Cultural Studies of Science Education (2022) 17:945–954
https://doi.org/10.1007/s11422-022-10124-5

FORUM

How to understand and support marginalized students' participation in a science classroom from the perspective of framing

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Received: 6 September 2021 / Accepted: 20 March 2022 / Published online: 13 June 2022

Abstract
Ha and Kim (this issue) qualitatively portrayed how a marginalized student's attempts to position himself as an accepted member were constrained or afforded by other members in the small-group argumentation activities. From a framing perspective, the authors described the features and changes of the marginalized student's participation in small-group argumentation in a science classroom. In this commentary, based on the reported features and shift of the marginalized student's participation, we illustrate how to understand and support marginalized students' participation in a science classroom from the perspective of framing. In particular, we interpret several features of marginalized students' participation that were reported in Ha and Kim's paper and existing studies from two aspects of framing: interactional dynamics and multilevel structures. Finally, we discuss how to support (re)framing of marginalized students as a basis of establishing equity in science classrooms.

Keywords Framing · Equity · Marginalized students · Participation · Science classrooms

초록
하희수와 김희백(2022)의 논문에서는 소집단 논변활동에서 소외된 학생이 자신을 수용된 구성원으로 자리 매김하려는 시도가 다른 구성원들에 의해 어떻게 제한되거나 허용되는지 질적으로 기술했다. 프레이밍 관점으로 과학 교실의 소집단 논변활동에서 소외된 학생의 참여의 특징과 변화를 설명했다. 이 논평에서는 이 논문에서 보고된 특징들과 변화를 기반으로, 프레이밍 관점에서 소외된 학생

Lead Editor: S. Martin.

This review essay addresses issues raised in Ha and Kim's paper entitled: "*How a marginalized student's attempts to position himself as an accepted member are constrained or afforded in small-group argumentation*". (https://doi.org/10.1007/s11422-021-10100-5)

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의 과학 수업 참여를 이해하고 지원하는 방법을 논의했다. 특히 하희수와 김희백의 논문 및 기존 연구들에서 보고된 소외된 학생들의 참여의 특징들을 프레이밍의 역동적 상호작용과 다층적 구조라는 두 가지 측면에서 해석했다. 끝으로 과학 교실에서 형평성을 확립하기 위한 토대로서, 소외된 학생들을 (재)프레이밍을 지원하는 방법에 대해 논의했다.

Equity issues in science classrooms

Equity issues in science classrooms have long been key issues in science education, and science educators have a responsibility to ensure that the inequity that occurs in science classrooms is not repeatedly reproduced (Yerrick, Roth and Tobin 2006). What does it mean to improve equity in a science classroom? In this commentary, we note that equity in education does not simply mean giving all students a quantitatively "equal" opportunity in science classroom activities. Instead, to achieve real equity in education, we premise that education needs to provide more active interventions and supports to fill the gaps that marginalized students experience, as shown in Fig. 1.

Marginalized students experience a variety of "differences" from other students, as shown in Fig. 1. Existing studies on equity in science education have focused on diagnosing the differences experienced by marginalized students in science classrooms and reducing these differences. For example, from a sociocultural perspective, school science culture tends to be rooted in the male-dominated culture from the West (Aikenhead 2000; Taconis and Kessels 2009). Thus, non-Western and/or female students have been reported to be marginalized due to differences from the languages, norms, and values that tend to be used in science (Aikenhead and Jegede 1999; Bianchini 2017).

So far, researchers have tried to find ways to support overcoming these social differences and/or cultural conflicts (Bianchini 2017). Existing studies have focused on identifying practical means of narrowing or bridging these gaps. For example, pedagogical strategies and instructional materials have been examined and developed to promote marginalized student participation in science classrooms (Lee and Buxton 2010). Similarly, curriculum revisions have been implemented to increase home-school connections by including content that is connected to the home-based language and/or culture of non-mainstream students (Lee and Buxton 2010).

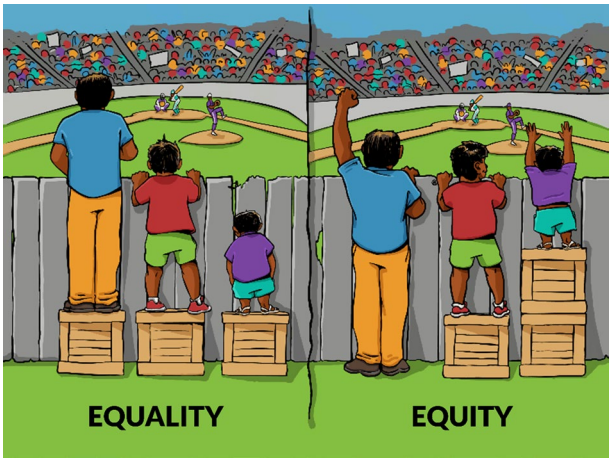

Fig. 1 Differences between Equality and Equity. Note: Illustration of equality versus equity Adapted from Interaction Institute for Social Change, Retrieved December 30, 2021, from https://interactioninstitute.org/illustrating-equality-vs-equity. Copyright 2016 by Angus Maguire. Reprinted with permission

Ha and Kim (this issue), however, dealt with the participation of students who are marginalized in peer relationships rather than the mainly gender and/or cultural differences that have been discussed in previous studies. Students marginalized by peer conflicts have received relatively little attention compared to students marginalized by gender and/or cultural differences. In particular, Ha and Kim interpreted the participation of marginalized students caused by peer conflicts from the perspective of framing.

Based on the research results of Ha and Kim (this issue) and other previous reports on various cases of marginalized students, this commentary explored how to understand and support marginalized students' classroom participation from the perspective of framing. In particular, we have focused on two key features of framing: (1) the interactional dynamics of framing and (2) the multilevel structures of framing. From two points of view, we identified the features of framing formed in science classrooms and interpreted the participation of marginalized students from the perspective of framing. Through these discussions, we derived educational implications for supporting the (re)framing of marginalized students and ultimately achieving equity in the science classroom.

Understanding the interactional dynamics of framing in science classrooms

When we look outside through a window, we understand that what is going on is outside by noting the inside of the window frame. While the frame denotes properties as already made, framing means the process of creating a frame through understanding and interpretation of the situation (Scherr and Hammer 2009). That is, framing refers to the dynamic process of making a frame, and this dynamic of framing shows that the frame and the process of framing are not one way, but a relationship where each affects the other, which is interactional. We will explain three aspects of how the interactional dynamics of framing are shown in science teaching and learning situations: selection and salience, continuous conceptualization, and activation of resources.

Framing is a process of *selection* and *salience* (Entman 1993 p. 52). The frame separates the outside from the inside and determines what is inside the frame and what is outside the frame. Therefore, the creation of a frame can be seen as a continuous process of selection that determines what to include in the frame. In science education, this aspect of framing can be used to understand how frames are constructed, which is referred to as *framing building* in teaching and learning science. For instance, Russ and Luna (2013) inferred teacher epistemological framing from patterns in teacher noticing. They examined patterns of how a high school biology teacher noticed their teaching and learning, and used these patterns as evidence to make inferences about how this teacher framed their classroom activity.

This frame building is not just a simple collection of small pieces of information about the current situation, but rather a process of interpreting the information of past and present situations in a continuum. Framing is the act of *continuous conceptualization* that build a specific relationship by weaving various scattered pieces of information of past and present (Entman 1993 p. 51). Therefore, even in the same situation, the framing process can be different depending on what is paid attention to and what kind of relationships have been built, with the resulting frame also being different.

In addition to dynamics that can differ from individual to individual in framing depending on each person's interpretation of the situation, there can be dynamics of

framing change within an individual. In terms of the dynamic nature of framing, the noun or verb "framing," meaning "the act of framing" puts the emphasis on the action rather than the frame itself (Davis and Russ 2015). Hammer, Elby, Scherr and Redish (2005) referred to framing as a coherent *activation of resources* from a resource-based perspective, which views learning as a cognitive state the learner forms by activating resources. This means that a set of resources that activate again and again may form a frame. Thus (re)framing needs deliberate attention and a coherent set of resources.

The three interactional dynamic natures of framing noted above were also revealed in students' framing in the science class dealt with in Ha and Kim (this issue). First, since framing goes through a process of *selection* and *salience*, students in the same group as June chose pranks such as June poking a friend or sitting next to and talking with his friends during the lesson as June's behavioral characteristics and highlighted those in particular as his characteristics. Although June may have aspects other than these negative aspects, June's other group members may have excluded these other aspects or June's other aspects may not have been sufficiently recognized, as there was little interaction between June and the group members. This shows that June's group members constructed their own positional framing of who was and was not a contributor in argumentation by referencing June's past behavioral characteristics, not just those in this lesson.

The positional framing of June's group members was closely connected to how they defined participation in class: It was closely related to judgments that we often make about participation and engagement in class based on how actively we participate in discourse about lesson topics without making jokes and small talk that is not related to the lesson (Schultz 2009). This means that the positional framing negotiated with the epistemological framing. Shim and Kim (2018) argued that epistemological framing and positional framing are dynamically intertwined with each other.

Next, considering the second aspect, the *continuous conceptualization* of dynamics of framing, the positional framing of June constructed by other students was not constructed from the information observed only while interacting with June in the same group, which was quite a short time. The positional framing of June was constructed using information about experience they had had with June as a classmate in the past, which was both historically and socially constructed. This occurred because people tend to form the central idea of framing based on their past experience (Huchison and Hammer 2010). Because of this, assessment of the positional framing of students requires consideration of and respect for the students' accumulated experience and understandings throughout the past.

Finally, from the last perspective of *activation of resources*, the positional framing of June shifted, but the process required time and effort. Other students framed June as a negative way by activating resources such as poking a friend and chatting with his friends during the lessons. We could see that this framing took time to shift because the shift needs activating a different set of resources. June kept attempting to engage in a discussion to have his idea acknowledged by others, but other group members did not always accept or acknowledge his idea. However, he was able to position himself as an accepted member after his idea was acknowledged by other students. The shift of a student's positional framing can also be understood as the concept of legitimate peripheral participation, which explains how a member moves forward toward full participation (Lave and Wenger 1991). To foster full participation in a community, a member's positional framing needs to be actively shifted and modified with continuous effort, as it was in June's case.

Understanding multilevel structures of framing in science classrooms

In this section, we discussed the natures of framing from a sociostructural perspective on science classrooms. In science classrooms, all students are affected by various levels of sociocultural structures surrounding science classrooms. For example, in the Korean context, students' participation in science classrooms has been reported to be affected by the following three levels of sociocultural structures: (1) social interactions of classroom members at the microlevel; (2) Korean education systems, including national curricula, evaluation and private education at the meso-level; and (3) Korean culture at the macro-level (Park, Martin and Chu 2015). As shown on the left side of Fig. 2, Korean students tend to be influenced by the teacher, the students, their resources, and their beliefs (schema) at the microlevel when they participate in science classrooms. This model shows that these microlevel factors are interconnected with macro- and meso-level factors. The meso-level factors in the Korean curriculum, the examination system and private education, deeply influence Korean students' beliefs about what learning is, what is important in their learning, and how they should participate in science classroom activities. For example, some Korean students have been reported to be either tired or bored in science classrooms because they have already covered the lesson content at private academies, and other students feel pressure to find the "right answer" with a focus on preparing for the college entrance exams (Park, Martin and Chu 2015). In this vein, the multilevel structures surrounding the classroom have an interconnected effect on students' perceptions about classroom activities.

The multilevel structures surrounding science classrooms play important roles in framing the participation and agency of a student. Considering the multilevel structural influences on forming frames, Hand, Penuel and Gutiérrez (2012) proposed a distinction between "*framing within* a classroom and *framing access to* educational processes and institutions" (p. 251). From the perspective of multilevel framings, he argued that framing within a classroom is linked to the structural frames outside the classroom, such as

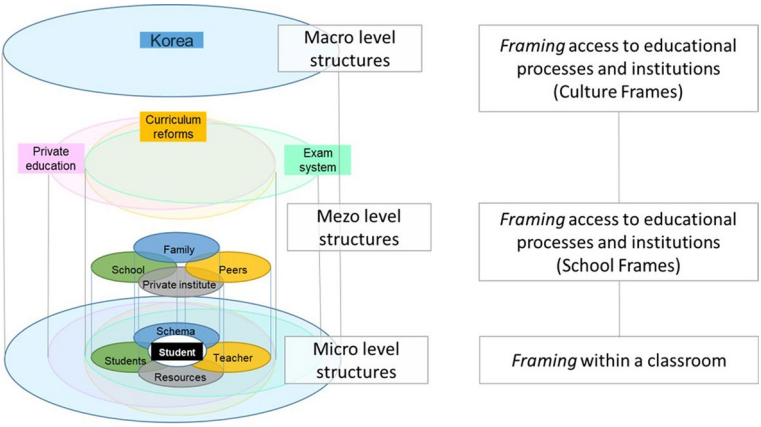

Fig. 2 Multilevel structures of framing in classrooms. (Note: This figure was reconstructed in this study in reflecting two perspectives of "structural influences shaping teaching and learning in science classrooms (Park, Martin and Chu 2015) and "multilevel framings" (Hand, Penuel and Gutiérrez 2012)

school frames and cultural frames. School frames are formed by educational systems, such as schools and curriculums, at the meso-level, while cultural frames are formed by a specific culture at the macro-level. as shown on the right side of Fig. 2.

The above multilevel structures of framing can also be adapted for understanding marginalized students' participation and their framing in science classrooms. Given that teachers need to understand and support various marginalized students in actual classrooms, it is especially important to enhance our understanding of different cases of marginalization. Thus, from the perspective of multilevel framing, this commentary interpreted various cases of marginalized students reported in previous studies as well as June's case.

First, June's case was analyzed in connection with the social and psychological relationships in a monoracial classroom. June's framing, which originated from peer conflicts, was interpreted mainly with teacher, peers, their resources, and their beliefs at the microlevel. In this case, the macro- and meso-level factors were not the main cause of June's marginalization. However, this does not mean that the macro- and meso-level factors were not at all unrelated to the behavior of June and his peers. The students' beliefs that were inherent in judging June's behavior to be appropriate or not and making group rules may have come from the influences of macro- and meso-level structures, even though they were not reported in June's case.

More widely, we can also understand the differences faced by marginalized students in science classrooms, such as cultural differences, gender differences, and economic differences, from the perspective of multilevel framings. For example, cultural differences experienced by students from non-Western cultures in science classroom stem from different cultural framings about values or norms at the macro-level. At the meso-level, school frames are formed in ways where certain cultures are excluded or reinforced by predominant power structures (Hand, Penuel and Gutiérrez 2012). Similarly, as another possible cultural frame, Korea has been reported to have an issue with socioeconomic polarization at the macro-level being connected to the issue of excessive private education expenses at the meso-level, which leads to educational gaps and student marginalization (Byun and Kim 2010; Park, Byun and Kim 2011). In other words, the macro-level factor of economic differences has an effect on educational inequality and student marginalization. These differences lead to gaps at the microlevel, which directly or indirectly can affect the ways in which marginalized students participate or interact in classrooms. In this way, cultural frames and school frames can be deeply involved in framing of marginalized students in their classrooms.

Again, various groups of marginalized students—non-dominant race and ethnicity students, girls, economically disadvantaged students, students with limited proficiency in their development, and gifted and talented students—have been reported to be influenced in their classroom participation by different factors (Bianchini 2017). The multilevel perspective discussed in this section is a theoretical description of the multilevel structure of framing and its possible related factors in Korean context. From this point of view, it cannot be seen that every factor on the three levels is equally reflected in all students, because the causes of marginalization and the patterns of classroom participation differ from class to class and from student to student. For example, June's marginalization is more related to psychological tendencies (Fiske, Kitayama, Markus and Nisbett 1998); however, marginalization due to cultural or economic differences could be more connected with the collective and structural reality in which students' beliefs are inherent (Fiske, Kitayama, Markus and Nisbett 1998). As such, we need to consider that the contexts, targets, and related factors that need to be reframed can change depending on the specific case of each marginalized student.

Importantly, no matter what the reason for being marginalized, in order for marginalized students to re-engage in their classroom activities, they need to have a chance to (re) frame themselves and surrounding contexts in some way. To provide them more suitable support, marginalized students' (re)framings need to be understood in connection with the multilevel structure contexts and sources that caused the marginalization. In this vein, taking into account where various differences they face come from could be the first step for supporting their (re)framing. We believe the perspective of multilevel framing can serve as an essential guide for identifying the characteristics of marginalized students and seeking out ways to support them.

How to support (re)framing of marginalized students to establish equity in science classrooms

This commentary discusses the characteristics of students' framing in science classrooms in terms of interactional dynamics and multilevel structures. In terms of the interactional dynamics of framing, students dynamically negotiate their positions and roles in groups through events and experiences with the peers with whom they have been continuously interacting. In particular, in science classrooms, students' epistemological framing of science activities is co-constructed interactively with their positional framing in peer relationships. Next, in terms of multilevel structures of framing, students' marginalization has been reported to be shaped and shifted by multiple levels of social structural factors. In other words, various causes of marginalization in classrooms occur as multilevel structural influences, which also affect the framing of students.

The above aspects of the nature of framing discussed in this commentary can be also adapted to change the framing of marginalized students, in other words, reframing them. In order to find a way to positively promote (re)framing of marginalized students, we interpreted the positive factors that promoted the participation of marginalized students reported in previous studies and Ha and Kim (this issue) from the perspective of framing. Considering that in actual classrooms the different aspects of the nature of framing occur together rather than appearing independently, we derived the following four integrative ways to support the (re)framing of marginalized students.

First, marginalized students need to be supported to (re)frame themselves. Previous studies have reported that marginalized students formed negative self-identities and low self-esteem (Brown 2004; Yerrick and Gilbert 2011). Ha and Kim (this issue) reported that June was not acknowledged by his peers at first, but June did not give up and continued to try to participate in group activities. June's continuous attempts may have been the biggest impetus for a shift of framing. June was eventually able to change his positional framing in his group, as he was acknowledged for his contributions. However, in many cases, it is not easy for marginalized students to create opportunities for (re)framing themselves in the way that June did. Given that positional framing can change with a great deal of effort and time, marginalized students' negative identities can be the biggest barrier to changing framing. Thus, marginalized students need to be encouraged to positively (re)frame their self-esteem with confidence. For example, marginalized students can be provided roles or opportunities to contribute to science classroom activities. These opportunities need to be carefully set up in various ways, such as academic contribution or social contribution, considering the characteristics of the individual student (Manning 2007; Marigold, Cavallo, Holmes and Wood 2014).

Second, in order to shift marginalized student' positional framing, the students' epistemological framing also needs to be improved. Epistemological framing and positional framing that occurs in science classrooms is intimately connected to students' behaviors, reasoning, and group dynamics (Scherr and Hammer 2009); however, they act in different ways on student behavior in science classrooms. Positional framing influences "how" one should engage in scientific activity in terms of social interaction, while epistemological framing is closely related to "what" participation in scientific activities is in terms of understanding knowledge and learning (Shim and Kim 2018). If a marginalized student wants to become a contributor in science activities, the student needs to know what meaningful participation is and how to contribute to it.

Third, in terms of (re)framing peer relationships, it is necessary to let not only marginalized students but also other students think back on their group performance and processes. It is difficult for teachers to control all aspects of peer conflicts. Instead, providing chances to look back on themselves can encourage students to be objectively aware of their words and behaviors in group work (Phielix, Prins and Kirschner 2010). Similarly, in the interviews conducted in Ha and Kim (this issue), the participant students were regularly asked the questions about their peer relationships and group work in every lesson. Interview processes can be good opportunities for students to reflect on peer relationships and their behaviors toward others.

Fourth, in terms of (re)framing sociocultural contexts, social resources need to be reorganized productively to establish opportunities to (re)frame the roles and positions of marginalized students. In order for marginalized students to be recognized as members rather than as isolated individuals, resetting sociocultural resources such as classroom norms and social spaces can contribute to promoting a sense of belonging and cooperative relationships in a group. For example, actively sharing their resources and ideas can be a good way to create social spaces reframed for marginalized students (West-Burns and Murray 2016). Teachers also can establish as a classroom norm that everyone should be given equal opportunities to participate, which helps a class to share social values about caring for others and improves equity (Chang and Song 2016). These social resources can be good means of connecting marginalized students to their groups (Bianchini 2017).

It is very difficult to establish equity in science classrooms, because, as has been discussed, marginalization in classrooms results from conflicting relationships that have accumulated from past experience or complex social structural influences. In particular, this commentary analyzed the classroom participation of marginalized students from a framing point of view. We have further shown that framing can serve as a framework to effectively show the interactional dynamics and social structural complexity faced by marginalized students. Again, despite the difficulties of establishing equity in education, as shown in Fig. 1, active support to bridge the gaps that marginalized children still face should continue. In this context, the various discussions in this commentary have contributed to recognizing and responding to the participation of marginalized students more sensitively.

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