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# Classroom Interaction Management in Achievement-Related Diversity: A Conversation Analytic Examination

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**Abstract:** This research delves into the intricate dynamics of classroom interactions, focusing on how students perceived as potentially high- and low-achieving demonstrate their epistemic status within these interactions and how teachers respond to and manage these displays. By employing a micro-analytical perspective, this study meticulously examines the interactional strategies and features utilized by both students and teachers throughout the research process. The data were collected from Turkish science and mathematics classrooms as part of a comprehensive, long-term professional development course aimed at enhancing teaching practices. The findings reveal that students employ specific interactional tools, referred to as epistemic stances, which vary according to their perceived epistemic status. These stances serve as indicators of their knowledge, understanding, and engagement within the learning environment. Furthermore, the study highlights how the intentional design of classroom interactions, grounded in the concept of epistemic access, equips science and mathematics teachers with the means to effectively manage the diverse achievement levels in their classrooms. This design not only fosters inclusive participation but also ensures that both high- and low-achieving students are actively engaged in the learning process. The implications of this study extend beyond the immediate findings. It underscores the need for further research into the ways epistemics are displayed and managed in classroom settings. Additionally, the insights gained from this research have the potential to significantly contribute to the fields of science and mathematics education. They offer valuable guidance for teachers, teacher trainers, and educational policymakers in designing professional development courses aimed at enhancing the quality of classroom discourse.

**Keywords:** Diversity, epistemics, classroom discourse, video analysis, micro-analytic perspective

# Başarıyla İlgili Çeşitlilikte Sınıf İçi Etkileşim Yönetimi: Bir Konuşma Çözümleme İncelemesi

**Öz:** Bu araştırma, potansiyel olarak yüksek ve düşük başarılı olarak algılanan öğrencilerin, epistemik statülerini etkileşimler içinde nasıl gösterdiklerine ve öğretmenlerin bu gösterilere nasıl karşılık verip yönettiklerine odaklanarak sınıf içi etkileşimlerin iç dinamiklerini incelemektedir. Mikro-analitik bir bakış açısı kullanılan bu çalışmada, araştırma süreci boyunca hem öğrenciler hem de öğretmenler tarafından

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kullanılan etkileşimsel stratejiler ve özellikler titizlikle incelenmektedir. Veriler, öğretim uygulamalarını geliştirmeyi amaçlayan kapsamlı, uzun vadeli bir mesleki gelişim programının bir parçası olarak Türkiye'deki fen ve matematik sınıflarından toplanmıştır. Bulgular, öğrencilerin epistemik statü olarak adlandırılan ve epistemik statü durumlarına göre değişen belirli etkileşimsel araçları kullandıklarını ortaya koymaktadır. Bu durumlar, öğrencilerin bilgi, anlayış ve öğrenme ortamına katılımlarının göstergeleri olarak işlev görmektedir. Ayrıca çalışma, epistemik erişim kavramına dayanan sınıf etkileşimlerinin kasıtlı tasarımının, fen ve matematik öğretmenlerini sınıflarındaki farklı başarı düzeylerini etkili bir şekilde yönetme araçlarıyla nasıl desteklediğini vurgulamaktadır. Bu tasarım sadece kapsayıcı katılımı teşvik etmekle kalmıyor, aynı zamanda hem yüksek hem de düşük başarılı öğrencilerin öğrenme sürecine aktif olarak katılmalarını sağlıyor. Bu çalışmanın sonuçları, anlık bulguların ötesine uzanmaktadır. Epistemiklerin sınıf ortamlarında sergilenme ve yönetilme biçimlerine ilişkin daha fazla araştırma yapılması gerektiğinin altını çizmektedir. Ayrıca, bu araştırmadan elde edilen bulgular fen ve matematik eğitimi alanlarına önemli katkılarda bulunma potansiyeline sahiptir. Öğretmenler, öğretmen eğitimcileri ve eğitim politikacıları için sınıf içi söylemin kalitesini artırmayı amaçlayan mesleki gelişim programları tasarlama konusunda değerli bir rehberlik sunmaktadır.

**Anahtar kelimeler:** Çeşitlilik, epistemik, sınıf söylemi, video analizi, mikro-analitik bakış açısı

## Introduction

Researchers in science education field concern two essential strands of learning, individual and sociocultural views of learning. First one reflects cognitive science learning views while latter related to social interactions between individuals (Leach & Scott, 2003). Second view also see science education as human social activities carried out within cultural and instructional settings (Lemke, 2001). Vygotsky who is pioneer of the sociocultural theory (1978) discussed that 'human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them' in his essential work, Mind in Society (p.88). Interaction, especially talking has a vital role in human learning in mentioned social nature. Moreover, thinking and talking are neither considered as completely different from each other nor as the same. Thought cannot be explained without considering how it is manifested by linguistic means, and linguistic activities. Similarly talking cannot be fully understood without considering them as manifestations of thought (Lantolf, 2000). In this perspective, language supplies the tools for individual thinking (Leach & Scott, 2003). The interrelationship of talking and thinking reflects the link between epistemic practices which represent some cognition processes, and epistemics which represents knowledge claims in talk-in-interaction when we consider talking may make visible thinking. In line with this perspective, classroom talk is seen as a crucial aspect of the learning process (Kelly, 2014; Lemke, 1990; Mortimer & Scott, 2003). Similarly, classroom interactions, student-student and student-teacher interactions, provide opportunities for enhancing scientific understanding of students by dialogic interaction (Morton, 2012) and for co-construction of knowledge. Since multiple modes like sound, gesture, movement, oral and written language support meaning construction in classroom interaction (Choi & Yi, 2016) and make visible the link between epistemic practices and epistemic status which is related to relative epistemic access to information.

The nature of talk in classrooms, and in particular the ways in which different kinds of interactions between teachers and students contribute to students' learning, have been the focus of several studies (Mortimer & Scott, 2003; Wellington & Osborne, 2001). Classrooms are complex social and institutional environments in which there is an inevitable heterogeneity concerning talking and thinking, and teachers struggle to interact with many students to support them

(Mortimer et al., 2012). One of the most prominent challenges teachers face is students' diversity (Meijer, 2010). The diversity in the classroom might be language, gender, cultural, and achievement-related diversity. The common view in the past was to keep diversity in the classroom to a minimum. However, there is a paradigm shift from homogeneity, where differences are not acknowledged, to diversity where differences are considered an asset and opportunity. This paradigm shift comes from the ideas that individual differences such as cultural, religious, ethnic identities, interests, abilities, and perspectives are essential sources for mutual learning (Sliwka, 2010) and that achievement-related diversity provide opportunities for mutual learning in group works in the perspective of the zone of proximal development in terms of socio-cultural learning. This shift in perspective towards diversity is also seen in white papers (e.g., European Commission (EC), 2007), and some strategies (e.g., inquiry-based learning) are recommended to provide science and mathematics education opportunities to be inclusive and manage diversity in the class (Kelly, 2014; Miles & Ainscow, 2010). In this understanding, where diversity is seen as an opportunity, it is important to examine how students display their epistemic status and how teachers manage displaying of epistemic access of students regarding diversity, especially in terms of achievement. Moreover, it is essential to reveal the link between epistemic practices and the epistemics in classrooms. In this view, we investigate how potentially high- and low-achieving students tend to display their epistemic status in interaction and how the participant teachers manage the (lack of) display of potentially high- and low-achieving students' epistemic access.

## Theoretical Framework

### *Epistemics and Classroom Interaction*

From an interactional perspective, such as conversation analysis, learning is considered a combination of participatory and interactional phenomena rather than individual, cognitive phenomena (Ingram, 2020). In a similar way, we focus on how participants manage the knowing and unknowing position through interaction rather than the cognitive domain in this study. While focusing on the mentioned issue, we will draw upon the concept of "epistemics" rather than the "epistemic practices" which involve knowledge production, evaluation process and gathering patterns from data (e.g., Erduran & Garcia-Mila, 2015), and epistemic cognition "how people build, understand, modify and use knowledge in formal and informal context" (e.g., Erduran 2019, p. 819) commonly mentioned in science education. Epistemics "focuses on the knowledge claims that interactants assert, contest and defend in and through turns-at-talk and sequences of interaction" (Heritage, 2013, p. 370). Early studies concerning the epistemics in the talk-in-interaction were focused upon daily conversation (e.g., Heritage, 2012a; Heritage, 2012b). However, there have been a growing number of studies investigating epistemics (Kämäräinen et al., 2019). Some focused on epistemic management (Ingram, 2020), epistemic stance (Skarbø Solem, 2016b), and epistemic status (Sert, 2013). Some scholars discuss the epistemic status and epistemic stance in the context of epistemics. Studies related to epistemics also emphasise these distinctions (Morek, 2015). Although used in the same context, they have a different essential point. The differentiation, thus, is critical in terms of the correct understanding of the epistemics in interaction (Heritage, 2013).

According to Heritage (2012b), epistemic status refers to:

The relative epistemic access to a domain or territory of information as stratified between interactants such that they occupy different positions on an epistemic gradient (more knowledgeable [K+] or less knowledgeable [K-]) (p. 4).

and epistemic stance refers to:

If epistemic status vis-à-vis an epistemic domain is conceived as a somewhat enduring feature of social relationships, epistemic stance, by contrast, concerns the moment-by-moment expression of these relationships, as managed through the design of turns at talk (p. 6).

### *Epistemic Management in Classroom Interaction*

Research on classroom interaction discloses an interactional asymmetry in which the teacher asks questions, evaluates responses, and decides most classroom activity settings to reflect institutional rights (Cazden, 2001; McHoul, 1978). This asymmetry can also be associated with epistemic asymmetry in the classroom. The epistemic asymmetry gives the teacher epistemic status for authority and responsibility to know (Skarbø Solem, 2016a). It can be thought that these asymmetries shift from the teacher's position to students' positions in the knowledge co-construction process in settings such as student-centred learning environments. Since students can initiate interaction and manage activities during group works in student-centred learning settings (Kämäräinen et al., 2020; Melander, 2012).

We must highlight epistemic management to shed light on classroom interaction management regarding achievement-related diversity (Stivers et al., 2011). This points out three main dimensions of knowledge concerning epistemic asymmetries, which are epistemic access, epistemic primacy, and epistemic responsibility. They reflect social alignment, affiliation, and social norms that both affect them and are affected by them. Epistemic access is concerned with knowing and unknowing, degree of certainty, knowledge source, and directness of knowledge (Stivers et al., 2011). In other words, from a narrow perspective, it is related to who may have access to the knowledge (Ingram, 2020). In line with the above-mentioned, epistemic stances can be seen as a resource and provide evidence about a person's knowledge or understanding (Rusk et al., 2016), that is to say, the epistemic stances reflect epistemic access.

Epistemic primacy is concerned with relative rights to know, relative rights to claim, and relative authority of knowledge. It refers to how interactants orient to epistemic asymmetries in their rights to tell, inform, assert, or assess something (Stivers et al., 2011). In classrooms, institutional roles concerning epistemic access and rights have been constructed (Ingram, 2020), and these roles shape the classroom interaction. Besides, many studies have found that teachers have epistemic primacy (e.g., Skarbø Solem, 2016b).

Lastly, epistemic responsibility is related to the knowable (Type 1 and Type 2), recipient design of action, and recipient design of turns, and points out that people have specific responsibilities concerning knowledge (Stivers et al., 2011). When epistemic responsibility is focused on in terms of the knowable, Pomerantz (1980) highlights that while "Type 1 knowables are those that subject-actors as *subject-actors* have rights and obligations to know", "Type 2 knowables are those that subject-actors are assumed to have access to by virtue of the knowings being occasioned" (p. 187, italics in original).

## Review of Related Research

Upon examining epistemics within classrooms by conversation analysis carried out on the language and content of instruction, Jakonen and Morton (2015) studied interactional sequences in which students collaboratively work on the task given by the teacher to identify and resolve knowledge gaps. Specifically, the study highlights three questions related to interactional management "How do participants display their epistemic status and stance and orient to other

epistemics?". The findings related to this paper indicate that students try to agree about what they know and do not know about the targeted knowledge by coordinating linguistic, embodied, and artefactual resources. Besides, different situations are disclosed about displaying a less knowledgeable epistemic between peer interaction and teacher-student interaction. Similarly, when focusing on two main research questions, Melander (2012) explored how knowing and unknowing local epistemic identities are set up, maintained, and contested during the talk-in-interaction, and how dynamically changing occurs between unknowing and knowing participants in the interaction process. The researcher suggests that the production of change-of-state token 'oh' is related to epistemic identities. Additionally, the position of asking for advice identified the participant as an expert or a novice.

In terms of science or mathematics classroom research, Ingram (2020) examined epistemic management of talk-in-interaction in mathematics classrooms. Conducting a study based on epistemic display, she focused on how mathematics teachers manage classroom interactions when students display claims of not knowing, not remembering, or not understanding. The study results point out that, on the one hand, when the initiation turn of the initiation-response-feedback (IRF) sequence (Sinclair & Coulthard, 1975) consists of a known-answer question expressed by a teacher, both claims of not knowing and not remembering are carried out during the response turn. After these claims, the teacher orients another student to make a response. On the other hand, when a student claims to understand, the teacher tends to deal with the same student. Also, shining a light on epistemic displays, Koole (2010) examined students' display of epistemic access within a mathematics context. The researcher used the epistemic access concept to refer to both understanding and knowing. When they examined how epistemic displays occur, Herder et al. (2020) discerned five different situations in which epistemic displays occur in their peer talk study. They are a) accounts, b) disagreeing, c) responses to a request for information, d) other-corrections, and e) expanding. The first two have a justification function in interaction, and the others have clarifying functions. In parallel with the study Herder et al. (2020), Kämäräinen et al. (2019) examined how peers manage their lack of/insufficient understanding or knowledge of a mathematical task's content. The findings of the study pointed out two trajectories. The first one is how the interaction between a K+ student and a K- student proceed when they interact with themselves. The second one is how the interaction between them moves forward when a K- student disputes the K+'s knowledge claim. The findings also illustrated that when a K+ student carried out epistemic work, the sequences revealed are similar to the IRE organisation. If the K+ student initiated the sequence, then the sequence would resemble the teacher's practices, such as known-answer questions, guiding questions, and designedly incomplete utterances. Besides, the K- student adapted his answers for evaluation by requesting and answering K+.

Lastly, Heller (2017) investigated multimodality displays that aim to (re)construct a congruency between students' actual knowledge claims and teacher's expectations related to participants' relative knowledge, which refer to more knowledgeable (K+) or less knowledgeable (K-), within mathematics classrooms. The findings illustrate that teachers explicitly define the students' knowledge instead of keeping track of their knowledge states. The teachers manage epistemic responsibilities within IRF sequences with "inserted knowledge questions" and "inserted knowledge accounts" practices. When epistemic statuses and epistemic stances are incongruences, teachers produce knowledge challenges after IRF sequences. Lastly, the researcher suggests that constructing a homogeneous epistemic status is essential to achieve classroom settings tasks. The

teachers explicitly identify students as "novices" or "advanced learners" after initiating IRF structures and providing an epistemic ecology.

**Significance and Contribution of the Study**

Epistemic concerns such as epistemic access, epistemic primacy, and epistemic responsibility are essential issues in classroom interaction. The claims of (not) knowing, (not) remembering, or (not) understanding, and other displays of epistemic status, provide essential opportunities for teachers to manage interaction based on classroom activities such as inquiry or argumentation activities as well as group work. Moreover, it is known that teachers' and students' interactions make observable their knowing and how it changes, develops, and is negotiated in classroom interaction (Ingram, 2020). Therefore, revealing how the students' epistemic status is displayed in achievement-related diversity classrooms will give us preliminary prognosticates about how teachers conduct epistemic management in the science and mathematics teaching process. Although there has been much research on epistemics in interaction, limited studies highlight students' epistemic status and teachers' epistemic management in the talk-in-interaction within science or mathematics classes. Thus, we consider that more research is needed both on how epistemics are displayed and how teachers carry out epistemic management, and that this study will contribute to the science and mathematics education fields, more specifically science and mathematics teachers, and teacher trainers, enabling them to design professional development courses to shift the quality of classroom talks.

Additionally, as can be seen from the above-mentioned situations, studies that examine the interactional management of diversity for achievement are needed. They highlight how achievement-related differences are considered an asset and opportunity. From these perspectives, this study's lens contributes to not only the research area on epistemics in teacher-student interaction but also epistemic management within science and mathematics classrooms.

Lastly, although many researchers have carried out studies in both science and mathematics education every year, the number of studies that provide a close examination of the interactions taking place in the science and mathematics classrooms is far less than others (e.g., Şardağ, 2019; Kaya & Şardağ, 2021; Ingram, 2020; Kämäräinen et al., 2019). Therefore, there is a need for studies that reveal what happens in the classrooms at any given moment and that closely examine the classroom interactions, and their findings will contribute significantly to the field. In line with the above-mentioned information, we intend to shed light on the students' epistemic status and the teachers' epistemic management in achievement-related diversity science and mathematics classrooms. More precisely, we aimed to investigate how potentially high- and low-achieving students tend to display their epistemic status in interaction and how the participant teachers manage the (lack of) display of potentially high- and low-achieving students' epistemic access by drawing on a micro-analytic perspective, which is a social interaction investigation approach that focuses on repeated conversations in a range of contexts and settings (Sidnell, 2009). In this study, the main rationale for examining low and high achieving students is to gain a deeper understanding of the role of different achievement levels in classroom interactions that exhibit appropriate behaviours. The achievement status of the students was determined by taking into account the situations indicating their epistemic status without using any criteria. Understanding these situations is the main purpose of this study. we aimed to bring light to the following two research questions:

- How do potentially high- and low-achieving students tend to display their epistemic status in interaction?
- How do the participant teachers manage the (lack of) display of the epistemic access of potentially high- and low-achieving students in interaction?

## Methodology

This study is qualitative research and is based on Conversation Analysis (CA) methodology to analyse classroom interactions in depth. Conversation analysis is a method that allows natural interactions to be examined from a micro-analytic perspective and provides a suitable framework for understanding the organisation of classroom conversations. This approach makes it possible to analyse in detail the social actions that individuals perform through language. CA has evolved from ethnomethodology (Kasper & Wagner, 2011). While ethnomethodology studies principles based on the social actions of people, CA focuses on the principles that individuals use in interacting with other individuals through language (Seedhouse, 2004), and repeated conversations in some contexts and settings (Sidnell, 2009). In line with the micro-analytic perspective, we investigated interlocutors' interaction line by line and studied the interactional patterns which emerged from the conversations.

### The Context of the Professional Development Course

In the study, 97 in-service science and mathematics teachers (34 males, 63 females) working in three different cities in Türkiye were provided with an EU project entitled Supporting Mathematics and Science Teachers in Addressing Diversity and Promoting Fundamental Values [MaSDiV] professional development (PD) courses in 2018 and 2019. The project's goals were to support science and mathematics teachers through the lens of inquiry-based learning in terms of inclusive education for all students, promoting active citizenship, and encouraging intercultural learning. In the current study, we mainly focus on inclusive education for all students in relation to science and mathematics. Within this study's scope, some teachers implemented their activities in their classrooms; others implemented the project activities in their classrooms. Detailed information about the activities is presented in Table 1 and before the excerpts to provide a meaningful context.

**Table 1**

*Activities and Their Aims*

| The activity name | The aim and content of the activity |
|---|---|
| Rope and age activity | • To understand how variables refer to varying unknowns;<br>• To construct and use expressions with variables to solve problems.<br>• To collaborate on an open and rich task allows for diversity in the ways of working as well as in the level of achievement. |
| Multicultural meal | • To investigate which cultures are represented in the school/class, what kind of meals are common, what we mean by ‘a healthy meal’ |

| | |
|---|---|
| | • To decide on which healthy, multicultural dishes they want to offer and find out how much of each ingredient is needed and what the costs are.<br>• To collaborate on an open and rich task allows for diversity in the ways of working as well as in the level of achievement. |
| Volume activity | • To understand volume measures<br>• To calculate the volume of the classroom<br>• To produce collaborative solutions for an open-ended problem that can be solved in different ways |
| Thermal power station | • To discuss on whether or not to establish thermal power plants in the region where the students live.<br>• To allow students collaborative work in a socio-scientific issue based context |
| Light pollution | • To recognize the environmental impact of light pollution and to develop devices to reduce light pollution<br>• To allow students collaborative work on a problem whose negative environmental effects are observed. |
| Escape room activity | • To understand prime numbers<br>• To reach the result step by step by solving the different problems presented |
| Polygon | • To understand the polygonal structures by considering the plant leaves they encounter in daily life. |

First two activities, rope and age activity and multicultural meal activity, was designed by MaSDiV researchers, the other was developed and implied by the teachers.

**Participants**

The primary participants of this study are teachers, with the classroom interactional data collected from their classes serving as the basis for the analysis. Although students are not directly identified as participants, the interactions within the teachers' classrooms were analyzed to uncover the students' epistemic states (e.g., access to and expression of knowledge). These epistemic states were interpreted by the teachers, focusing on high- and low-achieving student groups based on their interactional behaviors.

The main participant group comprises 3 science and 3 mathematics teachers who voluntarily recorded their classroom lessons as part of an EU-funded Continuous Professional Development (CPD) program. The participant teachers were 2 males and 4 females working in six middle schools located in three different cities in Türkiye. These teachers taught science and mathematics in the classrooms where the study was conducted.

The data were collected from video recordings of lessons in which the teachers implemented inquiry-based learning activities developed as part of the CPD program. The interactions captured in these lessons provided insights into how students' epistemic states were displayed and how the teachers managed these states in the context of high- and low-achieving students. While students' interactional data were analyzed to understand their epistemic states, they

were considered indirect participants of the study. The focus of the research remains on the teachers and their interactional management strategies in the classroom.

## Data Sources and Analysis

The study's data came from the video-audio recording of six science and nine mathematics lessons, each of which is approximately 35 minutes long, in six secondary schools in Türkiye. During the lessons, the teachers carried out above-mentioned inquiry-based learning activities.

The collected data were transcribed according to the Jefferson transcription system (Jefferson, 2004), examined line by line and turn by turn, and analysed from a micro-analytic perspective. micro-analytic perspective can show the interactive nature of classes by examining naturally evolving interaction data.

An inductive thematic analysis was conducted to identify interactional patterns. The interactional patterns identified through the data analysis have been presented in the findings section to illustrate how epistemic states and interactional strategies are manifested in classroom interactions. The first part of the analysis focuses on how potentially high- and low-achieving students tend to display their epistemic access in interaction. The second part of the analysis highlights how teachers manage the (lack of) display of potentially high- and low-achiever students' epistemic access in interaction. To ensure validity, two researchers analysed the data at two different times, and they applied the next-turn proof procedure during the analysis process. After that, when presenting the excerpts obtained, a multilinear transcription was used as much as possible and as needed. In transcription, the first line is in the participants' mother tongue, the second line presents a literal word-for-word English translation, and the third line gives an idiomatic English translation (Hepburn & Bolden, 2013).

# Results

The main findings are reported in two sub-sections: (1) how do students display their epistemic access during talk-in-interaction in science and maths classrooms and (2) how do teachers manage interactional management strategies for students who displayed different epistemic access through classroom interaction? In this section, we have presented a total of nine excerpts. These excerpts were chosen because they reflect the studied phenomenon as well as possible.

## Displaying Own Epistemic Access in Science and Maths Classrooms

The data show that students use many strategies through interaction to show their epistemic access. Furthermore, students' strategies vary according to their more knowledgeable or less knowledgeable position in the interaction. These interactional structures used by students are classified in Table 2 and discussed in detail below.

**Table 2**

E*pistemic Stances (Interactional Patterns) Used by Students to Display Epistemic Access*

| |
|---|
| ● Display of more knowledgeable position with |
| ○ *Giving the correct response* |

- Taking the floor
  - *Announcing their willingness to take the next action by body motion*
  - *Self-selecting*
  - *Overlapping speech*
  - *Raising a hand*

- Display of less knowledgeable position with
  - *Asking for clarification*
  - *Giving the wrong response*
  - *Disengagement (keeping silent, not being involved in the process, not raising a hand, avoiding taking the turn)*

**Displaying of More Knowledgeable Position**

Students draw on epistemic stances in talk-in-interaction to show their epistemic status in a more knowledgeable position. These stances are examined in Excerpts 1 and 2.

Excerpts 1 and 2 come from the activity that a mathematics teacher developed after the MaSDiV's PD courses. Students focus on measuring volume and measured the volume of the classroom during the activity.

**Excerpt 1**

*Taking the Floor Actions*

| | | |
|---|---|---|
| 21 | Student 6 | :hocam<br>*teacher*<br>***Teacher.*** |
| 22 | Math Teacher 1 | :öğrenci 7<br>*student 7*<br>***Student 7.*** |
| 23 | Student 7 | :hocam yüz elli dört<br>*teacher one hundred fifty-four*<br>***Teacher. One hundred and fifty-four.*** |
| 24 | Math Teacher 1 | :yüz=<br>*one hundred=*<br>***One hundred…*** |
| 25 | Student 8 | :=a hayır=<br>*=aah no=*<br>***Aah! No.*** |
| 26 | Student 7 | :=ellidört<br>*fifty-four*<br>***Fifty-four.*** |
| 27 | Math Teacher 1 | :yüz elli dört↑ tane bundan<br>*one hundred and fifty-four of that* |
| 28 | | yerleştirirs[ek dolar diyorsun]<br>*if we put into it, [it is filled you say*<br>***If we put into it one hundred and fifty-four of that, you say it is filled.*** |
| 29 | Student 9 | : [hayır hocam hayır] hocam=<br>*[no teacher no teacher=*<br>***No, Teacher, no. Teacher.*** |
| 30 | Math Teacher 1 | :=bir saniye bir saniye (0.2) bi saniye (0.5) |

=one second one second (0.2) one second (0.5)
***One second. One second. One second.***
31 yüzellidört↑ diyen arkadaşlar↓
*one hundred and fifty-four who said friends*
***Friends, who said one hundred and fifty-four?***

Before the excerpt, the teacher asked how many cubes they had put into the classroom, referring to a past learning event, and provided extended waiting time (see Excerpt 9). After these actions, Student 6 asks to take the turn (line 21). However, the teacher allocates the turn to Student 7 via individual nomination (Mehan, 1979) in line 22. Student 7 constructs a response turn "***Teacher. One hundred and fifty-four.***" as a possible answer to the teacher's question in line 23. Following that, the teacher's turn starts by repeating Student 7's response, "***one hundred…***" (line 24). However, Student 8 states a disagreement expression "***Aah! No"*** by latching to the teacher's proceeding turn (line 25). While the teacher completes the echo turn in line between 27 and 28, Student 9 tries to take the floor by overlapping with the teacher's turn and displaying disagreement with Student 7 (line 29). Following the overlapping turn, the teacher clearly rejects the self-selection turn-taking in line 30. The teacher insists on completing his own utterance, and he asks the whole classroom who agrees with Student 7. This is the end of the sequence.

In terms of displaying a more knowledgeable position, Student 8 takes the turn by latching to the teacher's uncompleted utterance to explain the previous speaker's answer was wrong. Although the teacher is not aligned with Student 8's action to take the floor, Student 8 clearly shows her epistemic access as a more knowledgeable position through the interaction. In the same excerpt, Student 9 explains that Student 7's response was wrong, using overlapping speech in line between 28 and 29. This is also called an interactional action to take the floor to display her epistemic access.

Displaying a more knowledgeable position expresses self-selection and overlapping speech and has some multimodal aspects, for instance, Excerpt 2.

**Excerpt 2**

***(****The Continuation of Excerpt 1 (Lines Between 31 and 56 Are Omitted))*

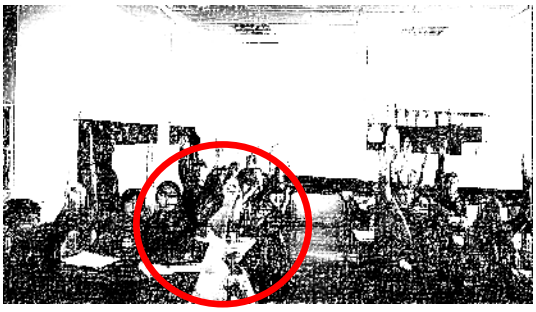
56 Math Teacher 1 :yüz kırk dört diyenler peki başka (0.4) başka
*one hundred forty-four those who say well any more (0.4)*
*any more*
***Those who say one hundred forty-four? Well, any more?***
***Any more?***
((students raise hands)).

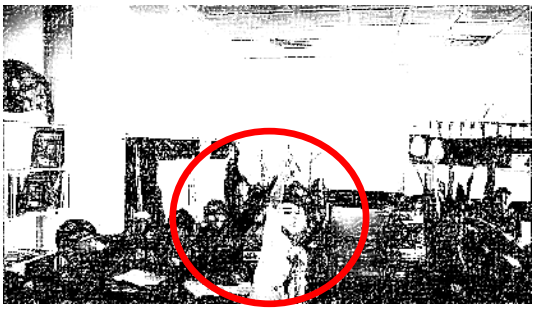
#1

#2

#3

#4





57 Student 12 : hocam ben hiç kalkmadım
*teacher I have never received the right to speak*
***Teacher. I have never received the right to speak.***

58 (1.6)

59 Math Teacher 1 : hiç kalk↑madın mı bugün öğrenci 12↑
*ever you ask for the right to speak did today student 12*
***Did you even ask for the right to speak today, Student 12?***

60 Student 12 : yüz kırk dört bin
*one hundred and forty-four thousand*
***One hundred and forty-four thousand.***

61 Math Teacher 1 : yüz kırk dört↑ bin tane diyor
*one hundred and forty-four thousand pieces he says*
***He says one hundred and forty-four thousand pieces.***

62 Students : doğru evet
*it is true yes*
***It is true, yes.***

63 Math Teacher 1 : o zaman↓ o zaman bizim sınıfın hacmi kaç litre
*and so and so of our class the volume how many litres is*
***And so. How many litres is the volume of our class?***

64 Students : yüz↑ kırkdörtbin bin
*one hundred and forty-four thousand*
***One hundred and forty-four thousand.***

53 Math Teacher 1 : yüzkırkdörtbin litre[lik bir ]hacme sahibiz.
*one hundred and forty-four thousand* lit[ers a volume we have
***We have a volume of one hundred and forty-four thousand litres.***

65 Students : [litre]
[***liter***

66 Math Teacher 1 : doğru mu↑
*correct is it*
***Is it correct?***

67 Students : evet
***Yes.***

The excerpt begins with the teacher's request, "***Those who say one hundred forty-four. Well, any more? Any more?"*** for alternative responses (line 56). Many raise their hands to take the floor. Student 12, also moves noticeably, jumping up and down, and this is probably the reason why the teacher allocates him the turn (line 57) (see #1, 2, 3, 4). In other words, Student 12 tries to take the turn with all his might. These situations, raising hands and the unusual behaviour of Student 12, may present interactional evidence for their epistemic access in a more knowledgeable position since they intend to display their knowledge. After 1.6 seconds of silence in the excerpt, the teacher nominates Student 12, who expresses his idea (line 60). The teacher echoes Student 12's turns to the whole class (line 61). Then some students take the turn by self-selecting and confirm Student 12's idea (line 62).

Similarly, the action of self-selection to take the floor is interpreted as an indicator of the more knowledgeable position. Afterwards, the teacher asks questions, and some students respond chorally (lines 64 and 66). Consequently, the students who are interactionally in a more knowledgeable position try to take the floor by raising hands, self-selection, or announce their willingness with multimodal aspects.

**Display of Less Knowledgeable Position**

The study's corpus does not have only displays of a more knowledgeable position; some interactional patterns indicate the less knowledgeable position. When classroom interactions are examined, some interactional features come into prominence in less knowledgeable positions. These interactional features are examined in Excerpts 3, 4, and 5.

Excerpt 3 involves a piece of rope activity. The activity allows achievement-related diversity to be addressed by collaborating on the open task and choosing a strategy. Students try to solve the following problem.

> *A rope of 30 metres is divided into five short and three long parts. A short and long part together total 9 metres. How long is a short part?*

**Excerpt 3**

*Wrong Response and Low-Level Achieving in Micro-Moment Context*

| | | | |
|---|---|---|---|
| 1 | Student 1 | : | hocam bir buçuk mu |
| | | | *teacher is it one-and-a-half* |
| | | | ***Teacher. Is it one-and-a-half?*** |
| 2 | Math Teacher 2 | : | bir buçuk nasıl buldunuz |
| | | | *one-and-a-half how did you find it* |
| | | | ***One-and-a-half. How did you find it?*** |
| 3 | Student 1 | : | hocam x artı x eşittir dokuz |
| | | | *teacher x plus x is equal to nine* |
| | | | ***Teacher. X plus X is equal to nine.*** |
| 4 | | | ikisinin beş parça ile üç parçanın toplamı sekizdir |
| | | | *of both of five pieces and three pieces the sum is eight* |
| | | | ***…of both. The sum of five pieces and three pieces is eight.*** |
| 5 | | | ama bu ikisinin eşit olabilmesi için |
| | | | *but these two could be equal since* |
| | | | ***but, since these two could be equal…*** |
| 6 | | | (2.2) |
| 7 | Math Teacher 2 | : | nasıl ben anlamadım şimdi ikisi uz- eşit uzunlukta |
| | | | *how I didn't understand now the two of them equal in length* |
| 8 | | | değil ya bun↑ların toplam[ını dokuza] eşitleyemeyiz |
| | | | *are not because of them the sum to nine we cannot equalise* |
| | | | ***How? I didn't understand. Now, because the two of them are not equal in length, we cannot equalise their sum to nine.*** |
| 9 | Student 1 | : | [evet tamam] |
| | | | [yes okay |

The excerpt begins with Student 1 asking a question to seek confirmation of their teacher (line 1). The teacher responds with a referential question, ***How did you find it?,*** instead of making any assessment or confirmation in line 2. Student 1 starts to explain their solution method (lines 3-5). After this, the 2.2-second pause is a signal of trouble; the teacher indicates they did not understand and explains why the student's solution method is wrong (lines 7-8). This interaction shows that the teacher does not prefer the given response. When the interaction is examined,

according to Raymond (2003), the 2.2-second silence and the teacher's hesitation, "***How? I did not understand.***" show that the response is not preferred. Besides, the teacher explicitly explains why the presented solution cannot be right *"**because the two of them are not equal in length, we cannot equalise their sum to nine***" in line 8. This situation might reflect that the student gives the wrong answer, displays his/her epistemic access as a less knowledgeable position, since s/he cannot produce the preferred responses at that moment.

Another example of the less knowledgeable position illustrated in Excerpt 4 comes from a multi-cultural meal activity. The conversation opens with a student's question following the teacher's informing process. This activity addresses achievement-related diversity, such as the rope exercise, collaborating on an open and prosperous task.

**Excerpt 4**

*Asking for Clarification and Epistemic Gradient*

| | | | |
|---|---|---|---|
| 1 | Student 1 | : | hocam birşey sorabilir miyiz |
| | | | *teacher something can we ask* |
| | | | ***Teacher. Can we ask something?*** |
| 2 | Science Teacher 1 | : | sor |
| | | | ask |
| | | | ***Ask.*** |
| 3 | Student 1 | : | hocam diyor ya sınıfınıza farklı kültürleri temsil |
| | | | *teacher it asks in classroom different cultures* |
| 4 | | | ettiği şeyler |
| | | | *represent what* |
| | | | ***Teacher. It asks what represents different cultures …in the classroom.*** |
| 5 | Science Teacher 1 | : | he |
| | | | yes |
| | | | ***Yes.*** |
| 6 | Student 1 | : | hocam mesela okulumuzda tost var |
| | | | *teacher for example in our school toasted sandwiches there are* |
| 7 | | | tost başka ülkelerde yap- onu mu demek istiyor |
| | | | *toasted sandwiches in other countries are made that does it state* |
| | | | ***Teacher. For example, there are toasted sandwiches in our school. Does it state that toasted sandwiches are made in other countries?*** |
| 8 | Science Teacher 1 | : | he olabilir ne yedik biz okulda ne yiyoruz |
| | | | *yes maybe what did we eat at school what do we eat* |
| | | | ***Yes, maybe. What did we eat at school? What do we eat?*** |
| 9 | | | çevrede ne yiyoruz |
| | | | *in the region, what do we eat* |
| | | | ***What do we eat in the region?*** |
| 10 | Student 1 | : | tamam hocam |
| | | | *okay teacher* |
| | | | ***Okay, Teacher.*** |
| 11 | Science Teacher 1 | : | benzerliğimiz ne fark↑lılığımız ne oradaki |
| | | | *our similarities what differences what from them* |
| | | | ***What are our similarities, differences from them?*** |
| 12 | | | olanları yazabilirsin |
| | | | *those you can write* |
| | | | ***You can write those.*** |

Before the teacher and student conversation, the teacher walks around the classroom and observes the investigation process. When the teacher gets close to a group, Student 1 produces a turn and requests permission to ask a question (line 1). Teacher allows that, and Student 1 explains she does not understand the task objectives, so she requests clarification (lines 3, 4, 6, and 7). While the teacher clarifies the task objective, Student 1 uses an acknowledgement token, ***Okay, Teacher***, in line 10 to show she understood the situation. This clarification request or clarification displays that Student 1 needs some information, and it continues throughout the task. Thus, it can be interpreted that the epistemic access of Student 1 is in a less knowledgeable position regarding the topic being spoken about at that moment. Using acknowledgement token signs for an epistemic imbalance between the speaker (student) and the recipient (teacher) was resolved through the interaction process.

This section's last point is related to displaying a less knowledgeable position and disengagement in science and maths classroom interaction. Excerpt 5 comes from the thermal power stations activity, which was managed by Science Teacher 2, in the science classroom.

**Excerpt 5**

*Disengagement*

Student 1: arkadaşlar bence termik santrallerin kurulmasini istiyorum
*friends I think thermal power stations to be established I want*
***Friends, I want thermal power stations to be established.***
çünkü termik santrel kurulursa
*because a thermal power plant is built if*
***Because if a thermal power plant is built,***

#1

türkiyenin oraya giden parası azalır
*Türkiye spends on it the money decreases*
***The money Türkiye spends on it decreases.***
yani türkiyenin elektriğe giden parası azalır
*in other words Türkiye's electricity purchase money decreases*
***In other words, Türkiye's electricity purchase money decreases.***
.
.
.

**Snapshots of 25 minutes of interactions between students**

**#2** **#3** **#4**

Students have discussions on whether to establish thermal power stations in the region they live. The students try to persuade the members of another group for the view they defend. In this context, Student 1 states his ideas about it. While these events are taking place, the students listen to each other and try to take the floor. However, one student, marked in the snapshots mentioned above, waits without being involved from the beginning to the end of the interaction, which lasted about 25 minutes. The student does not have any health problems or a disability that may prevent interaction. This situation can be interpreted as an indication that the student disengaged due to his less knowledgeable position.

Teachers draw on various interactional strategies to manage interaction in terms of addressing achievement-related diversity. These strategies vary according to students' epistemic access. These strategies were identified based on the emic nature of interaction and unmotivated looking (Sidnell, 2009) of the study corpus. These strategies are identified in several instances in the corpus. Unlike the high-achieving students, the teachers try to support the low-achieving students to increase the learners' contributions. These interactional strategies carried out by the teachers are shown in Table 3.

**Table 3**

*The Patterns of Teachers' Interactional Strategies*

- For potentially high-achieving student
  - Orientation to alternative methods
- For potentially low-achieving student
  - Orientation to task for engagement
  - To provide content feedback
  - Deferring the preferred answer
  - Extending waiting time

The teachers perform the orientation to alternative methods in talk-in-interaction to support potentially high-achieving students' epistemic access. The strategy is examined in Excerpt 6, which comes from the age activity in the math classroom.

**Excerpt 6**

*Orientation to Alternative Methods*

1 Student 3 :hocam biz böyle bul↑- bulduk doğru mu↓
*teacher we with this method solved it correct is it*
***Teacher. We solved it with this method. Is it correct?***
2 (0.2)
3 Student 4 :hocam ilk- birinci çocuğa x dedik↑=
*teacher first the first child x we called=*
***Teacher. We called the first child X;***
4 Math Teacher 2 :=hı hı=
*=uh huh=*
***Uh huh***
5 Student 4 :=yani küçük çocuğa öbürleri ı↑ büyük olduğu için=
*=that is the young child the others er are big since=*
***that is, the young child. Since the others are big…***
6 Math Teacher 2 :=hı hı
*=**Uh huh***
7 Student 4 :x artı üç x artı altı x artı dokuz oldu=
*x plus three x plus six x plus nine they became=*
*… **they became X plus three, X plus six, X plus nine.***
8 Math Teacher 2 :=hı hı
*=**Uh huh***
9 Student 4 :.hh hocam bunların toplamıda elliye eşit↑ oldu
*.hh teacher the total fifty came to*
***Teacher. The total came to fifty.***
10 Math Teacher 2 :evet top↑ladığında kaç tane x'im var
*yes when you add them up how many xs do we have*
***Yes. How many Xs do we have when you add them up?***
11 Student 4 :üç x
*three xs*
***Three Xs.***
12 Student 3 :°üç x°
*°three xs°*
***Three Xs.***
13 (0.4)
14 Student 4 :ay dört↑ x
***Oops four Xs.***
15 Math Teacher 2 :dört x:
*four xs:*
***Four Xs.***
16 Student 4 :otuz ikiyi dörde böleceğiz hocam sekiz
*thirty-two by four we're going to divide teacher eight*
***Teacher. We're going to divide thirty-two by four. Eight.***
17 Math Teacher 2 :evet sekiz mi buldunuz [bi d]eneyin bak↑alım
*okay eight did you find [try it*
***Okay. Did you find eight? Try it.***
18 Student 4 : [evet]
*[**Yes.***
19 Math Teacher 2 :küçük çocuk sekiz olursa dördünün yaş↑ları toplamı
*the young child eight if the sum of the ages of the four*
20 elli olacak mı
*fifty will be*
***If the young child is eight, will the sum of the ages of the four be fifty?***
21 Student 3 :tamam
***Okay.***

At the beginning of the sequence, Student 1 seeks the evaluation/confirmation of the given task's solution method. To obtain the teacher's confirmation, Student 1 shows the solution method to the teacher. After 0.2 seconds of silence, Student 2 takes the turn by self-selection and starts to explain the solution (line 3). As mentioned above (see Excerpt 2), the interaction of taking the floor and making explanations shows that the epistemic access of Student 2 is in a more knowledgeable position. While Student 2 explains it, the teacher produces go-ahead markers for the students to continue by latching (lines 4, 6, and 8). After Student 2 completes the part of her explanation, the teacher asks a display question, ***How many Xs do we have when you add them up?*** in line 10. Student 2 produces an answer to this question (line 11), and Student 1 echoes her utterance (line 12). This answer is wrong. It can be seen above that they have four Xs.

After 0.4 seconds of silence, Student 2 realises the mistake, so she repairs her response (line 14). The repair also shows Student 2 in a more knowledgeable position. Then, Student 2 completes the explanation. The teacher asks a polarity question to confirm the answer to the activity problem. Student 2 responds to the question, overlapping with the teacher. After that, the teacher guides the students to an alternative method to check whether the answer is correct or not, instead of just accepting the response as a correct answer (lines 17, 19, and 20). By this means, the teacher both produces a new challenge for those students in a more knowledgeable position, and balances the whole classroom, exceptionally, between the students in more and less knowledgeable positions.

## Teachers' Interactional Strategies for Potentially Low-Achieving Students

The science and maths teachers draw on several strategies in talk-in-interaction to manage potentially low-achieving students' epistemic access. The strategies are examined in Excerpts 7 (orientation to task for engagement), 8 (content feedback), and 9 (extended wait time). Excerpt 7 is related to the rope activity, which was conducted in a math classroom. The sequence opens with a teacher's explanation about expectations in the task in line 1. After the teacher initiates the sequence, Student 1 approves the task's expectations.

### Excerpt 7

*Orientation to the Task to Provide Engagement*

| | | |
|---|---|---|
| 1 | Math Teacher 3 | :ip yardımıyla da kesip denemenizi istiyorum.<br>*by a string also cutting try it I want you to*<br>***I also want you to try it by cutting a string.*** |
| 2 | Student 1 | :tamam=<br>*okay=*<br>***Okay.*** |
| 3 | Math Teacher 3 | :=öğrenci 2 (0.5) sende ikinci grup üyesisin değil mi<br>=student 2 *(0.5) you also the second group belong to right*<br>***Student 2. You also belong to the second group, right?*** |
| 4 | Student 2 | :evet<br>yes<br>***Yes.*** |
| 5 | Math Teacher 3 | :şöyle yapmanı istiyorum (0.4)<br>*like that you to do it I want (0.4)*<br>***I want you to do it like that…*** |
| 6 | | üç tane uzun par↑çayı onbeş santimetre buldunuz<br>*three long pieces fifteen centimetres you found*<br>***you found three long pieces of fifteen centimetres.*** |
| 7 | | üç tane on↑beş santimetre kes<br>*three pieces fifteen centimetres cut into* |

***Cut fifteen centimetres into three pieces.***

8 beş↑ tanede bir santimetre kes
*five pieces one centimetre cut out of*
***Cut one centimetre out of every five pieces.***

9 bunları uc uca eklediğinde elli oluyor mu ve
*these when you join the ends fifty does it become and*
***When you join the ends, does it become fifty?***

10 bi tane uzunla bir tane kısayı uc uca eklediğin de
*with one a long a short piece when you joint the ends of*
***When you join the ends of a short piece with a long one,***

11 onaltı oluyor mu olmuyor mu
*sixteen does it add up or not*
***does it add up to sixteen or not?***

12 bi kont↑rol ederek ölçmeni istiyorum.
*to check to measure them I want you*
***I want you to measure them to check.***

13 bir sonraki geldiğimde ona bakacağım.
*next when I come it I will look at*
***When I come next, I will look at it.***

14 şuraya şekilde çizmenizi istiyorum.
*over there a figure also draw I want you to*
***I also want you to draw a figure over there.***

15 Student 2 : tamam hocam
*okay teacher*
***Okay, Teacher.***

The teacher tries to confirm whether Student 2 belongs to the group by asking a question addressing her by name, ***Student 2. You also belong to the second group, right?*** (line 3). Student 2 confirms that she is a member of the second group (line 4). In the line between 3 and 4, the short question and answer sequence shows that the teacher is not sure whether Student 2 is a member of the group or not because she is not involved in group interaction and is disengaging. As mentioned earlier, the disengagement position can be seen as an epistemic access indicator, especially a less knowledgeable position. Thus, the teacher intends to orient Student 2 to the task by explaining and telling her to check the task later, from line 5 onward. By this means, the teacher tries to engage Student 2 in the activity process and shifts the epistemic access of Student 2 from a less knowledgeable position to a more knowledgeable position.

Excerpt 8 comes from a rope activity in the maths classroom. Before the excerpt, Student 1 gave the wrong answer, and then Teacher explained it was wrong. After the explanation, Student 1 stated her idea based on the teacher's explanation (lines 10-12).

**Excerpt 8**

*Using Content Feedback to Support Less Knowledgeable Position*

10 Student 1 : evet bunların toplamını dokuza eşitleyemeyiz ama
*yes they add up to nine we do not but*
***Yes. They do not add up to nine but…***

11 x'e eğer .hhh başka bir değer buna başka bir değer
*x if .hh another value to this another value*

12 verirsek toplamı sekiz olur
*we give the sum eight becomes*
***…if we give X another value and give this another value, the sum becomes eight.***

13 Math Teacher 2 : neden
*why*

| | | |
|---|---|---|
| | | ***Why?*** |
| 14 | Student 1 | :beş ile üçün toplamı sekiz olur diye |
| | | *five and three add up to eight because* |
| | | ***Because five and three add up to eight.*** |
| 15 | | (1.5) |
| 16 | Math Teacher 2 | : ı ı:: olmadı gibi biraz↑ geliştirebi↑lirsiniz |
| | | *er er: it didn't a little you can improve* |
| | | ***It didn't. You can improve a little.*** |
| 17 | | şimdi ikisi aynı uzunlukta değil ya o↑ yüzden |
| | | *now the two the same length are not so* |
| | | x x diyemedik↓ (1) kısa↑ ken- ı: kısa ip ile uzun |
| 18 | | *we couldn't call x x (1) short er: short rope and long* |
| | | ipin ölçüleri fark↑lı bir birinden (2.2) |
| | | *rope the lengths of are different from each other (2.2)* |
| 19 | | biri dört biri beş oldu toplamları dokuz değil mi |
| | | *one was four the other was five the total is nine isn't it* |
| | | ***Now. The two are not the same length so we couldn't call X, X. The lengths of the short rope and the long rope are different from each other. One was four, the other was five. The total is nine, isn't it?*** |
| 20 | Student 1: | evet |
| | | yes |
| | | ***Yes.*** |
| 21 | Math Teacher 2 | :peki ı: diğer türlü üç tanesiyle çarptığında beşi |
| | | *alright er: otherwise by three of them multiply five* |
| 22 | | üç ile çarptığında on↑ beş |
| | | *multiplied by three makes fifteen* |
| | | ***All right. Otherwise, … multiply them by three. Five multiplied by three makes fifteen.*** |
| 23 | Student 1 | :hı hı |
| | | *uh huh* |
| | | ***Uh huh*** |
| 24 | Math Teacher 2 | :kısa kenarıda↓ beş ile çarptığında (1) cevap↑ otuz |
| | | *the short side by five is multiplied (1) answer thirty* |
| | | oluyor mu? Onuda sağ↑laması lazım yani |
| | | *is also be correct it should* |
| | | ***The short side is multiplied by five. Is the answer thirty? It also should be correct.*** |

The teacher asks a question that seeks the student's response argument by using "why" in line 13, and Student 1 produces an answer turn to explain her solution. After the long silence (1.5 seconds), the teacher draws on a hesitation marker (er er::) and makes a negative assessment (***It didn't. You can improve a little)***. The following teacher turn may signal that a dispreferred response was given. Hence, the student's epistemic access is in a less knowledgeable position. Realising the students' solutions and arguments are wrong, the teacher starts to provide content feedback from line 15 onward as an interactional strategy. The teacher manages the interaction and tries to shift the students from a less knowledgeable position to a more knowledgeable position by giving content feedback.

In the final excerpt, students investigate their classroom volume as required in an inquiry-based maths task. The researchers here prefer to show the teacher's utterances at the top of the excerpt since displaying the teacher's turns word-by-word, and their idiomatic translation, would be located on entirely different lines.

## Excerpt 9

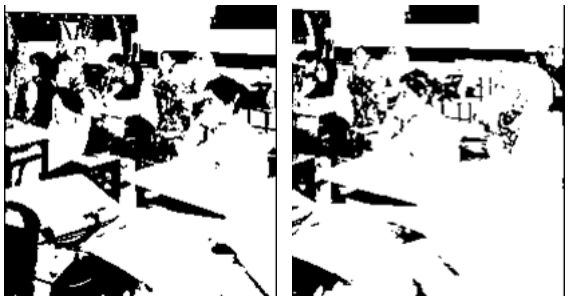
1 Science Teacher 3 : peki .hh bu cevap↑ların hepsine bi bakalım↓ (1.7)
*alright .hh these answers all of let's have a look at (1.7)*
**Alright. Let's have a look at all of these answers.**

2 ortak↑ bir↑ düşünceye varalım (.) arkadaşlar (1)
*common a idea let's have (.) friends (1)*
***Let's have a common idea, friends.***

3 resim↑lerde↓ (1) bunlardan hangilerine dikkat çekmiş
*in the pictures (1) of these to which to draw attention*

4 dikkat çekmek istiyor olabilirim
*to draw attention I want may do*
***Do I may want to draw attention to which of these in the pictures?***

#1 #2



5 (2.2)

#3

6 (3.8)

#4

7 hangilerine burda cevap arayabiliriz
*which ones here answers we can look for*
***Which ones can we look for answers here?***

Before the excerpt, the teacher takes the students ideas about pictures in which there are light pollutions. After that the teacher ask for the students to produce a common idea about the pictures. We see mentioned situation in lines 1-4. Although the teacher has finished her utterance

and given the turn to the students, any students do not raise their hands to take the floor and give responses (#1 and #2). In this situation, the teacher prefers to extend the waiting time. After he asks the question, he waits six seconds. There is an increase in the total number of raised hands in the class during this waiting time (#1 and #2 vs. #3 and #4). Thus, it can be said that the teacher manages the classroom interaction to provide an opportunity for the students who are in a less knowledgeable position and to shift them to a more knowledgeable position.

## Discussion

The science and maths classroom interaction, turn-taking mechanism and turn allocation systems are shaped by students' epistemic access and teachers' epistemic management, as shown in these research findings. We support the findings with a micro-analytical examination of classroom interactions. Student and teacher interactions create opportunities to make their knowledge visible and reveal how their knowing varies and develops (Ingram, 2020). The findings indicate that potentially high- and low-achieving students have different epistemic access, and the epistemic domain which the students have varies during interaction and is displayed by them in different ways. Particularly during the interactions in knowledge- and skill-oriented courses such as science and mathematics, it was observed that depending on their knowledge and degree of certainty, the participants display their epistemic access and could potentially appear in a more knowledgeable position. Besides, the potentially more knowledgeable students initiate the turn-taking and apply the turn allocation mechanism depending on their epistemic access. These efforts manifest themselves as "displaying of more knowledgeable position" and "taking the floor". The turn-taking mechanism unfolds with learners' initiations by raising their hands, also an indicator of their epistemic status (Sert, 2013), to be the next speaker so that the teachers can select one of the candidate students. Orletti (1981) calls this kind of learner initiative "embodied self-selection". In our data, students raise their hands without interrupting. Their overlapping speech and self-selection clearly show their epistemic access as a potentially high-achieving student. Showing their own more knowledgeable position leads to controlling the interactional activities in science and maths classrooms. Besides, potentially high-achieving students display their epistemic access by giving correct responses to the teacher or the task. According to Koole (2010), giving a correct answer to the question which the teacher poses as a pre-expansion question is a "display of having acquired access to the answer there-and-then". Kämäräinen (2019) explained that K+ students carried out epistemic work while interacting with peers, using some interactions, such as asking known-answer questions and designedly incomplete utterances.

On the one hand, K+ students' interactional actions provide ongoing classroom interaction and pedagogical targets. On the other hand, it hinders low-level students' participation, decreasing their rehearsal time (Walsh, 2006) and their ability to explain themselves (Lemke, 1990). In our corpus, we encountered potentially low-level students using disengaging positions such as keeping silent, not being an active member of the class, and avoiding taking turns. Besides that, giving the wrong response and asking for clarification occurs as other epistemic stances for these students. With a broader perspective, Melander (2012) explains that asking for advice or seeking clarification indicates whether the participant is an expert or a novice. In a similar vein, Koole (2012) points out that students who seek help can be in a more knowledgeable position on what the problem is. Additionally, Ingram (2020) discussed that students' response turns, when the teacher is asking a direct known-answer question, clearly show they do not remember the situation. Our findings come from teacher-student interaction, so displays of epistemic access refer to that interaction. However,

Herder et al. (2020) also shed light on epistemic displays in their peer talk study. Accounts, disagreeing, responses to a request for information, other-corrections, and expanding also display students' epistemic access.

Teachers' epistemic management varies in terms of epistemic access. While high-achieving students try to take the floor in the science and maths classroom, low-achieving students are not involved in the process; this situation causes the teacher to manage different epistemic access through interaction. Nevertheless, the differences being in the same classroom, teachers should manage and support all different levels in the same classroom (European Commission [EC], 2007). Teachers try to recognise students who are low-achieving students or do not show their epistemic access clearly. For that reason, the teachers draw on interactional management tools such as orientation to task for engagement, extended wait time, content feedback and deferring the preferred answer. These call for interactions related to teachers' classroom interactional competence (Walsh, 2006) to increase learners' contribution (Kaya & Şardağ, 2021) and provide opportunities for teachers to make a formative assessment (Şardağ, 2019). As echoed by Mortimer and Scott (2003), our results show how interactional management tools are the teacher's strategies to increase participation of all the students in science and maths classes. The teacher's interactional management gives opportunities for managing achievement-related diversity in science and math classrooms. It also supports all students' levels in their development process and balances epistemic gradient K- and K+ students. The management of epistemic gradient is related to the classroom interaction and science and maths conceptual developments and teachers' pedagogical aims.

Students' participation, taking the floor, disengagement, and keeping silence, which is called an epistemic stance in any classroom interaction, mostly show their epistemic access – in other words, epistemic domain status. Teachers should recognise the indicators that point out students' epistemic access to manage achievement-related diversity in the classroom. Teachers' classroom interactional competence leads to supporting students from all different levels, including those who show a more knowledgeable or a less knowledgeable position.

We believe that the study will contribute to shedding light on the students' epistemic access and the teachers' epistemic management in achievement-related diversity science and mathematics classrooms. Besides, we consider that this study will contribute both to science and mathematics teachers and to teacher trainers, who can design PD courses to shift the quality of classroom talk. The findings of this study are specific to a particular context and cannot be generalised. Limitations of the study include the fact that the participants were only teachers in Türkiye and the data collection process was limited to classroom video-audio records. The findings of this study align with prior research conducted in Türkiye, which has shown that science and mathematics classrooms often reflect a wide range of achievement levels among students (e.g., Akyüz Aru & Kale, 2021). This study further contributes to this body of literature by examining how teachers manage these diverse epistemic states through interactional strategies in the Turkish education context. Lastly, we feel certain that a close examination of the interactions in the science and mathematics classrooms using the micro-analytic perspective in science and mathematics research will provide more detailed information similar to what was seen in this study.

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## Geniş Özet

### Giriş

Etkileşimsel bir perspektiften bakıldığında, öğrenme bireysel ve bilişsel bir fenomen olmaktan ziyade katılımcı ve etkileşimsel bir fenomen olarak görülmektedir (Ingram, 2020). Benzer şekilde, bu çalışmada bilişsel alan yerine katılımcıların bilme ve bilmeme pozisyonlarını etkileşim yoluyla nasıl yönettiklerine odaklanılmaktadır. Bu hususta, epistemik pratikler yerine "epistemics" kavramı kullanılmaktadır. Epistemik pratikler, bilgi üretimi, değerlendirme süreçleri ve verilerden desen oluşturmayı içerirken (örn. Erduran & Garcia-Mila, 2015) epistemik biliş, "insanların formal ve informal bağlamlarda bilgiyi nasıl inşa ettikleri, anladıkları, değiştirdikleri ve kullandıkları" anlamına gelir (Erduran, 2019, s. 819). Ancak epistemics, "katılımcıların

konuşma sırası ve etkileşim dizileri aracılığıyla ileri sürdüğü, tartıştığı ve savunduğu bilgi iddialarına odaklanır" (Heritage, 2013, s. 370).

Bilme, hatırlamama ya da anlamama iddiaları ve diğer epistemik statü sergilemeleri, öğretmenlere sınıf aktivitelerine dayalı (örneğin, sorgulama ya da tartışma aktiviteleri ile grup çalışmaları) etkileşimleri yönetmek için önemli fırsatlar sunmaktadır. Ayrıca, öğretmen ve öğrencilerin etkileşimlerinin, öğrencilerin bilgi durumlarını ve bu durumların nasıl değiştiğini, geliştiğini ve sınıf etkileşiminde nasıl müzakere edildiğini görünür hale getirdiği bilinmektedir (Ingram, 2020). Bu nedenle, başarıya dayalı çeşitlilik bulunan sınıflarda öğrencilerin epistemik statülerinin nasıl sergilendiğini ortaya koymak, öğretmenlerin fen ve matematik öğretim süreçlerinde epistemik yönetimi nasıl yürüttükleri hakkında öngörüler sağlayacaktır.

Epistemik etkileşimler üzerine yapılan birçok araştırmaya rağmen, fen ve matematik derslerinde öğrencilerin epistemik statüleri ve öğretmenlerin epistemik yönetimleri hakkında sınıf içi etkileşim bağlamında yapılan çalışmalar sınırlıdır. Dolayısıyla, epistemik durumların nasıl sergilendiği ve öğretmenlerin epistemik yönetimi nasıl gerçekleştirdiği üzerine daha fazla araştırmaya ihtiyaç olduğu düşünülmektedir. Bu çalışma, fen ve matematik eğitimi alanına, özellikle fen ve matematik öğretmenleri ile öğretmen eğiticilerine, sınıf içi konuşma kalitesini artırmak için mesleki gelişim eğitimleri tasarlamalarına katkı sağlayacaktır.

Ayrıca, yukarıda belirtilen durumlarda görüldüğü üzere, başarı ile ilgili çeşitliliklerin bir değer ve fırsat olarak ele alınmasına yönelik etkileşim yönetimini inceleyen çalışmalara ihtiyaç vardır. Bu tür çalışmalar, başarıya dayalı farklılıkların nasıl bir öğrenme kaynağı olarak değerlendirildiğini vurgulamaktadır. Bu perspektiften bakıldığında, bu çalışma sadece öğretmen-öğrenci etkileşimlerinde epistemics üzerine değil, aynı zamanda fen ve matematik sınıflarındaki epistemik yönetim üzerine de katkı sağlamaktadır.

### *Araştırma Soruları*

1. Potansiyel olarak yüksek ve düşük başarılı öğrenciler, etkileşimde epistemik statülerini nasıl sergileme eğilimindedir?
2. Katılımcı öğretmenler, potansiyel olarak yüksek ve düşük başarılı öğrencilerin epistemik erişimlerini sergileyip sergilememelerini nasıl yönetir?

## Yöntem

Bu çalışma, fen ve matematik sınıflarındaki etkileşimleri inceleyen, nitel bir araştırmadır. Öğrencilerin etkileşimde epistemik erişimlerini nasıl sergileme eğiliminde olduklarını ve öğretmenlerin bu sergileme (veya eksikliğini) nasıl yönettiklerini incelemek için, konuşma analizi (KA) yöntemi uygulanarak mikro-analitik bir perspektif kullanılmıştır. Çalışmada, Türkiye'nin üç farklı şehrinde görev yapan 97 hizmet içi fen ve matematik öğretmenine (34 erkek, 63 kadın) 2018 ve 2019 yıllarında bir AB projesi kapsamında mesleki gelişim eğitimleri verilmiştir. Çalışma verileri, mesleki gelişim eğitimine katılmış öğretmenlerin, her biri yaklaşık 35 dakika süren altı fen ve dokuz matematik dersinin video-ses kayıtlarından elde edilmiştir. Veriler, Jefferson transkripsiyon sistemine (Jefferson, 2004) göre yazıya dökülmüş, satır satır ve konuşma sırası sırasına göre incelenmiş ve mikro-analitik bir perspektifle analiz edilmiştir.

## Bulgular

Bulgular, öğrencilerin epistemik statü olarak adlandırılan ve epistemik statü durumlarına göre değişen belirli etkileşimsel araçları kullandıklarını ortaya koymaktadır. Öğrenciler tarafından

kullanılan bu etkileşimsel yapılar, daha bilgili pozisyonun gösterilmesi (doğru yanıtı vermek, söz almak, bir sonraki adımı atmaya istekli olduklarını vücut hareketleriyle bildirmek, kendi kendini seçme, örtüşen konuşma, el kaldırmak) ve daha az bilgili pozisyonun gösterilmesi (açıklama istemek, yanlış yanıt vermek, katılmama) olarak belirlenmiştir. Ayrıca, öğretmenlerin başarıya dayalı çeşitliliği yönetmek için kullandıkları etkileşimsel stratejiler, potansiyel olarak yüksek başarılı öğrenciler için alternatif yöntemlere yönlendirme, potansiyel olarak düşük başarılı öğrenciler için 1) katılım için göreve yönlendirme, 2) içerik geri bildirimi sağlamak, 3) tercih edilen cevabın ertelenmesi, 4) bekleme süresinin uzatılması olarak tespit edilmiştir.

## Sonuç ve Tartışma

Fen ve matematik sınıflarındaki etkileşim, sıra alma mekanizması ve sıra tahsis sistemleri, bu araştırma bulgularında da gösterildiği üzere, öğrencilerin epistemik erişimi ve öğretmenlerin epistemik yönetimi tarafından şekillendirilmektedir. Bulgular, sınıf içi etkileşimlerin mikro-analitik incelemesiyle desteklenmektedir. Öğrenci ve öğretmen etkileşimleri, bilgilerini görünür kılmak ve bilgilerinin nasıl değişip geliştiğini ortaya çıkarmak için fırsatlar yaratmaktadır (Ingram, 2020). Bulgular, potansiyel olarak yüksek ve düşük başarılı öğrencilerin farklı epistemik erişimlere sahip olduğunu ve öğrencilerin sahip olduğu epistemik alanın etkileşim sırasında değiştiğini ve onlar tarafından farklı şekillerde sergilendiğini göstermektedir. Özellikle fen ve matematik gibi bilgi ve beceri odaklı derslerdeki etkileşimler sırasında, katılımcıların bilgi ve kesinlik derecelerine bağlı olarak epistemik erişimlerini sergiledikleri ve potansiyel olarak daha bilgili bir konumda görünebildikleri gözlemlenmiştir. Ayrıca, potansiyel olarak daha bilgili öğrenciler sıra alma sürecini başlatmakta ve epistemik erişimlerine bağlı olarak sıra tahsisi mekanizmasını uygulamaktadır. Bu çabalar kendilerini "daha bilgili pozisyon sergileme" ve "söz alma" olarak gösterir. Sıra alma mekanizması, öğrencilerin epistemik statülerinin de bir göstergesi olan (Sert, 2013) ellerini kaldırarak bir sonraki konuşmacı olmak için söz almalarıyla ortaya çıkar ve böylece öğretmenler aday öğrencilerden birini seçebilir.

Öğretmenlerin epistemik yönetimi epistemik erişim açısından farklılık göstermektedir. Fen ve matematik sınıfında yüksek başarılı öğrenciler söz almaya çalışırken, düşük başarılı öğrenciler sürece dahil olmamaktadırlar; bu durum öğretmenin etkileşim yoluyla farklı epistemik erişimleri yönetmesine neden olur. Yine de farklılıkların aynı sınıfta olması, öğretmenlerin tüm farklı seviyeleri aynı sınıfta yönetmesini ve desteklemesini gerektirir (European Commission, 2007). Öğretmenler, düşük başarılı ya da epistemik erişimlerini açıkça göstermeyen öğrencileri tanımaya çalışır. Bu nedenle öğretmenler, katılım için göreve yönlendirme, uzun bekleme süresi, içerik geri bildirimi ve tercih edilen cevabı erteleme gibi etkileşimsel yönetim araçlarından yararlanırlar. Bunlar, öğrencilerin katkısını artırmak (Kaya & Şardağ, 2021) ve öğretmenlerin biçimlendirici bir değerlendirme yapmaları için fırsatlar sağlamak (Şardağ, 2019) için öğretmenlerin sınıf içi etkileşimsel yetileriyle (Walsh, 2006) ilgili etkileşimleri gerektirir.