EXPLORING THE MEDIATING ROLE OF TEACHER EXPECTANCY ON PARTICIPATION IN WHOLE CLASS MATHEMATICS DISCUSSION

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Teacher expectancy (TE) refers to the inferences that teachers make about academic achievement, and future career choice of their students, it is a teacher level variable, and it mediates the teacher-student interaction. I hypothesize that the TE impacts the distribution of learning opportunities in 8th grade mathematics classes. So, I investigate the distribution of learning opportunities in terms of TE. An 8th grade class interaction is recorded (n =16), and investigated by using the EQUIP. The result of this study reveals that seven high expected students despite being the 35% of the class have 76.71% of entire student talk. In other words, a big chunk of the class interaction is only between teacher and high expected students.

Keywords: Equity & Justice, Middle School Education, Teacher Beliefs

Introduction

The mathematics education community has given explicit attention to issues of equity over the last 20 years. Gutiérrez defines equity as "the goal of being unable to predict student patterns (e.g., achievement, participation, the ability to critically analyze data or society) based solely on characteristics such as race, class, ethnicity, sex, beliefs, and creeds, and proficiency in the dominant language." (Gutierrez, 2002, p., 153). Regardless of the characteristics of students, all students should have the fair, not necessarily the same, chance to participate and learn.

Opportunities to learn mathematics are supposed to be accessible to all students rather than to a privileged few.

Students who have more opportunities to participate will learn more whereas students who participate less will learn less (Shah et al., 2021). The distribution of opportunities to participate in classroom discussions is an issue of equity. Equity in participation concerns equal and fair distribution of participation and opportunities to participate to the ongoing discussion (Ernest et al., 2019). Teachers, as the leaders of the classroom community, have power to distribute learning opportunities through how they structure participation. Yet, teachers, like all people, are not free of biases. Many studies report that pre-service and in-service teachers have implicit biases and attitudes toward their students from ethnic minorities and migrant families (Glock & Klapproth, 2017; Glock, et al., 2013). Teachers' evaluation of student potential is not necessarily accurate (Copur-Gencturk et al. 2020; Soto-Ardila et al., 2022). Teachers' implicit biases is one possible explanation for the occurrence of inequalities in our classroom. Some empirical evidence suggests that implicit biases impact students' academic achievement via Teacher Expectation (TE) (Van den Bergh et al., 2010). Teacher expectancy (TE) refers "inferences that teachers make about the present and future academic achievement and general classroom behavior of their students" (Good & Brophy, 1997, p. 79). Overestimated students will have more opportunities to participate and then likely learn more while, underestimated students will have less opportunities to participate and will likely learn less. Differential interaction occurs when some students receive different opportunities to interact or participate in class (Wang et al. 2018). This difference is mediated by the expectation the teacher has for the student. Therefore, students have different experiences based on what is expected from them.

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Current studies on inequalities and biases in mathematics classrooms investigate the pattern and the distribution of learning opportunities among students from different communities and backgrounds-- who participates and how are two important research questions that researchers want to understand. Researchers, commonly, compare participation and contributions of students with different identity markers such as race/ethnicity, class, and gender (Reinholz & Shah, 2018; Reinholz et al., 2020; Shah et al., 2021). The mathematics education community has learned a lot about ways inequalities occur in our classrooms. This work has been incredibly valuable in helping us better understand how markers such as race and gender can play a role in biases and thus in opportunities for students to participate in discussion. Yet, there may be other factors also playing a role in how opportunities are distributed by teachers. For example, Cohen and Lotan (2014) note that even in groups of people where the students are largely homogeneous regarding gender and race, for example, participation is not equally distributed. Inequalities and status orders quickly emerged within a group of four to seven white male Harvard sophomore students. Despite the initial similarities and homogeneity of the group, the status order emerged quickly, and the contributions of members were not distributed equally (Bales, 1950). According to Bales (1950), group members tended to consider the most talkative members as the one who contributes most and significantly; whereas they tended to consider quiet group members as the one who had the least significant ideas. Following the logic of that example, two students from a similar set of identity and demographic markers might still have very different characteristics in other regards and thus each student might have very different interactions with the teacher. That is, teachers might be picking up on characteristics not related to race and gender. This is not to suggest that race, for example, is not important; merely that in the absence of race, for example, as a distinguishing characteristic, teachers may be forming expectations using other features. In other terms, TE mediates the interaction between students and TE can be formed in the absence of obvious demographic distinctions. If we want to understand the inequalities within our classroom, we should take into consideration TE and the dyadic interactions between students and teacher. In this study, I aim to explore TE in a classroom environment where the students are largely homogenous with regard to race, gender, and language and attempt to better understand how TE develops and mediates classroom participation.

The Mediating Role of Teacher Expectancy

Teacher expectancy is a teacher level variable, and it's impacts on students' academic achievement is well reported (De Boer et al., 2018; McKown & Weinstein, 2008). It mediates the interaction between students and teacher where teachers interact more favorably with students whom they believe have the potential to succeed and less favorable/less frequent interactions with the students they believe have less potential for success and is well supported in teacher expectancy literature (İnan-Kaya & Rubie-Davies, 2021; Wang et al., 2018). Once teachers form their expectations for their students, they start interacting with their students differently. High-expected students tend to have more positive interactions (more frequent eye-contact, smile, etc.) with teachers, whereas the low-expected students have negative or less positive interactions (less frequent eye-contact, smile, etc.). Teachers tend to give high expected students more opportunities to demonstrate their thinking (being called to explain their idea), and low-expected students have less opportunities to do so (Good & Brophy, 1978).

Based on the aforementioned literature, I hypothesize that TE influences the distribution of learning opportunities in an 8th grade mathematics where racial, gender, and language characteristics were stable. This study aims to explore TE's role in mediating participation

opportunities in a setting where demographic features are more homogenous across the group of students. Therefore, the RQ of this study is the following:

How are the learning opportunities distributed across individual students based on teacher expectation?

Method

Framework

This study adopts the Motivation and Opportunity as Determinants model (MODE; Fazio & Olson, 2003). This model says we usually make decisions in two separate but related ways: (1) deliberate and (2) spontaneous.

The deliberate decision-making process refers to the idea that when there are sufficient time and resources available people make their decisions based on careful thought process and evaluations. The deliberate process is data driven decision-making. An individual considers the potential advantages or disadvantages of the situation with all the resources available to them, then they choose a best course of action. On the other hand, most of the social actions and decisions that people make in their lives happen in the absence of time and necessary resources-which is where spontaneous decisions occur. People make this kind of decision when they must respond immediately and do not have time and resources to consider the consequences of the choice that they make. In this kind of decision-making process, which happens spontaneously, their beliefs and attitudes toward the subject influence the decision that is being made. Once beliefs are activated in the decision-making process it will serve the role of a "filter". The positive attitudes usually help individuals to attend and notice the positive aspects of the subject. Whereas the negative attitudes will influence individuals to attend the negative side of the subject (Fazio, 1990; Fazio & Olson, 2003).

Data

The participants of this study include a Turkish mathematics teacher, and her 8th grade female students (n = 20). The teacher is teaching in a religious-oriented school in one of the southern provinces of Turkey. The teacher has more than 15 years of teaching experience. She is well respected among her colleagues, and she is pursuing her doctoral degree in mathematics education. The 40% percent of the students (n = 8) are Turkish, and the rest of the classroom (n = 12) have migrated to Turkey from Syria. The class was a fairly homogeneous environment with regard to the parent education, income, and other variables. All students are fluent in Turkish which is the language of the instruction. After obtaining the ethics board approval the teacher rated each student on a scale of 1 (very low) to 5 (very high). Each category represents the potential track that the students might have to go for high school. *High expected students* (n = 7) implies that they might go to elective high schools, *neutral expected students* (n =3) means that they might go to unselective academic high school, and the low *expected students* (n =10) might go to vocational schools, or they just stop having a formal education.

In order to understand the potential influence of TE on classroom participation, the class lessons were recorded (n =16) during Fall 2022. The recordings are being investigated by using the classroom observation tool, EQUIP (Reinholz & Shah, 2018). EQUIP captures and analyzes seven dimensions of classroom talk. (1) Discourse type, (2) the length of student talk, (3) the type of student talk, (4) the method of teacher solicitation, (5) wait time, (6) type of teacher solicitation, and (7) explicit evaluation. The table-1 shows the seven dimensions, and subcategories of EQUIP.

The key idea in this study is to find the participation ratio which compares the actual distribution of learning opportunities for high expected and low expected students and the

predicted distribution which assumes equal opportunity regardless of TE. For instance, the teacher identifies 35% of the class is considered high TE, 10% of neutral expected and the rest which is 50% of the class is considered low TE, then the predicted distribution would be that the high, neutral and low TE students, respectively, 35%, 15%, and 50% of the learning opportunities. If the actual distribution differs statistically significant (i.e., if the high TE students get 50% of the questions) from the predicted, there is reason to suspect that the learning opportunities are not distributed equally.

The influence of Teacher Expectancy to the classroom

Kruskal-Wallis which is non-parametric alternatives of one-way ANOVA is conducted to test the distribution of students' total number of participations is influenced by the TE. The results of the Kruskall-Wallis test reveals that there is a significant difference between the total number of participation and TE ($X^2 = 14.384$, df = 2, p-value = .0007527 < .05). In order to establish the relationship between the TE and the classroom participation the simple linear regression with the Heteroskedasticity-Consistent Standard Error. The model is significant and it explains the nearly 83.36% data ($F_{(2,16)} = 40.07$, p-value = 5.884e-07 < .05). The model is as follows:

$$Participation = 4 + 65.667 * NeutralExpectation + 124.429 * HighExpectation$$

According to the model being a neutral expected students means having a 65.667 more learning opportunity than the low expected students. Similarly, being a high expected students means on average having 124.429 more learning opportunities than the lower expected students.

Table 1: Dimensions of EQUIP

Dimension	Level
Discourse type	
	Content Logistics
Length of Student Talk	1-4 words 5 – 20 words 21 or more words
Type of student talk	What How Why Other
Method of Teacher Solicitation	Random selection Called on Not called on
Wait time	More than 3 seconds Less than 3 seconds NA

Type of Teacher Solicitation	Why How What Other
Explicit evaluation	Yes No

Results

Distribution of Length of the Student Talk

During the recordings students had 1172 opportunities to participate in the ongoing mathematical discussion. The teacher has high expectations from seven of her students which is 35% of the total number of students, and these seven students have contributed 76.71% of the total student contributions (n = 899) to the ongoing mathematical discussion. The neutral expected students (n= 3) are responsible for 17.83% (n = 209) contributions, and the low expected students (n = 10) had only 5.46% (n = 64) of the opportunities that occurs during the recordings. The table 2 summarizes the distribution of the student talk with respect to the TE and the migration status.

Table 2: Distribution of Student Talk

	High Exp. (35%)		Neutral Exp. (15%)		Low Exp. (50%)		Native (40%)		Migrant (60%)	
	Exp. Distr.	Obs. Distr.	Exp. Distr.	Obs. Distr.	Exp. Distr.	Obs. Distr.	Exp. Distr.	Obs. Distr.	Exp. Distr.	Obs. Distr.
Student Talk	35%	76.71%	15%	17.83%	50%	5.46 %	40%	58%	60%	42%

As it can be seen in the table 2, native students have contributed 58% of the entire student talk whereas the migrant students have only 42% of student talk. The native students despite being a smaller group, they have more opportunity to participate than the migrant students.

However, a bigger difference lies between the distribution based on the expectation. The high expected students despite being only 35% of the entire class they are responsible 76.71% of total student talk, and neutral student have 17.83% and the low expected student have only 5.46% of the student talk, despite being half of the classroom.

By default, EQUIP captures three levels of student talk: 1-4 words, 5-20 words, and 21+ words. *1-4 words* is a strong indicator of traditional Initiation-Response-Evaluation (IRE) pattern, and the *5-20 words* is roughly a sentence, and it is beyond the IRE pattern, but it is not considered as a high level of participation. *21+ words* is a very strong indicator of student mathematical thinking. A big portion of the length of the student talk is between *1-4 words* which is a strong indicator of IRE. 82.76% (n = 970) of students' participation were low level participation, and it was between *1- 4 words*. Of student talk that were *1-4 words* the high expected students were responsible for the 77.94%, the neutral expected students are responsible for 18.87% and the low expected student, despite being the half of the class, only have only 3.20% of the low-level participation. The distribution of high-level learning opportunities is also similar to the low-level participation. The high level-participation typically occurred when the teacher gave her authority to a student to solve a problem at the board individually. Of those, high expected students have 68.64% (n = 81), neutral expected students have 11.02% (n = 13), and low expected students have the rest 20.34% (n = 24) high level participation opportunities that occurs during recordings.

Distribution of Teacher Solicitation Method

In this particular classroom, the high expected students (n = 7) have more learning opportunities than the neutral (n = 3), and low expected (n = 10) students. The high expected students have 76.70% (n = 899) of total learning opportunities that are identified and recorded. They have more academic interaction with their teacher not just because they are given more opportunities, they also seek opportunities to participate.

A little over 68% (n = 798) of the total learning opportunities that were recorded in this class were not called on explicitly by the teacher. The teacher frequently uses a modified version of IRE where she asks a question to the whole class to make sure her students/ or a group of students are following her. In this case, she just wants to hear a response. Usually, the response comes from high expected students. Moreover, high expected students share their thinking and knowledge without any teacher solicitation. They want to show their knowledge and mathematical thinking to the teacher. The distribution of *not called on* is skewed toward the *high* (n = 7) and *neutral* (n =3) expected students. Together the neutral and high expected students have almost 97% total *not called on* learning opportunities (n = 798). The neutral expected students (n = 3) have 17.17% (n = 137), and finally the high expected students (n = 7) are responsible for the 79.82% (n = 637) of the classroom participation without being called by the teacher. Low expected students (n = 10), despite being half of the class, have only 24 opportunities to participate without being called on which is equivalent to a little over 3%.

The interaction diagram

The results of this study indicate that the high expected students have more opportunities than the neutral and low expected students. They have more opportunity to participate than the low and neutral expected students. They have more interaction with the teacher. In order to illustrate the distribution of the learning opportunities based on TE. The following graph summarizes the student teacher interaction. In the graph each node represents a student, and the shape of the nodes represents the expectation. The teacher's solicitation is used as an edge between nodes, and the width of the edge is the average number of teacher's solicitation in a class time. The Figure 1 represents the teacher student academic interaction in total 16 class time.

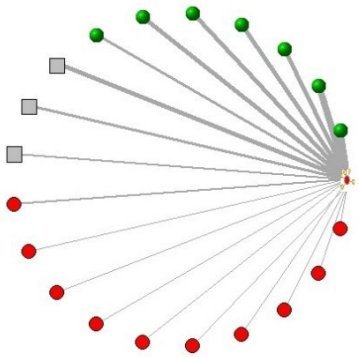

Figure 1: The teacher-student interaction pattern

As it is clearly seen that spheres nodes (high expected students), have more interaction with the teacher (raster) than the squares nodes (neutral), and circle nodes (low) expectations. In the graph the width of edges gets a steady increase if you start from the raster (teacher) and follow it from the clockwise all the way back to the raster. In other words, TE is almost perfectly aligned with the students' participation to the ongoing mathematical discussion.

Conclusion

First, the result of this study confirms the hypothesis that the distribution of the learning opportunities is influenced by the teacher's expectations. In this study high expected students have more opportunities than the low or neutral expected students. However, high expected students are not just given more opportunities they also ask more questions and seek every opportunity to participate more than others. The result of this study indicates that the dyadic teacher-student interaction is an important variable; however, most of the scholarship on the issue is coming from the late 70s and early 80s (Brophy & Good, 1970; Good, 1980).

Considering how much the population and our classroom have changed we need to update the knowledge on this issue. This area is also important because it tells us so much about the inequalities within our classroom, and it suggests a new perspective to explore the inequalities occurs in a classroom.

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