

CONCEPTUALIZING MATHEMATICS MODULES THAT INTEGRATE PROFESSIONAL NOTICING AND EQUITY

Cindy Jong
University of Kentucky
cindy.jong@uky.edu

Molly Fisher
University of Kentucky
molly.fisher@uky.edu

Jonathan Thomas
University of Kentucky
anderbi.thomas1@uky.edu

Edna Schack
Morehead State University
edna.schack@gmail.com

Walker Mask
University of Kentucky
walker.mask@uky.edu

In this paper, we describe the theory guiding the development of microlearning modules connecting noticing and equity in mathematics. Gutiérrez's (2009) four dimensions of equity framework is used to inform the modules. The professional noticing of children's mathematical thinking (Jacobs, Lamb, & Philipp, 2010) is also woven into the module development. We analyze data from preservice elementary teachers' ideas about equity and responses to a video to inform our project and discuss the importance of making equity explicit in mathematics methods courses. Results indicate that preservice elementary teachers' ideas of equity primarily fall into the dominant axes of access and achievement, but also show evidence of the critical axes of identity and power in responses to the classroom video.

Keywords: Equity, Inclusion, and Diversity; Teacher Noticing; Preservice Teacher Education; Instructional Activities and Practices

Culture permeates every aspect of life by definition; thus, it has some impact on how students think about mathematics (Civil, 2018), and should be recognized when considering equitable contexts for the teaching and learning of mathematics. Students from non-dominant cultures should be encouraged to draw upon their experiences to think critically in mathematics. Projects like Funds of Knowledge (Civil, 2007; Moll, Amanti, Neff, & Gonzalez, 1992) propose teaching structures that include and use individuals' unique cultural experiences and knowledge. While culture may be a positive and powerful classroom dynamic, teachers' assumptions about mathematical ability based on any student attributes are an inequity that comes from student culture (Gutiérrez, 2002). Students' understanding of dominant mathematics, or what counts as mathematics, can also hinder equity (Civil, 2014; Gee, 2002) through the reinforcement of their positioning within a cultural outgroup (Gutiérrez, 2008). This research responds to the call for equity to be used as a lens to enhance the collective mathematics education research enterprise by challenging "the false dichotomy between equity and mathematics education research" via the fundamental conjoining of equity concerns with responsive mathematics teaching practice (Aguirre et al, 2017, p. 130). In this paper, we describe the theory that guides the development of microlearning modules integrating noticing and equity in mathematics. We include baseline results from preservice elementary teachers' (PSET) ideas about equity that inform our project and discuss the critical importance of making equity explicit in mathematics methods courses.

Theoretical Frameworks

There is emerging interest in connecting and studying aspects of equity in conjunction with professional noticing (Jong, 2017). For example, both Kalinec-Craig (2017) and Hand (2012)

have examined student positioning and power in the context of professional noticing. Such connections are consistent with portrayals of professional noticing as contested and political space (Lefstein & Snell, 2011; Louie, 2018). Regarding the pedagogical activity that might productively influence such spaces, van Es et al. (2017) posited several practices and associated foci for professional noticing that they describe as *noticing for equity*.

Gutiérrez (2009) describes four dimensions of equity as a way to frame the complex ways in which equity plays a role in mathematics education. The dimensions include access (resources children have available), achievement (student outcomes), identity (connecting to students' backgrounds), and power (voices in the classroom and challenging structural inequities). She notes that access and achievement are part of the dominant axis, yielding to the status quo, whereas identity and power comprise the critical axis, confronting or challenging the status quo. Gutiérrez (2002) makes it clear that the two axes are essential, and may even act symbiotically.

Teacher noticing literature frequently emphasizes a cognitive perspective, concerned with the cognition needed to recognize and act on mathematical thinking. Jacobs, Lamb, and Philipp's (2010) work expressly addressed professional noticing of children's mathematical thinking defined as three interrelated components, attending, interpreting, and deciding. Recent studies consider the three components in the context of the broader construct of teacher competence and address a situational aspect of noticing under the perception, interpretation, and deciding, or PID, model (Blömeke, Gustafsson, and Shavelson, 2015). Jong et al.'s (2021) empirical study demonstrated support for this proposed relationship between dispositional resources and noticing (i.e. PID). Santagata and Yeh (2016) further proposed that the continuum is not linear, but that practice, too, influences PID; this idea is evident in Louie, Adiredja and Jessup's (2021) work. These situational, or ecological, approaches to noticing are relevant when Gutiérrez' dimensions of equity (2002). Teacher noticing along both axes has the potential to broaden equity through the dynamic interplay of cognition, attitudes, beliefs and practice with noticing. The microlearning modules incorporate situational noticing to increase PSETs' knowledge and shift their beliefs regarding equity and support the development of equitable noticing practices.

Methodology

Project Design

For this project, we focus on microlearning experiences as an avenue for the construction of equitable professional noticing practices which will enhance learning compared to more traditional modalities across a range of subjects (Mohammed, Wakil, & Nawroly, 2018). The titles of the modules indicate the mathematical and some of the equity-based concepts they contain: Intro to Professional Noticing and Equity, Fractions and Productive Struggle, Number Talks and Smartness, Patterns and Student Work, Functions and Inclusive Story Problems, Ratio and Language, Fractions and Representations, and Social Justice Applications. Instructors implementing these modules start with the introduction but can select which other modules are included based on preference and instructional goals. Each module after the introduction contains a review of the components of professional noticing and the dimensions of equity highlighted in that module, a segment which focuses on the language of teachers and how chosen words can be harmful to students in marginalized populations, and a wrap-up of the theories explored with an opportunity for discussion of the highlighted components and dimensions.

Data Collection and Analysis

PSETs in three sections of mathematics methods courses completed a survey at the beginning and end of the semester in fall 2020. Using random selection, 200 responses from pre- and post-

surveys of 50 PSETs inform the initial stage of analysis. The first item inquired about PSETs' own ideas of equity (Q1, Table 1). Then, the PSETs viewed a brief (74-second) clip of a diverse group of second grade students engaging in a number talk. After the video, they were asked one question each concerning the professional noticing components about the video followed by a prompt relating the video to equity (Q5, Table 1). Preservice teacher responses to the two equity items were analyzed through the lens of Gutiérrez's (2009) four dimensions of equity; a codebook was created to determine which phrases would code a PSET response with a specific equity dimension. (e.g., "differentiation, opportunity to learn, teaching in a fair way", were coded as *access*, and "gender, race, connecting to students' lives, or representation" were coded as *identity*). Four members of the research team individually coded each response for the four dimensions to include any/all that applied, and inconsistencies were negotiated by pairs of coders to achieve complete agreement (Campbell et al., 2013).

Results and Discussion

Table 1: Frequency of Responses by Equity Dimensions

Equity Dimensions	Q1. What does equity in teaching mean to you?			Q5. Describe how equity relates to this classroom scenario.		
	Pre	Post	Total	Pre	Post	Total
Access	45	50	95	32	28	60
Achievement	17	23	40	5	7	12
Identity	13	6	19	15	19	34
Power	1	2	3	33	35	68

The Dominant Axis: Access and Achievement

The most common views in all responses were about giving all students the same opportunities or some notion of fairness. While both ideas are basic and could be categorized into the access dimension of equity, there is a distinction between ideas of equality and equity. While we coded access responses with notions of equality or mentions of being "fair" to all students, we also looked for other key indicators, such as differentiation, use of multiple strategies, mentions of manipulatives, and responses that mentioned the use of resources. In a broad sense, the PSETs think equity in teaching does mean some level of fairness; however, those responses of fairness come with varying sophistication. For example, in a pre-response to question 1, a PSET stated "...I will be fair when it comes to all my students. I will try my best to meet the needs of all my students when teaching," which indicates a baseline approach to the notion of fairness. A post-response that addresses and interprets multiple dimensions of equity from a different PSET was,

"Equity in teaching means that all students are presented with what they need to be successful in the classroom. Despite a child's backgrounds or specific needs, they are able to reach their goals by whatever means possible in the classroom. This means that the teacher provides the necessary components for each student to be successful. This could mean that instruction is differentiated to fit individual students' needs. Each student with an IEP is accounted for and is given the appropriate help. Students with language and cultural differences are given what they need specifically to succeed."

When identifying responses as “achievement”, we used codes such as a mention of student success, expectations, standards, quality of education or learning, and references to “correctness” of the mathematics. Substantial increases in the pre to post responses in the achievement dimension were not evident in either question. Perhaps the most interesting outcome was that only twelve of the 100 responses from question 5 contained a reference to achievement, eleven of which mention “correctness” of mathematics. This is likely linked to the specificity of the video and many of the codes from achievement were links to broader scale observations that are not necessarily evident in a short video clip. Those broader scale responses would be evident in question 1 that prompts for their overall understanding of equity. Most of those indicated the teacher let students share responses, regardless of whether it was correct or incorrect.

The Critical Axis: Identity and Power

Limited responses to the first question touched on the dimension of identity by stating that regardless of students’ backgrounds, they should have access. One part of a response that was coded as identity stated, “Every student has different life experiences and backgrounds and we have to be aware of these things.” It was somewhat surprising that identity responses decreased for the item. While many more included the word “differentiate” in post-responses, this was not enough for the identity code. However, many more responses to question 5 were coded as identity, which increased slightly from pre to post. The limited responses informed the project team of the need to focus more teacher education instruction on students’ identity through more interactions that involve connections to students’ culture, language, and experiences.

It was somewhat surprising that preservice teachers’ responses to question 1 did not include more characteristics of power at the end of the mathematics methods course. In the few instances, there was mention of listening to students and allowing them to share their ideas. Thus, it was not a connection to broader power structures for question 1. However, there was a dramatic increase in the responses coded as the power dimension for question 5. This was likely due to the video including three students who were selected to share their three unique answers to the open-number sentence and an explanation of their thinking. Thus, student voice, sharing strategies, and eliciting multiple strategies were all aspects of the power dimension. The brief video limits connections to the power dimension; however, our goal is for PSETs who participate in the social justice module to empower students to use mathematics to change the world.

Conclusion

Preliminary results indicate a need to engage preservice elementary teachers in more critical dimensions of equity (Gutiérrez, 2009). Students’ backgrounds and identities can serve as an asset to teaching, and power can be incorporated as a way for their students to have a voice in their mathematics learning and use mathematics as a tool to analyze the world around them.

Our results show varying operationalizations of complex ideas such as fairness and opportunity. For some, these are signified by the equalizing of instructional practices across students, others see them as the product of differentiation, and for others, these ideas are taken as self-evident and left unclearly defined. Our next analytical steps will be to consider varying levels of each dimension and examine anti-deficit language in responses as we establish a more complex process in understanding PSETs ideas and patterns (Jacobs, 2017). We are encouraged by PSETs’ capacity to perceive different dimensions of equity. Across both presented items, we observed each of the dimensions within our response set. Interestingly, although PSETs tended not to personally connect to the equity dimension of power (Q1), when presented with an instructional vignette, PSETs perceived aspects of the power dimension therein. This suggests a

relatively broad formation of equity ideas within our sample of PSETs that might connect an instructional moment to broader sociopolitical contexts (Louie et al., 2021).

Acknowledgments

This research was supported by a grant from the IUSE Award #1914810. The opinions expressed herein are those of the authors and do not necessarily reflect views of the National Science Foundation.

References

- Aguirre, J.A., Herbel-Eisenmann, B., Celedón-Pattichis, S., Civil, M., Wilkerson, T., Stephan, M., Pape, S., & Clements, D.H. (2017). Equity Within Mathematics Education Research as a Political Act: Moving From Choice to Intentional Collective Professional Responsibility. *Journal for Research in Mathematics Education*, 48, 124-147.
- Blömeke, S., Gustafsson, J.-E., & Shavelson, R. J. (2015). Beyond dichotomies: Competence viewed as a continuum. *Zeitschrift für Psychologie*, 223(1), 3–13.
- Campbell, J. L., Quincy, C., Osserman, J., & Pedersen, O. K. (2013). Coding in-depth semistructured interviews: Problems of unitization and intercoder reliability and agreement. *Sociological Methods & Research*, 42(3), 294-320.
- Civil, M. (2007). Building on community knowledge: An avenue to equity in mathematics education. In N. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 105–117). New York, NY: Teachers College Press.
- Civil, M. (2014). Musings around participation in the mathematics classroom (guest editorial). *The Mathematics Educator*, 23, 3–22.
- Civil, M. (2018). Looking back, looking ahead: Equity in mathematics education. In T. E. Hodges, G. J. Roy, and A. M. Tyminski (Eds.), *PME-NA 40: Looking back, Looking ahead*. (Proceedings of the 40th annual conference of the Psychology of Mathematics Education – North America Chapter, pp. 16-31). Greenville, SC: University of South Carolina, Clemson University.
- Confrey, J. (2010). “Both And” Equity and mathematics: A response to Martin, Gholson, and Leonard. *Journal of Urban Mathematics Education*, 3, 25-33.
- Gee, J. P. (2002). Literacies, identities, and discourses. In M. J. Schlepppegrell & M. C. Colombi (Eds.) *Developing advanced literacy in first and second languages: Meaning with power* (pp. 159-175). Mahwah, New Jersey: Lawrence Erlbaum.
- Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: Toward a new equity research agenda. *Mathematical Thinking and Learning*, 4, 145-187.
- Gutiérrez, R. (2008). A “Gap-Gazing” fetish in mathematics education? Problematizing research on the achievement gap. *Journal for Research in Mathematics Education*, 39, 357-364.
- Gutiérrez, R. (2009). Framing equity: Helping students “play the game” and “change the game.”. *Teaching for Excellence and Equity in Mathematics*, 1(1), 4-8.
- Hand, V. (2012). Seeing culture and power in mathematical learning: Toward a model of equitable instruction. *Educational Studies in Mathematics*, 80, 233-247.
- Jacobs, V. R. (2017). Complexities in measuring teacher noticing: Commentary. In E. O. Schack, M. H. Fisher, & J. A. Wilhelm (Eds.), *Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks* (pp. 273-279). New York, NY: Springer.
- Jacobs, V. R., Lamb, L. L. C., & Philipp, R. A. (2010). Professional noticing of children’s mathematical thinking. *Journal for Research in Mathematics Education*, 41, 169-202.
- Jong, C. (2017). Extending equitable teaching practices in teacher noticing: Commentary. In Schack, E. O., Fisher, M. H., & Wilhelm, J.A. (Eds.). *Teacher Noticing: Bridging and Broadening Perspectives, Contexts, and Frameworks* (pp. 207-214). New York, NY: Springer.
- Jong, C., Schack, E.O., Thomas, J., Fisher, M.H., & Dueber, D. (2021). What role does professional noticing play? Examining connections with affect and mathematical knowledge for teaching among preservice teachers. *ZDM Mathematics Education*, 53(1), 151-164.
- Kalinec-Craig, C. (2017). Everything matters: Mexican-American prospective elementary teachers noticing issues of status and participation while learning to teach mathematics. In E. O. Schack, M. H. Fisher, & J. A. Wilhelm

- (Eds.), *Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks* (pp. 215-229). New York, NY: Springer.
- Lefstein, A. & Snell, J. (2011). Professional vision and the politics of teacher learning. *Teacher and Teacher Education*, 27, 505-514.
- Louie, N. L. (2018). Culture and ideology in mathematics teacher noticing. *Educational Studies of Mathematics*, 97, 55-69.
- Louie, N., Adiredja, A. P., & Jessup, N. (2021). Teacher noticing from a sociopolitical perspective: the FAIR framework for anti-deficit noticing. *ZDM-Mathematics Education*, 1-13.
- Mohammed, G. S., Wakil, K., & Nawroly, S. S. (2018). The Effectiveness of Microlearning to Improve Students' Learning Ability. *International Journal of Educational Research Review*, 3, 32-38.
- Moll, L., Amanti, C., Neff, D., & Gonz lez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice*, 31, 132-141.
- Santagata, R., & Yeh, C. (2016). The role of perception, interpretation, and decision making in the development of beginning teachers' competence. *ZDM-Mathematics Education*, 48(1-2), 153-165.
- Van Es, E., Hand, V., & Mercado, J. (2017). Making visible the relationship between teachers' noticing for equity and equitable teaching practice. In E. O. Schack, M. H. Fisher, & J. A. Wilhelm (Eds.), *Teacher noticing: Bridging and broadening perspectives, contexts, and frameworks* (pp. 251-272). New York, NY: Springer.

CONCEPTUALIZAR MÓDULOS DE MATEMÁTICAS QUE INTEGRAN LA MIRADA PROFESIONAL Y LA EQUITAD