be more specific, eliciting rich descriptions of the students' experiences of engagement. In fact, detailed lived experience descriptions are the main goal of phenomenological interviewing (van Manen, 2014).

During the poster presentation, conference attendees will be able to learn about the methodology, see examples of student-produced sketches, and discuss the affordances of the elicitation tool for understanding college students' engagement in the mathematics classroom. Affect graphing is not new in mathematics education research (Riske et al., 2021; Satyam et al., 2022), and pairing the tool with phenomenological interviewing practices can allow us to gain insight into students' experiences, grasp aspects of students' mathematics engagement that are hard to capture through traditional interviewing methods, and study it as the complex dynamic multi-dimensional construct that it is.

References

- Apkarian, N., Kirin, D., Gehrtz, J., & Vroom, K. (2021). Connecting the stakeholders: Departments, policy, and research in undergraduate mathematics education. *PRIMUS*, 31(1), 17–36. <https://doi.org/10.1080/10511970.2019.1629135>
- Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools*, 45(5), 369–386. <https://doi.org/10.1002/pits.20303>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59–109. <https://doi.org/10.3102/00346543074001059>
- Middleton, J. A., Jansen, A., & Goldin, G. A. (2017). The complexities of mathematical engagement: Motivation, affect, and social interactions. In *The compendium for research in mathematics education* (pp. 667–699). The National Council of Teachers of Mathematics.
- Rasmussen, C., Apkarian, N., Hagman, J. E., Johnson, E., Larsen, S., Bressoud, D., & The Progress through Calculus Team. (2019). Brief report: Characteristics of precalculus through calculus 2 programs: Insights from a national census survey. *Journal for Research in Mathematics Education*, 50(1), 98–111. <https://doi.org/10.5951/jresmetheduc.50.1.0098>
- Riske, A. K., Cullicott, C. E., Mirzaei, A. M., Jansen, A., & Middleton, J. (2021). Student engagement with the “Into Math Graph” tool. *Mathematics Teacher: Learning and Teaching PK-12*, 114(9), 677–684. <https://doi.org/10.5951/MTLT.2020.0322>
- Satyam, V. R., Bae, Y., Smith, J. P., & Levin, M. (2022). Affect graphing: Leveraging graphical representations in the study of students’ affect in mathematics. *Educational Studies in Mathematics*, 110(3), 481–501. <https://doi.org/10.1007/s10649-021-10131-3>
- Uhing, K., Hass, M., Voigt, M., Strom, A., & Calleros, E. (2021). Students’ experiences with active learning mathematics. In W. M. Smith, M. Voigt, & A. Ström (Eds.), *Transformational change efforts: Student engagement in mathematics through an institutional network for active learning* (pp. 221–241). American Mathematical Society.
- van Manen, M. (2014). *Phenomenology of practice*. Left Coast Press, Inc.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.
- Wong, Z. Y., & Liem, G. A. D. (2022). Student engagement: Current state of the construct, conceptual refinement, and future research directions. *Educational Psychology Review*, 34(1), 107–138. <https://doi.org/10.1007/s10648-021-09628-3>



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Background

Using graphs as elicitation tools to understand students' affect is not new for mathematics education research (Riske et al., 2021; Satyam et al., 2022). This study is using the graphing engagement tool to solicit students' self-described experiences of mathematics engagement in their college Precalculus course.

Engagement is a multi-dimensional meta-construct (Fredricks et al., 2004; Middleton et al., 2017). The key dimensions of engagement in education research are the *affective*, *behavioral*, and *cognitive* dimensions (Appleton et al., 2008; Fredricks et al., 2004; Wong & Liem, 2022).

Stay for a chat if you want to:

- learn how the participants in this study were prompted to share their lived experiences of engagement through graphs,
- view select examples of student-produced graphs with highlighted quotes from interviews,
- discuss the affordances of the elicitation tool for understanding undergraduate students' engagement in the college Precalculus classroom,
- learn about the phenomenological underpinnings of the study design and the graphing prompts.

Methods of the overall study

- ❖ 12 participants enrolled in Precalculus
- ❖ 8 distinct sections taught by 4 instructors
 - 2 lecture-based sections
 - 6 flipped classroom sections
- ❖ partially coordinated Precalculus course

- ❖ 4 phenomenological interviews over the course of one semester
- ❖ during each interview participants sketch a segment of their engagement graph

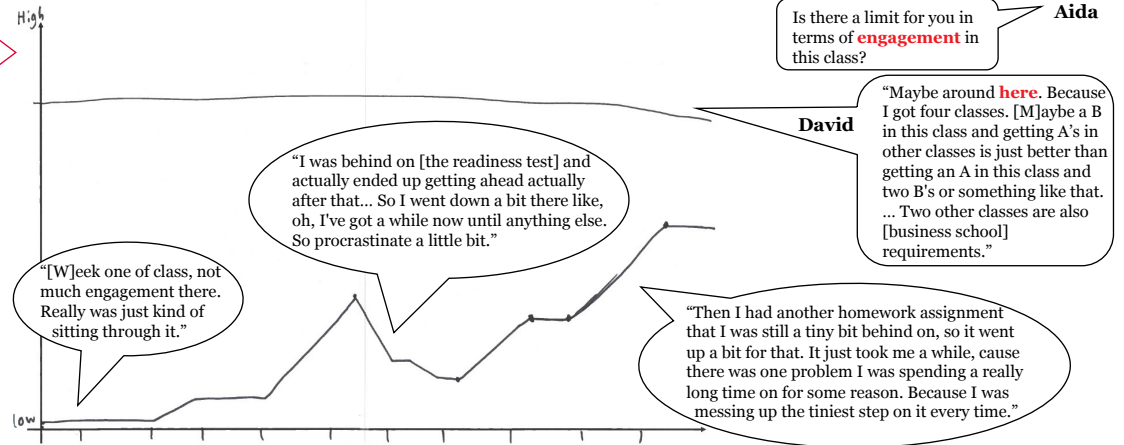


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Asking students to graph how their engagement in Precalculus shifts throughout the semester is a powerful way to elicit rich qualitative data.

David (he/him)

- Freshman at UGA
- Intended major: Finance
- In a lecture-based classroom



Penelope (she/her)

- Freshman at UGA
- Intended major: Accounting
- Switched Precalculus sections after 1 week of classes
- In a flipped classroom

