Inclusion and peer-collaboration in mathematics classrooms: the case of students' perspectives

Maria Vasilopoulou[1] and Chrissavgi Triantafillou[2]

[1, 2] National and Kapodistrian University of Athens, Athens, Greece

[1]vasilopouloumath@gmail.com; [2]chrtriantaf@math.uoa.gr,

This study aims to highlight students' perceptions of team collaboration in mathematics classrooms. We focus on students who expressed that they have an easy access to mathematics (GR1) and students who admitted that they struggle to get access to mathematics (GR2). Positioning theory is used to study participants' narratives about mathematics group work. Nine interviews were conducted, which were online. The interviews lasted about 1 hour. The analysis of research data was done with the help of grounded theory. The results indicate the following categories of participants' perspectives: Students' emotions while involved in peer-collaboration activities; *Students' role in peer-collaboration activities; Participants' setting rules on how and with whom to collaborate; Participants' rationale for collaborating with their classmates. Similarities and differences between the two groups were identified as well as their implications for promoting inclusion in peer-collaboration activities.*

Keywords: Inclusion, Peer-collaboration, Mathematics, Students' perspectives

Introduction

Inclusion is built on the principle that all students should be valued for their exceptional abilities and included as important members of the school community (Causton-Theoharis & Theoharis, 2008). Recent studies argue that students' collaborative learning, where small group of students work together to complete a mathematical task, could promote inclusion and equity in classrooms settings and affects students' identity as mathematics learners (e.g., César & Santos, 2006; Florian & Black-Hawkins, 2010; Kotsopoulos, 2014). Particularly, César & Santos (2006) argue that the role of collaboration in mathematics classrooms seems to facilitate students' positive attitudes towards learning and school achievement. Florian and Black-Hawkins (2010) suggest that teachers in inclusive practices should provide students with options to choose 'how, where, when, and with whom they learn', in conditions that are designed to respond to their individual needs. On the other side, students' experiences in collaborative learning activities may create roadblocks in the way they position themselves as mathematics learners (Kotsopoulos, 2014) while a 'distributed balance' between students' contributions in teamwork was identified by Dekker, Elshout-Mohr and Wood (2006). The last findings could create unequitable learning opportunities and a sense of not feeling included in the school activities for some students. Hence, the prerequisites for group work which are enacted in an inclusive manner remain still an open issue (Forslund Frykedal & Hammar Chiriac, 2018).

The current study focuses on how students are positioning themselves in peer-collaboration activities in mathematical classrooms. The participants are nine students ranging from 11 to 16 years old who

are placed in two groups (GR1 and GR2). Participants in GR1 are five students who feel competent in mathematics and participants in GR2 are four students who feel that they struggle to get access to mathematics. The two groups were distinguished in their own words. Additionally, some of them are certified by certain Greek institutions as gifted (GR1) or with mild disabilities in mathematics (GR2). We consider that all participants in this study are students with Special needs in Mathematics (SEM) (Scherer et al., 2019).

The research questions are: RQ1: what characteristics do we identify in all participants' perceptions when talking about their experiences from peer-collaboration in mathematics classroom activities? RQ2: which similarities and differences can we identify in two groups' members' perceptions?

By responding to the above research questions we expect to identify if and how participants' experiences on peer-collaboration activities might affect their *inclusion in* mathematics activities. We view inclusion as the equal opportunities for someone to participate and learn in mathematics classrooms (Esmonde, 2009; Civil, Hunter & Crespo, 2019).

Theoretical framework

We view students' perceptions about their cooperative learning under the *positioning theory* perspective (Harré & Van Langenhove, 1999). Positioning involves the process of ongoing construction of the self through personal storylines that describe relations and interactions of people jointly engaged in an activity. This research also draws on related research in mathematics that consider the potentiality of positioning in studying students' conceptions of what doing and knowing mathematics entails (e.g., Evans, 2003; Esmonde, 2009). In particular, researchers argued that students' perceptions and emotions about their participation in any classroom activity may form their positional identities as mathematics learners. Esmonde (2009) argued that students' positioning and identity-related processes are just as central to their mathematical development as their content learning (Esmonde, 2009).

Students' perceptions about peer-collaboration in mathematics classrooms

Since students' sense of belonging in mathematical activities seems to be critical for forming their positional identities as mathematics learners' researchers tried to understand and compare the experiences of different students in peer-collaboration activities. In Mulryan's (1994) study perceptions of high mathematical achievers with low achievers are compared. She concluded that both groups focus on the social dimension of the collaboration experience while high achievers emerged as having a more complex understanding of co-operative small-group work than did low achievers). Webel (2010) comparing the perspectives of two high school math students, showed up that both students see collaboration as knowledge transfer from capable students to struggling peers. Kanevsky, Owen & Marghelis (2021) studied mixed ability students' considerations that influencing their preferences for working alone or in collaborative settings. The results indicate that high ability students were more concerned about the content characteristics (e.g., efficiency and quality of their work) while others were more concerned about the social characteristics (e.g., potentiality for fun) in this type of school activities. Kotsopoulos (2014) study how one student (Mitchell) experienced his peers' rejection of his contributions for solving a mathematical task. Mitchell reacted in how his peers were positioning himself by taking a 'silence' stance. In this way he created a wall between his mathematical thinking and his involvement in the peer-collaboration activity.

The above outcomes highlight the critical role of different students' perceptions about peer collaboration activities. In this study we try to highlight how two groups of students, who viewing in different ways their involvement in mathematical activities (struggle to gain access and have an easy access) position themselves in peer-collaboration activities and how these positions might affect their inclusion in mathematics classroom activities.

Methodology

This study is a part of PhD program which aims to highlight issues of inclusion in the Greek mathematics classrooms. Even though in Greece, according to law 2817/2000 inclusive education is a legitimized school obligation to facilitate all students' educational needs for many Greek teachers, this is still a challenging issue when trying to accommodate different types of students' needs in mainstream classrooms (Avramidis & Kalyva, 2007).

Participants

The participants were nine students who voluntarily participated in this study. The nine students were placed in two groups. The first group, which we call GR1_stX (Group 1, student X) includes 5 students who feel that they are competent in mathematics, and they feel that they understand them quicker than their classmates. Three of them are certified as gifted by the Hellenic MENSA association. The second group, on which we use the abbreviation GR2_stX (Group 2, student Y), consists of 4 students who feel that they struggle to get access to mathematics, and they think that their classmates are better than them. Three of them, are students who are certified with learning disabilities from training and counseling centers of the Hellenic Ministry of Education. The rest of them were placed in groups we formed based on the way they talk about their access to mathematics (in their own words). Students' grades vary from 5^{th} to 9^{th} grade (Table 1)

Table 1: Participants' profile

Name	Sex	Age	Class	Certified or Words
GR1_st1	Female	15	9^{th} grade	In their own Words
GR1_st2	Male	15	9^{th} grade	Certified
GR1_st3	Female	16	10^{th} grade	Certified
GR1_st4	Female	11	5^{th} grade	Certified
GR1_st5	Male	12	6^{th} grade	In their own Words
GR2_st1	Female	13	7^{th} grade	Certified
GR2_st2	Male	13	7^{th} grade	Certified
GR2_st3	Female	14	8^{th} grade	In their own Words
GR2_st4	Male	14	8^{th} grade	Certified

The researcher (first author) recruited the participants she was working with, as math tutor in three different institutions. The Hellenic Mensa Institution (certified students in GR1), a private Study

Center (certified students in GR2), and a Music School (students that admitted in their own words that they have an easy or a struggling access in mathematics). We have to mention even the former categories of students also expressed similar feelings.

Research Data

Nine interviews were conducted, which were online. The interviews lasted about 1 hour, and they were recorded after the researcher got permission from students' parents. In the beginning it was made clear to the participants that we are interested to identify instances that they feel included or excluded in mathematics classroom activities. We used open-ended questions, to build upon and explore their responses so students themselves to be able to reconstruct their experience within the topic under study. The interview consisted of three main areas of students' experiences : a) about specific mathematical lessons and tasks e.g. "*on which mathematical task did this happen*?", or "*give me more details about this lesson*"; b) about instances of mathematics teaching (e.g. "*describe a case in which you felt you were actively involved in the lesson and how often does this happen?"; "are there cases where you think that you could be involved but you didn't have the chance?'; "what is your opinion of an ideal math lesson?"*; c) about peer-collaboration activities (e.g., *"do you prefer to work alone or with your classmates?"; "What kind of working groups you want to be part of and why? " "If were a teacher, in what ways you could form a group?"*). In this article, we are focusing on data as regards the last area. Through students' answers, more close questions emerged about their perceptions or/and their preferences in learning conditions.

Data analysis

Giving a voice to students is the main concern, because discourse is socially constructed, and words have meaning when used by participants. The analysis of research data was done with the help of grounded theory. Specifically, our study is lined up with Charmaz's (2006) approach in which feelings and views of the participants are emphasized and make sense depending on readers' and researchers' perspectives, practices, and purposes. The analysis of the data was carried out in four steps. Firstly, students' interviews were transcribed. In the second step of the analysis, we distinguished parts of participants' interviews that refer to peer collaboration. In the third step, we tried to focus on the main issues that characterize participants' positions about collaborating learning activities. In this step, categories of participants' positions emerged. These categories were under negotiation among researchers until the final categories were established. In this way, we tried to respond to the first RQ. In the last step, we tried to focus on differences in two groups' perceptions about peer collaboration and respond to the second RQ of our study.

Results

Participants' perspectives about peer-collaboration

Through analyzing students' answers, we came up with the following categories of participants' perspectives: *Students' emotions while involved in peer-collaboration activities*; *Students' role in peer-collaboration activities; Participants' setting rules on how and with whom to collaborate; Participants' rationale for collaborating with their classmates.*

We present each category and characteristic students' responses

a) Students' emotions when involved in peer-collaboration activities.

Most students expressed positive emotions like 'happiness' or 'satisfaction' while collaborating with their peers. These feelings are related mostly with a positive outcome from this collaboration like 'helping the others understand'.

Some characteristic examples of both groups' responses are: "when they understand, I feel happy" (GR1_st1); "it's a good feeling, it is a satisfaction that I know that and I can help others" (GR1_st2); "I like math and I like to show what I know and help others understand" (GR1_st3);"I like to explain math" (GR1_st5); "I feel enjoyment and satisfaction when they have understood them" (GR1_st4); "I feel glad that I helped my classmate"(GR2_st1)

Only two students expressed negative feelings like 'dislike' or 'shame' or 'anxiousness': "I feel a little uncomfortable" (GR2_st1); "I don't want to…I feel ashamed. I'm a little anxious that the children will say something like 'look, you did it wrong' and staff like that… this is what happened when I was in elementary school" (GR2_st2)." Student GR2_st4 expressed an insider in the community feeling while participating in peer-collaboration activity "I felt that my classmates like me, otherwise they wouldn't tell me anything…they wouldn't help me… this means that I have an active role at school".

b) Students' perceptions of their role in peer-collaboration

We identified two participants' perceptions of their role during collaboration activities: as *helpers* (e.g., 'I explain' 'I share ideas') or *help receivers* (e.g., 'I am asking for their help').

Students that position themselves as helpers said: "Usually, my classmates ask for my help (laughs) […] I try to explain it to them […]" (GR1_st1); "my classmates ask me about their homework and how we might solve this exercise" (GR1_st3); "many of them who need help in math come to me" (GR1_st5); "if they ask for my help, I'll try to explain to them what they need, the best way I can, it doesn't happen a lot, It only happened once […]" (GR2_st4); "I just give them a little push when they have fallen behind." (GR1_st4). Other students position themselves as help receivers. Some characteristic examples are the following: "I am the one who asks for help a lot" (GR2_st1); "Yesterday I asked for their help since I couldn't figure out how exactly I would define x and y'' (GR2_st3).

c) Participants setting rules on how and with whom to collaborate

Some of the participants would prefer to work with others under certain conditions or rules.

Students GR1_st1 and GR1_st5 expressed the *No competition* rule especially when collaborating in mixed-ability groups. Characteristic responses: "I wouldn't prefer it to be a competition, it just makes me feel nervous. […] because I don't like to fail." (GR1_st1); "Not to be competitive […] if you fail you get really upset (GR1_st5). At the same time, the above participants' *no competition rule* hides their perception that a mixed-ability group is likely not to have a successful outcome.

Students GR1_st1 and GR1_st2 expressed the *collaborating with those who really want to work* rule regardless his/her mathematical competence.

GR1_st1: I wouldn't like to be in the same group with others who don't pay attention. I wouldn't mind if students who have difficulty were in my team, but not those who don't pay attention and want to copy my answers… in that case I just get angry

because I would probably end up doing the whole project myself as it happens many times in other courses' teamwork.

GR1_st2: I don't see it only with students who have the ability to learn easily, but with the ones who have an interest to work. Even if they have never studied math, but they want to contribute to the team, that's ok for me.

Student GR2_st2 expressed the *collaborating only with friends* rule: "I like sharing ideas with each other […] but only with my friends". No participant expressed rules for collaborating with students sharing the same math ability with high achievers in mathematics.

d) Participants' rationale for collaborating with their classmates

When students were asked if they prefer to work individually or in groups, they all tend to choose to work in groups and especially in mixed-ability groups. Here are some examples of their rationale for collaborating with their peers, which are linked with either *collective gains* ('team progress' or 'team building' or 'socializing') or *personal gains*. Analyzing students' words, two dimensions came up: *collective with specific direction's gains,* in which there are specific types of students that benefit from the others, and *general collective gains* in which each student can benefit one another. On the other hand, personal gains seem to have three reasons which are: *making repetitions*, *listening to a new idea*, and *not losing teaching time* with the teacher's explaining.

Students GR1_st3 and GR2_st3 seem to refer to collective gains when the students might benefit from each other, but this has a concrete direction i.e., the students who have access in mathematics to help the others who struggle to have access, or they are afraid to be unsheltered. Characteristic responses are: "Those of them who are good at math and understand them, should help the ones they aren't'' (GR1_st3); "When it is difficult for someone to understand, another one from the same group could guide the rest of them […] those who had questions and wouldn't have the courage to ask" (GR2_st3). Furthermore, GR2_st4 "sees" that the whole team might help one member: "to work in groups, when a member has difficulty incomprehension, the team could help".

GR1_st2 and GR2_st2 refer to collective gains when the students might benefit from each other but without concrete direction: "for me, it's not the ability that matters, it has to do with someone's interest to work. Even for someone who has never studied math, the willingness to help will somehow contribute to the team" (GR1_st2); "not only the high achiever has some nice ideas but also the underachiever" (GR2_st2). The same students highlight the reasons 'team progress' and 'helping each other': "We try to make progress altogether" (GR1_st2); "To help one another" (GR2_st1).

GR1_st3 except the collective gains refers to socializing with peers. "In that way, we are able to talk to each other. Because there are times we don't even talk in the classroom. I might haven't talked to my classmates at all''. That makes us feel gratified too."

Three students prefer working in mixed ability groups but for *personal reasons*. GR1_st4 likes to help others because this is the only way (as she feels) she can move on and learn new things. "I was pleased that everybody understood because when they don't, the whole group falls behind [in classroom teaching]*"*. The other two participants take the opportunity to improve their mathematical knowledge *"*I do repetitions [on the classroom material] and I definitely understand it better when I am explaining something to someone else" (GR1_st2) or "actually I prefer working in groups whereas

I can listen to others' point of view since there might be another solution I haven't thought about" (GR2_st1).

Comparing two group members' perceptions

GR1's participants feel positive emotions when they work with their classmates for both collective and personal reasons. They all perceive themselves as helpers and some of them expressed specific rules and conditions for participating in such activities. GR2's students feel positive too when they collaborate with their classmates, but they mostly perceive themselves as help receivers. They also prefer to work with mixed ability groups, like GR1, for collective gaining or personal reasons. They didn't set criteria and rules for participating in such activities except for one student who wants to work only with his friends.

Conclusion

This study aims to highlight students' perceptions of team collaboration. We focus on students who feel that they have easy access to mathematics (GR1) and students who feel that they struggle to get access to mathematics (GR2). Comparing the two groups' perceptions about peer collaboration, we came upon the following observations: All participants prefer to work in mixed-ability groups in mathematic class and highlight the inclusive dimension since nobody considers math skills as a problem in collaborating with their peers unless there is a competition among mixed ability groups. The last was identified in the case with students who have easy access to mathematics. Some participants expressed their options to choose their classmates in peer-collaboration activities (e.g., working with friends or students willing to contribute to the discussion). Students who feel that they have easy access to mathematics see themselves as helpers or knowledge-givers (Webel, 2010).

Viewing students' perceptions from an inclusion perspective we noticed that the participants who admitted that they have easy access to mathematics seem to implicitly position themselves as *directors of the peer-collaboration activity* since they consider themselves as the helpers, they set certain criteria with whom to collaborate while one of them is taking up the role of the teacher as a way to move on with the lesson. On the other side, participants who admitted that they struggle to gain access to mathematics seem implicitly to position themselves as the *followers of the peer-collaboration activity* since they see themselves as the help receivers. The above two groups' perceptions may cause a 'distributed balance' between students' contributions in teamwork (Dekker, Elshout-Mohr & Wood, 2006) thus it challenges the fair distribution of all group members' opportunities to participate and learn in teamwork, which is a prerequisite for equity and inclusion (Esmonde, 2009). The above outcomes indicate the challenges mathematics teachers face when trying to include students who view in different ways their involvement in mathematical peer-collaboration activities. Managing equity issues among students' contributions in mathematics classrooms is a complex issue (Esmonde, 2009) but it is critical in order to establish meetings amongst and between students' differences (Skovsmose, 2019).

References

Avramidis, E., & Kalyva, E. (2007). The influence of teaching experience and professional development on Greek teachers' attitudes towards inclusion. *European journal of special needs education, 22*(4), 367-389.

Causton-Theoharis, J., & Theoharis, G. (2008). Creating inclusive schools for all students. *School Administrator*, *65*(8), 24-25.

César, M., & Santos, N. (2006). From exclusion to inclusion: Collaborative work contributions to more inclusive learning settings. *European journal of psychology of education*, 21(3), 333-346.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. sage.

Civil, M., Hunter, R., & Crespo, S. (2019). Mathematics teachers committed to equity: A review of teaching practices. *International Handbook of Mathematics Teacher Education*, Vol.1, 243-273.

Dekker, R., Elshout-Mohr, M., & Wood, T. (2006). How children regulate their own collaborative learning. *Educational Studies in Mathematics, 62*, 57–79.

Esmonde, I. (2009). Ideas and identities: Supporting equity in cooperative mathematics learning. *Review of Educational Research, 79*(2), 1008-1043.

Evans, J. (2003). Methods and findings in research on affect and emotion in mathematics education. *In Proceedings of 3rd Conference of European Research in Mathematics Education* (CERME-3): Topic Group (Vol. 3, p. 28).

Florian, L. and Black-Hawkins, K. (2010). Exploring inclusive pedagogy. *British educational research journal*.

Forslund Frykedal, K., & Hammar Chiriac, E. (2018). Student collaboration in group work: Inclusion as participation. *International journal of disability, development and education*, *65*(2), 183-198.

Harré, R., & Van Langenhove, L. (1999). Positioning theory. *The discursive turn in social psychology*, 129-136.

Kanevsky, L., Lo, C. O., & Marghelis, V. (2021). Individual or collaborative projects? Considerations influencing the preferences of students with high reasoning ability and others their age. High Ability Studies, 1-33.

Kotsopoulos, D. (2014). The case of Mitchell's cube: Interactive and reflexive positioning during collaborative learning in mathematics. Mind, Culture, and Activity, 21(1), 34-52.

Mulryan, C. M. (1994). Perceptions of intermediate students' cooperative small-group work in mathematics. *The Journal of Educational Research*, 87(5), 280-291.

Scherer, P., Kroesbergen, E., Moraová, H., & Roos, H. (2019). Introduction to the work of TWG25: Inclusive Mathematics Education: challenges for students with special needs. In The eleventh Congress of the European Society for Research in Mathematics Education (CERME11), Utrecht, 6-11 February, 2019. European Society for Research in Mathematics Education.

Skovsmose, O. (2019). Inclusions, meetings and landscapes. In *Inclusive Mathematics Education* (pp. 71-84). Springer, Cham.

Webel, C. (2010). High school students' perspectives on collaboration in their mathematics class. In *Proceedings of the 26th Annual Meeting of the International Group for the Psychology of Mathematics Education*. Columbus: Ohio.