Move Towards Discourse Rich Mathematics Through Action Research

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Abstract

This paper explores the need for teacher development considering the typical ways of teaching mathematics are not aligned to common reform efforts and disciplinary practices. It takes a sociocultural perspective of learning to link pedagogical decisions to students learning. I acknowledge the role of teachers as a facilitator who negotiates tensions in efforts to support development of content knowledge in line with disciplinary practices. To conclude, I propose a design of an participatory action research, PAR, project to explore the implementation of whole group discussions investigating mathematics as introductions to instructional blocks.

Keywords: action research, classroom discourse, participation structures, mathematical literacy

A Move Towards Discourse Rich Mathematics Through Action Research

Fostering the development of mathematical literacy is one of the main tasks entrusted to educators. The typical American mathematics classroom experience implies a teacher-dictated participation structure is best suited for student learning. From this perspective, the teacher is the holder of knowledge and delivers a standardized curriculum through his or her discourse that dominates the classroom by policing conversation and guiding students' attention to aspects of content deemed important. Implementation of the now prevalent Common Core State Standards, CCSS, for Mathematical Practice (2010) requires educators to change this participation structure as students are expected to extend their mathematical knowledge beyond computation towards disciplinary practices like "construct viable arguments and critique the reasoning of others" and "look for and make use of structure". Having students engage in these practices means teachers need to become discourse facilitators who carefully negotiate social and academic tensions in their quest to promote mathematical literacy.

I intend to explore this dichotomy of my professional practice while I plan for continued professional development and consider my teaching practice. Research studing teacher learning has studied how teacher learning can occur through opportunities to investigate their own practice (Ball & Cohen, 1999; Cochran-Smith & Lytle, 1999; Horn, 2005; Shulman, 1987). I seek to refine understandings of my practice and of my students through classroom inquiry. While all of my experiences at Peabody College inform my thinking, the inspiration and foundation of this capstone project was established through my experiences investigating classroom participation structures and action research in EDUC 7140: Discourse in STEM Classrooms and EDUC 7810: Inquiry into Contexts. I will also utilize and build on ideas that I

considered in MTED 7330: Introduction to Mathematical Literacies. In this paper I will provide a brief overview of the theoretical underpinnings of my ideas and design by explaining the theories of learning informing my decisions, defining mathematical literacy in a way that responds to disciplinary practices, arguing for the importance of considering discourse in a learning community, and explaining my reasoning for designing an action research project. Lastly, I will present the design of my action research project.

Theoretical Underpinnings

Like many researchers, I propose using the sociocultural and the situated learning theories, that dictates learning and knowing are context dependent, to propose designing learning environments that more closely align to disciplinary practices (Lemke, 2001; Levinson & Holland 1996; Stigler & Hiebert, 1998; Foreman 2003; Lampert, 1990; Nasir, 2002). Here learning is seen through changes in participation in a community of practice (Lave, 1996; Lave & Wegner, 1991). Using a sociocultural approach allows educators to think about the links between pedagogical choices, student learning, and how learning happens in social context through communication (Forman, 2003). Thus, it is particularly useful for my goal to study the implications of discourse and the opportunities provided through participation structures for students' learning and development of mathematical literacy.

Mathematical literacy

Mathematical literacy is often conflated with computation and a fixed view of mathematical ability. This means students who have to the ability to solve problems with numbers quickly are good at math and others are not. This definition is limiting because it does not align to the disciplinary practices of mathematicians or challenge the problematic

homogenous treatment of mathematics that facilitates the subject being used as a gatekeeper to academic success, future educational opportunities, and future employment opportunities. Hersh (1993) challenges the status quo by explaining the essential activity of mathematicians, the activity of finding a proof, as the iterative process of presenting a mathematical idea to peers, having it examined for errors, and then revising mathematical ideas. I draw upon this idea to develop a broadened and refined definition of mathematical literacy that includes two interwoven components with heterogeneity as a central construct: *social disciplinary ways of acting* and *mathematical proficiency*. Together these not only reflect the disciplinary practices but also epistemic practices of mathematicians. I elaborate more on the teaching implications of social disciplinary ways of knowing as they will be key area I am attempting to address in my research design.

Social disciplinary ways of knowing. The overarching disciplinary way of acting is a mathematical disposition that encompases a *mathematical mindset* (Boaler, 2016) and a belief that mathematics is logical and worthy pursuit (National Research Council, 2001; Schoenfeld, 2007). This means students believe in their own ability to learn and make sense of mathematics and believe that learning mathematics has value for their lives. Having this mathematical disposition enables one to learn and use their proficiencies through mathematical ways of acting: representation, agency, and argumentation (Godfrey & O'Connor, 1995; Horn, 2008; Selling, 2016).

The social world of a classroom provides locis for identity formation and provide the context for participants to negotiate meaning (Holland, Lachicotte, & Cain, 1989). Students without a mathematical disposition are less likely to be willing to take the social and emotional

risks required in practices like argumentation or group discourse. One ways teachers can mitigate the social risks, is to frame mistakes as natural and a resource for learning. To do this, a teacher might assign students competence for sharing a mistake because it provided the class an opportunity to learn through fleshing out important mathematical concepts. When one's mathematical competency is not evaluated by a correct answer, students will further develop their conceptual agency, or the way one acts to negotiate their own methods and ways of thinking (Gresalfi, Martin, Hand, & Greeno, 2009). As students learn to use the epistemic practice of argumentation through classroom discussions with the goal of persuasion, they utilize their content knowledge and establish norms for what counts as good argument (Ryu & Sandoval, 2011). In this way students transform their understanding of mathematics and what it means to do mathematics through their participation in mathematical discourse.

Mathematical proficiency. Disciplinary practices, like sustained argumentation, require the specialized mathematical knowledge that comes with mathematical proficiencies. Mathematical proficiencies include: knowledge about procedures, pattern recognition (Cuoco, 1996), and contextualization and decontextualization (National Research Council, 2001). One example of how the strands of mathematical literacy are interwoven occurs when using one's knowledge about procedures is seen through disciplinary agency, or the norms of mathematics, while supporting pattern recognition and aiding the ability to participate in the social practice of argumentation by facilitating the analysis of mathematical thinking (Cuoco, 1996; Selling, 2014).

Equity implications. Considering the situated nature of knowledge, It is a false assumption that mathematics is devoid of culture. Although, enculturation is assumed to happen in our schools, the great disparity in achievement among racial groups proves this not true.

Nasir's (2002) study complicates the deficit cultural narrative of the achievement gap problem as one where the issue is not inherent in the students but is in fact one of misalignment between school and home cultural practices. This is in part due to a narrow view of mathematics. Since, the valued ways of thinking and representing in the USA are founded in its eurocentric dominant culture, those in the dominant group are provided more access and opportunities. For example, the formation of a mathematical disposition can be dependant on relevance to one's critical and community knowledge (Gutstein, 2007). Educators want students to adopt the identity of a professional by "taking on the common values, language, and tools" used in the discipline (Lampert, 2009 p. 29). Considering this, for equitable development of mathematical literacy, we must expand learning environments beyond the dominant culture's ways of knowing. There is no silver bullet for these issues as teachers must be diligent in negotiating tensions.

Discourse and Participation Structures

Brown, Collins, and Duguid (1989) argue that "knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and used" (p. 32). Since discourse is the main way through which communication and learning occurs, looking at participation structures that organize discourse allow researchers to investigate the ways social negotiations produce barriers to or provide opportunities for conceptual development, access to ideas, and identity formation. Discourse is directly connected to the classroom culture, which results from the social norms, participation structures, framing of competency, and delineation of power dynamics within the learning environment (Horn, 1999; Wood, Williams, & McNeal, 2006; Gresalfi, Martin, Hand, & Greno, 2009).

Socio-cultural theories insist that studying learning activities calls for the need to study the context of learning itself (Sfard, 1989, pg.6). In other words, students' understandings of mathematics and their perceptions of their own abilities are greatly shaped in the social minutia and activity systems of daily classroom life. Lampert (1990) defines participation structures as

> "the allocation of interactional rights and obligations among participants in a social event, it represents the consensual expectations of the participants about what they are supposed to be doing together, their relative rights and duties in accomplishing tasks, and the range of behaviors appropriate within the event." pg. 34

Classroom participation structures provide a framework for typical ways, the rights, and responsibilities, provided through activities (O'Connor & Michaels, 1993). The activities teachers employ frame who and when participants get to talk, what roles they can take when talking, the expectations for actors. Students positionality in relation to content matter is directly impacted by the negotiations of classroom participation structures and teacher facilitation (Forman, 2003; Horn, 1999; Rosebery et. al 2010).

Implications

These conclusions call for the investigation and design of participation structures that facilitate equity and the development of mathematical literacy. Many reform efforts have refuted the logic of traditional didactic discourse structures seen in acquisition theories of learning and promote student led, participation theories. However, Sfard (1989) introduces nuance to this by arguing both participation and acquisition theories have their own downfalls but they can best reduced by utilizing both theories in instruction. "A dictatorship of a single ideology, may lead

to theories that serve the interests of certain groups to the disadvantage of others" (Sfard, 1989, p.11). Zevenbergen's (2000) research illustrated this idea when the overutilization of an authoritative discourse based in the acquisition theory led to students from the non-dominant culture to receive less access to important mathematical knowledge because their cultural patterns of discourse were misaligned to the school's interaction patterns. In contrast, Langer-Osuna (2011) discusses how through communication in a group participation structure one student was positioned as bossy and another was positioned as smart. Negotiating discourse participation structures is a difficult undertaking because it requires teachers to teach their content matter while simultaneously managing of social tensions.

For students to develop both social ways of knowing and mathematical proficiency they need learning environments, where instead of presenting students with content knowledge in its finalized form, teachers engage students in problem solving activities where they have opportunities to develop epistemic ways of thinking (Cohen, 2011). This can be done through allowing students to engage in group work with authentic problems and tasks where they collaborate to uncover mathematics instead of teaching students a strategy then giving them problems in which to practice the teacher strategy. This does not mean that students are exclusively learning through discovery. In negotiating the tensions between participation and acquisition, Jo Boaler (2016) explains that the questions is not "Do we tell methods?" but "When is the best time to do this?". Her review of research found that teachers should reverse the order of participation structures to engage students' intuition and excitement about mathematics by having students explore methods after exploring a problem and realizing the need behind the methods (p. 66). I plan on utilizing this participation structure when I introduce new

mathematical ideas through class discussions investigating problems. These discussion will be underpinned with Elham Kazemi and Allison Hintz (2014) four principles that should guide classroom discussions:

1. Discussions should achieve a mathematical goal and different types of goals require planning and leading discussions differently.
2. Students need to know what and how to share so their ideas are heard and are useful to others.
3. Teachers need to orient student to one another and the mathematical ideas so that every member of the class is involved in achieving the mathematical goal.
4. Teacher must communicate that all children are sense makers and that their ideas are valued. (p.2)

Teachers learn to manage the complex worlds of their classroom through making sense of their practice. I have designed an action research project where I implement discourse teaching strategies in order to support students mathematical literacy while considering how these participation structures influence formation or reification of students' identities and status.

Action Research Design

Ball and Cohen (1999) recommends teacher learning to include tasks grounded in activities of practice and development of dispositions for inquiry. Considering these recommendations, participatory action research, PAR, is particularly suited to be a mechanism for teacher learning as it calls for teachers to investigate their work and has the potential to facilitate the developing specialized content knowledge and pedagogical content knowledge which act as bridge between content knowledge and the practice of teaching (Ball, Thames, &

Phelps, 2008). **S**tephen Kemmis and Robin McTaggart (2005) define PAR as a "social process of collaborative learning realized by groups of people who join together in changing the practices through which they interact in a shared social world in which, for better or worse, we live with the consequences of one another's actions" (p. 563).

Action Research Plan

To investigate the social context of my mathematics instruction, I designed my action research plan to facilitate systematic classroom research that is informed by expectations of education academic communities (Denzin & Lincoln, 2011; Erikson, 2006; Frank, 1999; Kemmis & McTaggart, 2005; Mills, 2014).

Identifying an area of focus and making a plan

My area of focus is looking at the design of discourse participation structures and lived experiences during mathematics instruction to consider the form and nature of opportunities and barriers for student participation. In preparation for the research project, I have read a variety of research addressing my focus area, including peer-reviewed articles, curriculum resources, and practitioner texts. I have utilized much of this research for the above literature review as well as created a triangulation matrix for the research project (see Appendix A). This preparation will facilitate my ability to reference any needed information quickly during research and set up the organization for me to write a report of my findings. Although I expect the questions and data sources will need alteration and refinement once I become familiar with my setting, I have developed a triangulation matrix to ensure each research question can be addressed through multiple sources of data (see table 1).

Research Questions	**Data Sources**		
In what ways are students able to participate in mathematics? 1. How are students engaging with each others mathematics ideas? 2. How do students explain their mathematical thinking? 3. What disciplinary practices do teacher moves facilitate?	Video	Peer observation field notes and debrief	Field notes
How do students perceive mathematics? 1. How do students define the discipline of mathematics? 2. How do students picture mathematicians? 3. What disposition do students hold in relation to mathematics?	Video	Peer observation field notes and debrief	Student Interviews and surveys
How do my design of instructional activities allow or disallow for equitable participation? 1. Is there culturally sensitive third spaces in which students become mathematically literate?	Video	Peer observation field notes and debrief	Field notes

Table 1. Triangulation matrix for research questions and data sources.

Develop a timeline. In EDUC 7810: Inquiry into Contexts, I began my research project utilizing Mills' (2014) dialectic action research spiral but soon learned the work called for a less linear and defined sequence. Therefore, I have planned this project to utilize Mills' process stages, *(1) identifying an area of focus, (2) collecting data, (3) analyzing and interpreting data, and (4) developing an action plan,* in the simplified, circular and iterative manner depicted by Stephen Kemmis and Robin McTaggarts (2005) research spiral (see figure 1). Acknowledging this from the

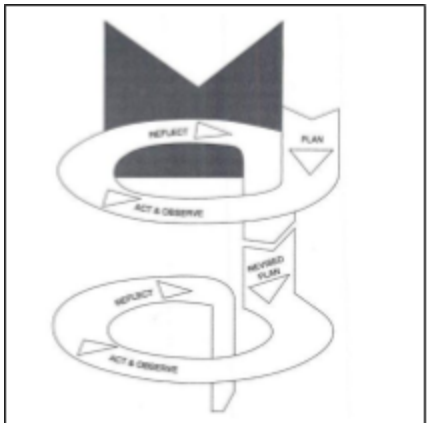

Figure 1. The Action Research Spiral. Reprinted from *Participatory Action Research* (p.564), by Kemmis & McTaggart.

beginning, will enable me to plan for, anticipate, and inact reflection and refinement stages.

If I am to enact this plan during the 2018-2019 school year, I will be working in a new school context in a classroom with students in one of the elementary grades. Considering I will be a newcomer to the learning community, I have planned my first phase for the first three months of the professional school year, June to October. During this time, I will gain insight into my area of focus for my context through descriptive activities for reconnaissance (Mills, 2014, p.45). In the second phase, from November to January, I will focus on my initial data collection. This will include implementation of math talks at start every class utilizing a whole group participation structure and planning strategies promoted by Elham Kazemi and Allison Hintz (2014) in their book *Intentional Talk*. During this time, I will work with my partners to collect preliminary data during these instructional times. In the beginning of February, we will reflect on our findings and make adjustments to our plan and questions. Then, in the remainder of February and through March, I will enact the refined plan and collect more data. I have intentionally front loaded the research timeline to the beginning of the year to allow for any adjustments to be made and to avoid data collection during end of the year standardized testing. In acknowledgement of the demands of teaching and how I do my best writing when I have less demanding distractors, I will utilize the summer to further reflect on my findings as I write a report.

Stage 1: Investigating the context and planning

Prior to the start of school, I will study school and district instructional materials, take field notes during events, and conduct informal ethnographic interviews with peers and local stakeholders to learn about the theories, beliefs, assumptions, and historical contexts embedded

in the social world of the school that will inevitably influence my practice (Frank, 1999; Mills, 2014, p. 44).

As a teacher new to the district, I will be required to attend professional development meetings before the start of the school year to promote induction into the norms and expectations of the district and school cultures. During this time, I will attempt to make visits to my future students homes. I will employ an ethnographic perspective by seeking to be thorough, systematic, and objective. Ethnographic research attempts to understand people's lives and cultures of people by looking overtime through an insider's perspective (Frank, 1999). One way I will do this is by implementing the note taking/note making method for descriptive field notes. This way I am attentive to separating my observations from my interpretations. Frank (1999) warns, that culture cannot be understood solely through observation, it must be paired with interviews. When possible, I will conduct informal interviews and record notes in a field journal at the end of each day. To address the collaborative nature PAR, I will take advantage of this time to seek out like minded teachers or academics to partner with as critical friends.

In the first few weeks, I will engage the class in activities that flesh out student's mathematical mindsets, build relational trust, and set norms for class discussions. To gather information relating to students' beliefs about mathematics, their abilities, and how they perceive their role as students through survey utilizing open answer questions and likert scales (see Appendix B). Before initiating a whole group discussion to establish math norms, I will give students independent think time by asking them to draw a picture of themselves doing math that they will share with the class (Kazemi & Hintz, 2014, p.132). This activity would provide time for students to gather their ideas to share when they are asked a question that is differs from the

typical classroom questions which have a right or wrong answer. Then, I will facilitate a discussion where we agree upon norms for math discussions and the students will then make a poster together listing and illustrating the agreed upon expectations (Appendix C). This poster will be utilized as a resource during the next phase by proving a tool to orient and remind students of our norms. After discussions like these, I will journal in my field note journal to collect data. In line with the iterative and participatory nature of this PAR, my partner and I will review this data to refine our research questions, methods, and plans before moving on to the next stage.

Stage 2: Act and Collect

During these instructional months, the focus is on implementation of a new discourse participation structure and the collection of data during these lessons. Specifically, I will plan to open each math lesson with a brief, 15-20 minute, math talk following one of the Kazemi and Hintz's (2014) five targeted discussion structures based on my instructional goal for developing mathematical literacy (see table 2). During these discussions I will take into consideration the

Targeted Discussion Structure	**Goal**
Compare and Connect	To compare similarities and differences among strategies
Why? Let's Justify	To generate justifications for why a particular mathematical strategy works
What's Best and Why?	To determine a best (most efficient) solution strategy in a particular circumstance
Define and Clarify	To define and discuss appropriate ways to use mathematical models, tools, vocabulary, or notation
Troubleshoot and Revise	To reason through which strategy produces a correct solution or figure out where a strategy when awry

Table 2. Adapted from Kazemi, E., & Hintz, A. (2014). *Intentional talk*, p. 3.

ways that I can promote a mathematical disposition through the framing of the work of mathematics. These targeted discussions provide discourse participation structures that focus on achieving a mathematical goal. When planning for these I will utilize the planning templates in *Intentional Talk* and consult my research collaborative planning team and research partner (p. 137-141). Discourse moves by teachers and students provide epistemic resources, or ways for students to make sense of mathematics (Zimmerman et al., 2009). Teacher talk moves can have many purposes, like: orienting students to the important mathematical concepts or each other's' ideas, assigning students competence, pressing for conceptual thinking, or to establish and affirm norms for argumentation. (Cazden 2001; Horn, 2008; Kazemi & Stipek, 2001). While I am teaching, there are many aspects I must simultaneously consider beyond my instructional goals of a given lesson like, student behavior, lesson pacing, interruptions, and accommodations required by IEPs. To support my ability to ground discussions in the instructional goals of facilitating productive and equitable classroom discourse, I compiled findings and recommendations from discourse research into a one page resource that explains teacher talk moves and their uses (see Appendix C). I will keep this resource in my planner that I often hold or have near me while teaching to reference in preparation to and during math talks. I will continue to add to and refine this resource as I try out new teacher talk moves and discuss options with my peers.

As the main teacher, I take on the role of an active participant observer and will need to be fully immersed in my teaching (Mills, 2014, p. 85). This means, for realistic collection, my sources of data must be either passive on my part, like video or peer observation, or post lesson. I will video record at least one fifteen minute math talk lesson a week. I will choose which

lesson to record based on the lesson goal to ensure I look across the various types. This will enable generalizations to be made relating to math talks and not just individual lesson goals. If possible, I will ask my research partner to observe several lessons and field notes. I will also reflect daily in a field note journal.

Stage 3-5: Preliminary Analysis, Refinement, & Analysis

Preliminary Analysis and Refinement

During these stages, I have planned for analysis of preliminary data. These analyses will be used to seek out areas that need adjustment. During these conversations, I will take a reflective stance where I try to analyze the ways I have been thinking about teaching and learning and search for links between my beliefs and the analysis results. Working with a team member during analysis stages will greatly increase my ability to address biases I have when looking through the data. We will organize, read, and make memos on the data we have collected thus far. Then I will use the data to write a comprehensive description of the participants, setting, and phenomenon being investigated to paint picture of the context that is being investigated (Mills, 2014, p. 133). We will reflect on our findings and make adjustments to our math lessons, data collection plan, and questions as needed. Then, in the remainder of February and through March, I will enact the refined plan and collect more data.

Analysis

I will continue to take a inductive, or whole-to-part, analysis approach. Utilizing Mills (2014) recommendations for qualitative data, I will first read over all of the data collected and make memos. When sorting data, I will not only consider instances that are of particular interest but also ones that are reflective of the the larger data set (Erikson, 2006). This will help me

consider emerging codes and themes from both macro and micro perspectives. Then I will start classifying the memos into codes and use methods like a conceptual webs to organize my codes into themes. I expect this to be an iterative process where I also go back and look at small sections of data to ensure trustworthiness of my analysis.

Reporting & Action Plan

In my writing I will state my beliefs & acknowledge that these beliefs play into my interpretations of the data. Denzin and Lincoln (2001) argue that objectivity doesn't exist because what I know is shaped by who I am and what I know shapes who I am. While my position in the school increases my access and ability to conduct this type of research that it also influences my analysis and interpretation of data.

Reporting is a key part of action research as it holds me, the researcher, accountable to a larger community and can place my work in conversations with others. I also know the act of formally writing about my action research will be a generative activity that helps me think deeply about my findings and create an action plan for the next school year. The action plan is a crucial aspect and largely represents the purpose of undertaking a PAR project because it will enable me to improve the educational experiences of my future students.

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Appendix A

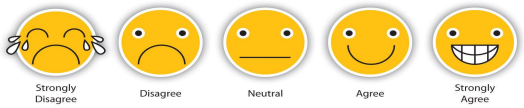
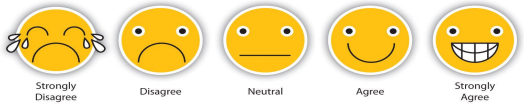
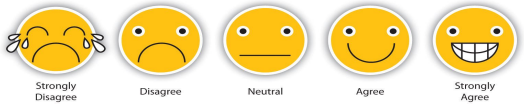
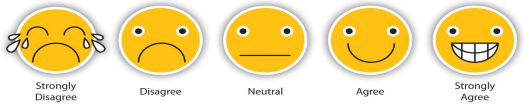
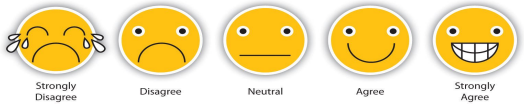
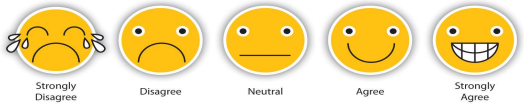
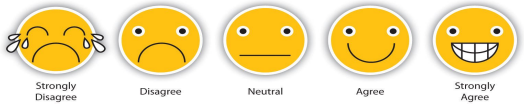
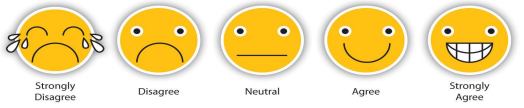
Literature Matrix

Resource	Discourse	equity	norms	Mathematical disposition	Mathematical literacy	Participation structures	Practical Application for planning	Research Methods
Cazden (2001)	x		x					
Boaler (2016)		X inequity in homework		x	x	x	x	
CGI (2015)	x		x		x	x	x	
Hand (2010)		x		x		x		
Horn, (2008)	X argumentation	x	x	x		x		
Intentional Talk (2014)	x				x	x	X	
Kazemi & Stipek (2001)	x		x		x	x		
Frank, C. (1999)								x
Lemke (2001)	X social interaction	X						
Mills (2014)							x	x

*Adapted from Mills, G.E. (2014) pg. 67

Appendix B: Student Inventory

*Adapted from Kazemi & Hintz (2014) and Flessner (2009)

1. I enjoy math.	
2. Learning math will help me later in life.	
3. Do you see math in the world outside of school?	
4. I believe you can change how smart you are.	
5. I learn from my mistakes in math.	
6. I enjoy sharing my math strategies in class.	
7. Listening to other students' strategies helps me.	
8. I think some people are good at math and others are not good at math.	

9. What does it mean to be good at math?
10. Something I wish my math teachers could know about me is:

Appendix C: Activities to set norms as a class

Draw a picture of yourself in math class. Be ready to share your ideas for the picture with the class.

Example of classroom discourse norm posters:

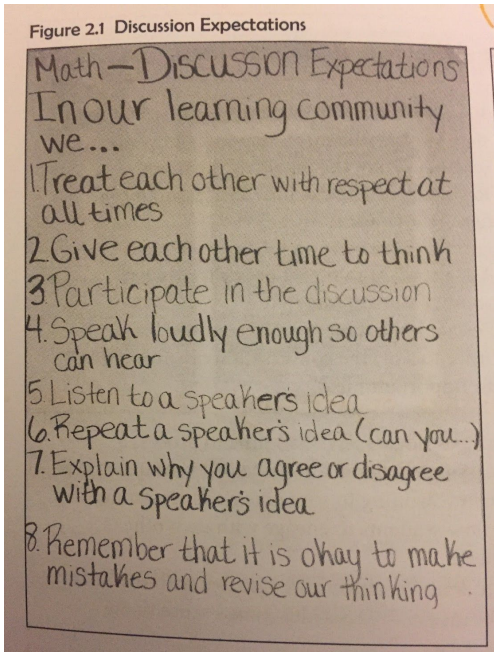


Figure 2.1 Kazemi, E., & Hintz, A. (2014) p. 22

Appendix D

Resource for quick reference during whole class discussions.

Talk Moves to Support Classroom Discussions	
Inviting "____, would you like to share your strategy with the class?"	**Uses:** gathering strategies; encouraging students to make claims **Recommendations:** consider asking students while monitoring independent work or turn and talk if they are willing to share; promoting conceptual agency;
Revoicing *"So, I'm hearing ___ say…"*	Can be a direct or indirect quote (repeating, rephrasing, summarizing or elaborating); ask student to verify accuracy of my depiction **Uses**: rebroadcasting idea, expansion, naming authorship, assigning competence, position students in relationship to content and/or eachother; orienting students to common ground when exploring new ideas; encouraging use of academic language;
Repeating *"Who can repeat what ___ said in their own words?"* *"Who can explain ____ part of what ___ said (using their picture)?"*	Students repeat or rephrase other's ideas. **Uses**: provides opportunity to hear ideas again; reinforce important aspect of a complex idea; slow down conversation
Reasoning *"Why does ____ make sense?"*	**Uses:** building consensus; promoting questioning mathematical ideas; engaging students with eachothers ideas, showing value and

"Does anyone have a question they want to ask ____ about their strategy?" *"Do you agree or disagree? Explain why?"* *"How did ____ (tool) help you understand ___?"*	the sense behind mistakes; promoting disciplinary agency; promoting persuasion **Recommendations**: provide process time first; establishing norms for justification; can be used to encourage sustained argumentation
Adding On " Would someone like to add on to this?" "Can you explain what you meant by___?"	Prompting students to participate and engage in another's idea or asks a student to clarify their thinking **Uses:** clarification, fleshing out ideas, hold accountable to disciplinary norms (press for evidence based explanations); **Recommendation:** establish a common ground and then use it as foundation for new inquiry & discussion
Wait Time *"Take your time…"* Not speaking for a prolonged time	**Uses:** provide processing time, students self selecting speaking rights; **Norm building:** conversation doesn't need to flow through teacher
Turn-and-talk "Explain how you understood ____'s strategy to your partner"	**Uses:** orients students to each other's thinking, brings all students into the conversation, teacher listens and decides who should share in whole group, students clarify and share ideas,
Revise *"Has anyone's thinking changed?"* *"Would you like to revise your thinking?"*	**Uses:** promoting growth mindset; defining mathematics as a process;

For this resource, I adapted Kazemi & Hintz (2014) chart using ideas from: Cazden, C. (2001), Forman (2003); Gresalfi, Martin, Hand, Greeno (2009); Staples, M. (2007); Wood, Williams, & McNeal (2006)