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# STUDENTS' PERSPECTIVES ON CRITICAL MATHEMATICS EDUCATION

## *PERSPECTIVAS DE LOS ESTUDIANTES SOBRE LA EDUCACIÓN MATEMÁTICA CRÍTICA*

## *PERSPECTIVAS DOS ALUNOS SOBRE A EDUCAÇÃO MATEMÁTICA CRÍTICA*

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## ABSTRACT

Theoretically, critical mathematics education (CME) differs markedly from traditional, teacher-centered mathematics teaching approaches. In addition to meeting mathematical goals, a main focus of CME lies on fostering students' critical consciousness and positioning them as active and informed actors in the classroom and beyond. However, only few empirical studies explicitly focus on how students experience CME instruction and curriculum. In this contribution, we draw on interview data to examine how K-12 students in one Austrian and one American school setting respond to and perceive CME lessons. The analysis revealed that, within both classroom settings, students' perceptions vary greatly, with some perceiving CME lessons as being completely different from prior experiences in school mathematics to some seeing little-to-no difference. Additionally features of CME instruction that mathematics teachers and researchers might consider to be the most salient are not necessarily the ones that students report attending to. Reasons for that might be manifold, and students might need more time with CME instruction and especially with reflecting on such lessons to identify the rationale behind the instructional approach. Moreover, researchers should be aware that students might not share their understanding of critical instructional reforms and might have diverse or even divergent perceptions.

Keywords: critical mathematics education, students' perspectives.

## RESUMEN

Teóricamente, la educación matemática crítica (EMC) difiere notablemente de los enfoques tradicionales de enseñanza de las matemáticas centrados en el profesor. Además de alcanzar objetivos matemáticos, la EMC se centra en fomentar la conciencia crítica de los estudiantes y en posicionarlos como actores activos e informados en el aula y fuera de ella. Sin embargo, sólo unos pocos estudios empíricos se centran explícitamente en cómo los estudiantes experimentan la enseñanza y el plan de estudios de la EMC. En esta contribución, nos basamos en datos de entrevistas para examinar cómo responden y perciben las clases de

EMC los alumnos de K-12 de un centro escolar austriaco y otro estadounidense. El análisis reveló que, en ambos contextos, las percepciones de los alumnos varían enormemente: algunos perciben las clases de EMC como completamente diferentes de sus experiencias previas en matemáticas en la escuela, mientras que otros ven poca o ninguna diferencia. Además, las características de las clases de EMC que los profesores de matemáticas y los investigadores podrían considerar más destacadas no son necesariamente las que los alumnos dicen haber tenido en cuenta. Las razones pueden ser múltiples, y los alumnos pueden necesitar más tiempo para la enseñanza de la EMC y, sobre todo, para reflexionar sobre esas lecciones e identificar la lógica que subyace al enfoque didáctico. Además, los investigadores deben ser conscientes de que los estudiantes pueden no compartir su comprensión de las reformas críticas de la enseñanza y pueden tener percepciones diversas o incluso divergentes.

Palabras clave: educación matemática crítica, perspectivas de los estudiantes, educación matemática.

RESUMO

Teoricamente, a educação matemática crítica (EMC) difere bastante das abordagens tradicionais de ensino de matemática centradas no professor. Além de atingir metas matemáticas, a EMC se concentra em promover a consciência crítica dos alunos e posicioná-los como atores ativos e informados na sala de aula e fora dela. Entretanto, apenas alguns estudos empíricos enfocam explicitamente como os alunos vivenciam o ensino e o currículo da EMC. Nesta contribuição, utilizamos dados de entrevistas para examinar como os alunos do ensino fundamental e médio de uma escola austríaca e de uma escola americana respondem e percebem as aulas de EMC. A análise revelou que, em ambos os contextos, as percepções dos alunos variam muito: alguns percebem as aulas de EMC como completamente diferentes de suas experiências anteriores de matemática na escola, enquanto outros veem pouca ou nenhuma diferença. Além disso, as características das aulas de EMC que os professores e pesquisadores de matemática podem considerar mais importantes não são necessariamente aquelas que os alunos relatam ter levado em consideração. Os motivos podem ser diversos, e os alunos podem precisar de mais tempo para o ensino de EMC e, o que é mais importante, para refletir sobre essas aulas e identificar a lógica por trás da abordagem didática. Além disso, os pesquisadores devem estar cientes de que os alunos podem não compartilhar sua compreensão das reformas críticas de ensino e podem ter percepções diversas ou até mesmo divergentes.

Palavras-chave: educação matemática crítica, perspectivas dos alunos, educação matemática.

## Introduction

Critical pedagogy, as outlined by Freire (1970), rejects teacher-centered, assimilationist teaching and instead is designed to foster students' critical consciousness, or understandings of the forces and institutions that shape their lives, and critical agency, the sense that students can fight for justice and make a difference in the world. It requires that students be positioned subjectively so that they come to understand themselves as competent and informed political actors and also co-determine the ends and means of their own education (Freire, 1970). As part of this subjective positioning, students should be provided opportunities to construct their own understandings of disciplinary subject matter and to take critical perspectives on disciplinary knowledge and how it is used in society (Skovsmose, 1994).

In recent decades, there have been calls for critical pedagogy to be adopted in schools. Especially in times of national and global uncertainties and challenges such as racism, economic inequalities, or global

warming, schools need to take responsibility for equipping students so that they are able to collectively transform these conditions. In many different nations, attempts have been made to include critical pedagogical approaches in different school subjects, including mathematics. Theoretically, at least, critical mathematics education (CME) is a radical departure from both traditional and (non-critical) reform-oriented mathematics instruction (Gutstein, 2006; Gutiérrez, 2002). As with other critical pedagogies, CME is designed "disrupt" status quo arrangements, practices, and understandings. That said, the schooling has institutional momentum and logics which may subsume radical possibilities (Shor, 2014).

In this paper, we examine how secondary students in two different national contexts experience and understand CME curriculum and instruction – the extent to which they see it as being disruptive of, or at least different from, school mathematics as they have experienced it. We specifically draw on interview data from high school students in Chicago and middle grades students in Austria who were in classrooms where their teachers taught a series of CME lessons. With this in mind, we aim to answer the following research question: *(How) do students perceive CME lessons in comparison to other, "normal" math lessons?*

## Theoretical Background

Although having commonalities with other critical pedagogies, CME is in some ways distinctive, in particular, for having goals that are specific to mathematics and, different than the basic, reading and writing literacy goals that Freire (1970) was concerned with. Reflective of this, Gutstein (2003) distinguishes between social justice goals and reform-oriented mathematical goals for CME instruction. From this perspective, the mathematical goals include the development of mathematical power, which means the ability to solve nonroutine (and routine) mathematics problems as a mathematician might, and also reading the world with mathematics which means, for example, positioning students to "mathematize" the socioeconomic conditions that shape their lives. The social justice goals include fostering students' critical consciousness about the social world and their sense of agency (i.e., the confidence that they can affect positive social change). The social justice goals require that CME materials be contextualized in ways that are more responsive to social and political concerns than (non-critical) reform materials (Brantlinger, 2022; Gutiérrez, 2002; Gutstein, 2003).

As with other reformers, CME advocates have directed much criticism at traditional mathematics instruction in which the teacher lectures from the front of the room and students are expected to learn passively and work independently on routine tasks. While traditional instruction can result in students developing fluidity with mathematical conventions and procedures, students come to understand mathematics as pre-ordained and mostly irrelevant to their own interests and futures.

Few empirical studies have explicitly focused on how students respond to and perceive CME curriculum and instruction. Some student reactions were either included in teacher-researchers analysis of their own teaching (e.g., Avcı, 2019; Brantlinger, 2013; Gutstein, 2006; Voss & Rickards, 2016) or in examinations of teachers' approaches to implementing CME (e.g., Kokka, 2020; Wright, 2020). Many of these studies reported an increased engagement of (most) students as they could make personal connections to the topics covered in class (Avcı, 2019; Gutstein, 2006; Voss & Rickards, 2016). Wright (2020) found that this increased engagement was most evident among lower-achieving students and students who did not participate much in traditional mathematics classrooms. Students did, however, not always react to CME instruction as intended by their teachers. Initially at least, some students could not see how social issues would fit into a mathematics classroom and resisted teaching mathematics differently (e.g., Gutstein, 2006; Voss & Rickards, 2016). In particular, higher-performing students expressed concern about wasting time discussing things that are not part of standardized tests. Avcı (2019) reported about initial challenges to dismantle usual power structures and familiar hierarchies in the classroom as students were suggesting teacher interventions instead of wanting more shared authority when problems within group work arose. It needed a continual praxis to achieve more horizontal teacher-student relationships and egalitarian peer interactions.

While these previous studies provide insights about general student reactions or feedback to the introduction of CME approaches that touch diverse aspects of classroom practice, we want to explicitly address whether and to what extent students perceive CME as possibly disruptive or different from more traditional approaches.

## Methods

The research projects from which this paper was developed were both focused on various dimensions of CME. Brantlinger is White, middle class, and male and had a decade of mathematics teaching experience, five years teaching Black and Latinx high school students in Chicago, at the time of his CME study. Steflitsch is White, female and middle class and had been teaching in different Austrian public schools with a predominantly white student body, but with students from diverse socio-economic backgrounds. In both projects, this included a description of the CME curriculum design, implementation processes, and student reactions (e.g., engagement, resistance). Both studies included pre- and post-interviews with students to better understand the perspectives of youth whose views are rarely considered in the reform of mathematics education. Given that in Brantlinger's project, he was a teacher-researcher, other researchers conducted the most of the student interviews. Steflitsch conducted the interviews in her project as she was not the CME instructor. In both projects, participating students were asked about their perceptions of CME lessons and, in particular, how they saw them as being different or similar to the mathematics instruction they had experienced in previous coursework and also the standard (i.e., non-CME) lessons they had experienced in their current classroom. As detailed below, the two research contexts were quite different, one with Black and Latinx students in a US high school and one with White, middle-class students in an Austrian middle school (gymnasium). Although the comparison of results from these different settings was in some ways limiting – high school students, in particular those from historically marginalized groups, might have stronger critiques of society and its institutions, than middle school students – it was also a strength as there were some surprising (to us) similarities in the ways that both groups discussed CME lessons and their relationship to the standard (non-CME) curriculum.

For the analysis, we followed a qualitative thematic analysis method (Braun & Clarke, 2006). After reading and re-reading the transcripts of all the interviews from both projects, we inductively coded the data. After individually coding the transcripts we discussed created codes and interesting parts. We identified broader themes including the following: (1) difference or no difference in *real-world themes and contexts* considered, (2) differences or no difference *between CME and typical instruction*, and (3) difference or no difference in *classroom organization*. Although there were other themes that we identified (e.g., difference or no difference in *student attitudes, motivation, and behavior*), the focus of the present paper is on themes related to the first three codes. As part of the interview analysis, we also wrote analytic memos where we considered potential cross-cutting claims (i.e., across student interviews, across the US and Austrian settings) and sought evidence from interviews in support of, but also that did not support, these potential claims.

## Context US

The US student interviews come from Brantlinger's (2007, 2014) research on his CME instruction in two high school settings in Chicago Public Schools (CPS), the first being a night school program at Guevara High School and the second being a summer school program at Park Vista High School (all names are pseudonyms). These were semester-long "make-up" geometry courses that were offered to CPS students on compressed timelines – nine weeks at Guevara and three weeks at Park Vista. Almost all of the sixty students across the two settings were African American or Latinx. Almost all had failed geometry previously. In interviews and conservations, some of the students expressed frustration with having to retake geometry in a remedial school setting.

CME lessons comprised about 20 percent of the curriculum at both Guevara and Park Vista. Brantlinger (2007, 2014) documented encountering significant obstacles to designing CME lessons for high school geometry. Although he found social topics of potential critical interest to his Black and Latinx students that might be mathematized, he found that many did not fit with school geometry. Reciprocally, there were required geometry topics that did not lend themselves to critical, real world application. However, at that time in CPS, statistics topics were to be included in the geometry curriculum. Although somewhat odd, this also was beneficial, as most of Brantlinger's CME lessons involved data analysis, statistics, or probability whereas only some involved geometry. In terms of social issues, Brantlinger's curriculum addressed such issues as economic inequality in the US, institutional racism, and student access to recess by race in CPS schools, and Eurocentrism in global map making.

## Context Austria

The Austrian student interviews come from Steflitsch's research, where she collaboratively worked with nine math teachers in workshops on the concept of CME and possible practical realizations of it in their classrooms. The analysis for this paper focuses on interviews with 8$^{th}$-grade students taught by Miss Kenny, a math and physics teacher for grades 5-12 at Mountain View grammar school. The school is located in a smaller city in the South of Austria. The student population at Austrian public grammar schools is fairly homogeneous (at least in this area), and most students come from middle class family backgrounds. Academically, this grammar school is known for being one of the best in the region, and therefore, the pressure on but also the willingness of students to perform well is relatively high.

While the Austrian curriculum is formulated so mathematics teachers have a lot of freedom to choose how to translate content-related goals into practice, many teachers are concerned with preparing students for the standardized matriculation exam. Often students (and their parents) mainly care about acquiring the tools and knowledge for passing this test rather than other competencies. Still, mathematics teaching is very traditional in many schools, with a teacher-centered presentation of knowledge followed by a work phase where students can practice applying it.

Miss Kenny was the only teacher from the workshops who designed CME lessons herself. As she particularly values an open exchange of ideas in her classroom and has been teaching this class for three years, she has a very intimate relationship with her students. That was why she found it easy to come up with a social topic that might interest her students. The Austrian curriculum allows freedom as to when a teacher wants to cover a particular mathematical content during the year, and all different mathematical branches (such as geometry, algebra, statistics, or calculus) are taught combined in math classes. In part because of this, Miss Kenny did not find it to be particularly challenging to design CME lessons that aligned with the mathematical objectives that she was required to meet. Also, as with Brantlinger, Miss Kenny's lessons mainly involved data analysis, statistical reasoning, and basic mathematical operations, including dealing with different units and large numbers. In terms of the social context, the lessons dealt with the topic of water consumption of food. These aimed at letting students critically reflect on their consumer behavior by using math to question myth about environmental impacts of food production. It initiated reflections about how their decisions can have an impact on the environment and also about individual versus political responsibilities in regard to environmental issues.

## Students' comparisons of CME and "normal" mathematics

Both Brantlinger and Miss Kenny understood that, as CME educators, they needed to think about the mathematical and social goals of their lessons but also about how they would teach those lessons. Most obviously, they understood that they needed to avoid traditional, "banking" instruction (Freire, 1970; Gutstein, 2003). As such, both teachers attempted to position their students to take ownership of their learning in CME lessons and non-CME lessons alike. However, as both the rules and roles should change with the transition to critical pedagogy, Brantlinger and Miss Kenny both understood that they needed to prepare students to discuss critical, and potentially controversial, ideas about social reality, something

that many students have never experienced previously, at least in the mathematics classroom. Both teachers also were aware that the CME tasks they designed differed from traditional – even reform-oriented - mathematics tasks in two clear ways: (1) they should simultaneously address important mathematical and social justice issues and (2) they are open-ended (or open-middled) in the sense that there is no formulaic way to arrive at a mathematical "answer" or, for that matter, no shared stance on social reality that students should arrive at.

In sum, the CME lessons felt, to the teachers, as a substantial – even radical – departure from mathematics lessons as usual. However, the interviews indicate that whereas, for some students in both settings, CME lessons did seem like a substantial (if not radical) departure from typical mathematics lessons, for other students, they did not. That is, in both classroom contexts, the students' perceptions of CME tasks and lessons varied greatly. When asked about how they compared to typical mathematics lessons, some students reported perceiving CME lessons as being completely different whereas other reported seeing little-to-no difference. Further, in both settings, only a small proportion explicitly named the critical social contexts and consideration of social issues in mathematics lessons as being different. This was surprising to both of us as researchers.

Amongst those students in both settings who saw CME it as a departure, some specifically reported that they saw CME lessons as helping them to see *connections between mathematics and real-world issues* and/or their lives outside of school. Peter, an Austrian student, immediately highlighted the real-life connections in CME lessons, indicating that this is something they do not usually experience in mathematics lessons:

> Interviewer: Was there anything special about the lessons? Something you would say you don't have in 'normal' math class? Anything special?
>
> Peter: Um... Yeah, definitely with like.... Um... situations that you have in real life. We don't have that so often in math and that's actually it. So, that you look at something that is also like that in real life.
>
> Interviewer: Is that something that you like?
>
> Peter: Yes, it is. Because I think you really also learn something for life then.

Similarly, some US students seemed to appreciate how they were asked to consider and discuss critical societal issues in CME lessons. Diego argued that this "strengthened" the mathematics curriculum.

> Interviewer: What kind of things about the course that—sorry. What are the things that you appreciated about the class?
>
> Diego: I don't know, he gave us real life facts, and put it to math. Thought it was cool.
>
> Interviewer: So you like doing both? Like, you don't mind the math if it's mixed in with other stuff?
>
> Diego: Nah, thought it was strengthened.

Yet, other US students seemed to initially struggle to see how social issues might relate to mathematics but seemed to change their minds after experiencing CME instruction.

> Ingrid: It's the same, it's just I like this math course, you know, cause you know, we didn't just do math, he lets us talk about our opinions and stuff. And, we did all that other/even though it wasn't really RELATED to math, but you know, it was interesting.
>
> Interviewer: Could you think of that as math?
>
> Ingrid: Yeah, it DOES have to do with math, cause, you know, measurements, and/ yeah. It's just that we never, I never thought of it before as math, and so.

Even if not explicitly referring to societal topics, students in both US settings saw the (non-critical) reform-oriented instruction that built a foundation for CME lessons as being a *departure from the*

*traditional instruction* they had experienced in other classrooms, and as being more responsive to their thinking and learning.

> Jaime: And, Mr. B[rantlinger] would always explain everything. Like if we don't understand, he'll have someone that knows about it, help us out or work in teams or groups or something. Because probably I might not know something, but Anabel might know something. And we all help each other, we all collaborate.

While students in the Austrian setting were already used to a form of instruction that focused on conveying understanding and exchanging mathematical ideas, as this was of importance for Miss Kenny, some still highlighted that CME units were different as the tasks demanded another form of working. Katrin explicitly pointed to this difference as the students were not supposed to just calculate but to think about their consumer behavior in CME lessons. She also referred to the openness of the tasks and how this allowed students to share their opinions and come up with different solutions:

> Interviewer: Would you say that these lessons were somehow different from 'normal' math lessons? Was there anything that was special for these units?
>
> Katrin: It was not a task where we were told: "Please calculate this now" or something quite mathematical. For example, we had to write a shopping list. That was different. […] Um… of course, we are always allowed to think and contribute [to the lesson] ourselves, but this was really very special that we really had a lot, a lot of free space.

Similarly, Jaime, a US student, implied that CME instruction can foster student agency as it opened up opportunities to draw individual connections to the material. Jaime explained that by including personal questions to start discussions, Brantlinger was "not only giving them [the students], well, not only giving the students a voice, but actually giving them the opportunity to experience math "in your own way."

In contrast, for other students in both settings CME lessons did not stand out as being all that different from typical mathematics lessons. Even if explicitly prompted for differences in teaching style or the content of the lessons, some students did not name any. The US student, Brody's response illustrates this:

> Interviewer: Okay, any other differences?
>
> Brody: No.
>
> Interviewer: Like, in his teaching style, or in the content of the class, or anything?
>
> Brody: No.

An Austrian middle school student also considered CME lessons to be quite similar to their 'normal' math lessons. Instead of pointing to the discussion of critical social issues, he observed that he and his classmates had never before watched a video in mathematics class. Another Austrian student stated that the only thing special for him in CME lessons was that the researcher (Steflitsch) was present for observations. The implication was that, for him, CME lessons were similar to typical mathematics instruction. In sum, the variation of student responses in interviews suggested that they experience and make sense of CME instruction in very different ways.

Second, when considering differences, instead of discussing the novelty of having considered critical social issues, a number of interviewed students in both settings pointed to aspects of student-centered instruction that undergirded or were foundational to CME instruction in both settings. For example, when asked about differences, many students referred to the *organization of instruction*, especially group work, as a key difference between mathematics learning in Brantlinger's or Miss Kenny's classrooms and mathematics learning in previous mathematics classrooms. Although students in both settings appreciated the opportunity to work collaboratively with peers, some students were not used to it and voiced skepticism about it. Consider the following excerpt from Maya, a summer school student at Park Vista:

> Maya: I don't like those type of [CME] projects, yeah. They kind of, I don't know. It's 'cause right now, like working in groups, like, my group doesn't talk a lot, you know. 'Cause it just kinda sucks, you know, trying to do something. Or there's two people that'll do everything, and the others ones will be doing nothing, so. I don't know. They don't really know how to work as a group.

In contrast, Maya's classmate Emma named collaborative groupwork as something that she found improved her engagement:

> Emma: Actually, yeah, it's a little, it's better, it's more fun than I expected. I thought it was going to be boring.
>
> Interviewer: Why is it more fun? Like, what makes it more fun?
>
> Emma: Well, 'cause, we were working in groups so that's a lot better than working just alone, not talking or whatever. 'Cause he gives you time to talk and whatever, you know?

In contrast to many of the US students, the Austrian students had a history of working in groups in mathematics classrooms. Nevertheless, when asked to name differences between CME and typical mathematics lessons, some Austrian students focused mainly on the organization of the classroom. For some, groupwork was cited as a point of commonality and as the reason they did not consider CME instruction to be different from typical mathematics instruction. However, for other Austrian students, classroom organization was salient as CME lessons seemed to change how students worked in groups. For example, Peter explained how working with classmates on CME lessons differed from his experiences working in groups during 'normal' mathematics lessons. He highlighted how it was not just a matter of distributing different types of calculations in the group, but that everyone had to actively contribute to the solution process, as differing opinions might lead to differing results.

> Peter: Well, I found it very exciting to work in groups and to do things together. I find that only solving tasks in group work, I don't think it's so good to just solve mathematical tasks, because you can always distribute the work: this one does these calculations and that one does those. But to discuss things together, what his opinion is, I find that more exciting.
>
> Interviewer: Did you have the feeling that everyone contributed?
>
> Peter: Yes, well, with tasks where you only have to do the calculations in groups, I think there are always people who just... who tend to push the work onto the others, but [in these lessons] everyone definitely had a say.

Another classmate shared Peter's view that collaboration worked much better in CME lessons than in the partner work they had experienced in previous mathematics lessons.

Some other students, in both settings, did not address social issues, differences in teaching style, or classroom organization in their feedback but referred to some changes in the classroom setting, as it appeared that external changes primarily caught their attention. They talked about the cameras that Brantlinger and Steflitsch set up in some lessons for analytical reasons, a change of class size, as more students attended previous courses, or tables being positioned differently to support group work. Lisa's comments capture quite well how some students did not perceive CME instruction as being much different compared to more traditional instruction, except for mentioning these classroom setting characteristics:

> Lisa: The thing that was different was that cameras were there, but.... Yes... But otherwise it was... Well... We moved the tables differently. Maybe we don't do that so often. But otherwise I can't think of any differences.

## Discussion

The purpose of this study was to add to the empirical literature on CME and, in particular, that which focuses on students' experiences with and perceptions of CME. There is a sizable theoretical and/or

advocacy literature that assumes that critical pedagogy, and CME as part of that, will be a radical departure from school as usual and, as such, that teachers and students alike will experience it as transformative and inspirational. Only some of this literature acknowledges that schools have institutional momenta and logics that inhibits transformation and reform.

Of course, it is possible that the study teachers – Brantlinger and Miss Kenny – simply got CME wrong. Brantlinger (2013, 2014) documents some of the shortcomings of his CME instruction while at the same time arguing that the CME theoretical and advocacy literatures are divorced from many of the practical and institutional realities that mathematics teachers face; for example, in the US context at least, the non-applied nature of the required secondary curriculum and the intensive, nature of teachers' day-to-day work that provides little time for curriculum design and reflection. That said, from a perspective of the researchers, the CME lessons in both the US and Austrian settings were a clear departure from typical mathematics lessons. Brantlinger's discourse analysis (2013) of CME and other (non-CME) lessons in his classroom provides evidence of this. Steflitsch's initial analyses of activities in Miss Kenny's classroom is also consistent with this claim.

However, as the results of this study demonstrated, student perceptions of CME lessons can vary greatly, even when they attend the same course/class and experience the same lessons. It also revealed that the features of CME instruction that mathematics teachers and researchers might consider to be the most salient, or different from typical school mathematics, are not necessarily the features that students seem to attend to. There are several possible explanations for this. We consider three here.

First, it may be that students needed additional experience with CME to be able to clearly distinguish between CME lessons and other mathematics lessons. For example, that CME lessons needed to comprise a much greater proportion of the curriculum throughout a school year. This is easier said than done. As Brantlinger (2022) argues, although CME lessons have made inroads into public schools in the US and elsewhere, CME activities, tasks, and lesson plans available to teachers map onto only certain secondary content strands and required topics (e.g., proportional reasoning). Although there are a number of CME curriculum resources for teachers, none seem to provide the level of curriculum coverage that the CME equity agendas as articulated by Gutstein (2003) and others (e.g., Gutiérrez, 2002; Skovsmose, 1994) seem to demand.

Second, in both contexts, the students generally were not used to reflecting and talking about their experiences in mathematics classrooms. This was evident in the analysis of all their pre- and post-interviews that also included questions about their general experiences and attitudes toward mathematics and mathematics teaching. To varying degrees, in interviews, the students seemed to lack the language to describe or express what they have and were experiencing in the mathematics classroom. It was not uncommon that students answered questions with "I don't really know," which frequently led the interviewers to ask detailed follow-up questions, to which the students sometimes only responded with general agreement or disagreement. Although most of the students in both contexts described long histories with traditional mathematics instruction, they lacked experiences with alternative models. This was the first time they would have been asked to reflect on and articulate distinctions about a set of CME lessons and other lessons they had experienced.

An implication for research is that researchers not assume that students will share their understanding of a particular curricular or instructional reform and, really, that they anticipate diverse, if not divergent, student reactions to and understandings of particular instructional reforms. While this may seem obvious to some qualitative researchers, the widespread use of observational protocols and rubrics to 'measure' some aspect of instruction and learning suggests that many educational researchers fail to adequately account for students' perspectives.

An implication for teachers and other practitioners (e.g., curriculum designers) is that they take time to name and have students reflect on aspects of their curriculum and instruction and the rationale behind particular instructional approaches. For example, that they set aside class time for students to reflect on why and how they are working in groups on non-routine mathematics tasks or CME projects. This did

happen in both classrooms but often through an impromptu discussion (e.g., in response to student resistance to working in groups, in response to students' sometimes hegemonic reactions to CME lessons) rather than a planned discussion. Not only would this help students to understand the differences but also give them a 'language of description' that might help them to articulate their preferences and goals to their teachers and school administrators.

## Conclusion

There is a considerable literature on CME, although much of it is theoretical or advocacy work (e.g., Gutiérrez, 2002; Skovsmose, 1994) and, therefore, there is a need for research that is well grounded in the realities of schooling, teachers' worklives, or student experience. This research adds to the empirical literature on CME and, in particular, that which examines how K-12 students in a range of settings respond to and perceive the integration of critical social issues into the school mathematics curriculum. The results of this study seem to run counter to common assertations in the CME literature; for example, the assumption that students, or at least those from less privileged backgrounds, will uniformly embrace CME instruction or, at the very least, recognize it as being different from school as usual. Following Shor (2014),our concluding contention is that school resists and transforms reforms, even those that are critical and potentially transformative, such as CME instruction. and that this is something that is rarely explicitly addressed in the CME literature. Pais (2017) already pointed out that mathematics education research tends to "obliterate the real of schools for the sake or research, thus allowing it to flourish" (p.787). To avoid this, at the very least, there is a need for more *empirical work* like the current study and a need for theoretical and advocacy work on CME instruction to engage more fully and responsively with the empirical results such as those we present in this paper.

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