Curious Classrooms:

A Drama Approach to Mathematics Teaching

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Abstract

Given two traditional and rather teacher-dominated classrooms, how can a discourse emphasizing student questions, explanations, and evaluations be developed? This article reports on a project that has used tools and knowledge from the field of drama to develop a discourse characterized by student talk (particularly questions and explanations), teacher facilitation, and a focus on accessing and sharing student ideas. To achieve this, we used knowledge of the development of roles and fiction from drama to create three main role categories for students to use during mathematical lessons: the curious, who asks to understand, the sceptic, who is critical, and the elder (authority), who evaluates and eventually decides. These role categories were developed to elicit more student questions, explanations, and evaluations. In addition to developing these role categories, both theoretically and in practice, the main contributions of this article are the theoretical framework established to characterize classroom cultures based on interaction types, the development of the concept of facilitation related to positioning theory, and more generally the description of a drama approach to mathematics discourse. The article is part of a project called Theatre in Mathematics (TIM).

Keywords: Classroom discourse, process drama, discourse, roles, positioning, facilitate.

Introduction

In this article, we report on a long-term project aimed at developing a deeper understanding of how to activate students as participants in more dialogic mathematical teaching. Our starting point is classroom discourse, in which the teacher is involved and often dominant. In general, to develop this discourse, we started with the hypothesis that there is a need to change who says what, possibly to change what is said, and probably to reshuffle responsibility. This can be systematized by thinking about different types of interactions, positions, and roles.

To change or develop how teachers and students talk with each other when working with mathematics, we found that drama might offer helpful tools. Working with roles is at the core of the field of drama, and vast knowledge exists about different ways to model, develop, and work with roles. How can this knowledge be used to develop and change mathematics teaching by involving students more actively in core mathematics activities? With this general question in mind, a small research team from both mathematics education and drama worked in an exploratory way and identified specific and productive roles, used this work to develop and conduct a process drama to experience and comprehend roles, and applied the roles during regular mathematics teaching. This project has developed ideas over years and is now part of an international project called Theatre in Mathematics (TIM).

The TIM project builds on research in areas such as teacher and student interactions, norms, and positioning, which together describe the complexity of classroom discourse in mathematics. There are several frameworks that describe different types of teacher interactions, different types of classroom cultures, and even how certain teacher interactions lead to specific student interactions (Drageset, 2020). Nevertheless, we need to know more about how to activate students as something more than respondents. There is also much knowledge about norms and positions but little about how we can help students to be more aware of the need for different positions in a discourse and thus the need to change position.

This article reports from exploratory work in two fifth grade classrooms. We investigated how giving student's specific roles changed the classroom discourse. The analysis in this article is mainly focused on how the teachers crafted the student roles to change the way students participated in the classroom. In order to analyze this, there is a need to position this work within research on roles in drama, and within research on teacher and student interactions, norms, and positions in the mathematics classroom.

Literature

Connecting Process Drama, Roles, and Positioning

Drama is both part of art as a school subject and a way of learning. This means that drama can be understood from its intrinsic value (Winner et al., 2013) as well as being a way of facilitating learning in other subjects. Drama includes different genres and forms of expression that can be used in the classroom, from traditional, text-based theater productions to simpler dramatization and more improvised drama, such as process drama. A few decades ago, drama would have been connected to specific exercises, such as safety exercises and sensitivity training (Way, 1967). Drama pedagogy has removed itself from this tradition with disjointed exercises and, instead, highlights exploration, communication, and learning through the symbolic–esthetic language of theater (Bolton, 1979; O'Toole, 1992). Simple exercises can be used to introduce or prepare for role play, cooperation, and activities in process drama and are not seen as drama per se as there is no real fiction involved. This means that there are no fiction-developing elements, such as story, role, time, and place (Sørensen, 2019).

Process drama is a form of drama that is set as a series of episodes in which attitudes are of greater concern than characters (Bowell & Heap, 2013). As actors in process drama, the participants try to solve problems and challenges rather than presenting lines from a pre-written text. “It focuses on developing a dramatic response to situations and materials from a range of perspectives” and to “take on roles that are required for the enquiry, investigation or exploration of the subject matter of the drama” (Bowell & Heap, 2013). In this approach to process drama, inspired by a feature in Live Action Role Plays (Mochocki, 2013), participants are not given fixed lines but instead start the play by reading or developing role cards. These role cards contain information such as name, age, family, values, tasks, and occasionally some background history, experiences, or secrets. From this information, the participants develop a role based on their role card during different events or scenes in which challenges or opportunities have to be addressed with the other participants. Typically, the role cards mean that the participants will act differently in different situations.

Goffman (1969) defined a role as a routine performance for an audience, observer, or participant as part of a social setting. A role works not in isolation but in a context with other roles and is connected to persons, ideas, and surroundings. Taking on a role requires one to identify with the values and beliefs that suit the role in the actual situation. Playing such a role means that one has to be responsive not only to other participants’ signals and ideas but also to the beliefs or attitudes of the actual role (O’Toole & Haseman, 1988). Playing a role also implies a change of perspective as “transformation of the persona gives us a new perspective on an event: We learn more about it and this changes our knowledge about it” (Courtney, 1991). The fiction enables an opportunity to transform a general, wide, or abstract theme into a specific situation in which the participants can interact and explore the theme within a context (Bowell & Heap, 2013). This also means that both context and roles can evolve and change. Learning a role does not necessarily mean adapting to given patterns of interaction but, instead, developing the capability to vary between equivalence and considerations (Allern, 1995). Referring to Moreno, O'Neill (1995) stated that there is a distinction between role taking, enacting a situation in a totally predetermined manner, and role creating, which involves a spontaneous response that is appropriate for the given circumstances: "It is this spontaneity that is at the heart of the roles that arise in improvisational drama" (O'Neill, 1995). Creating and exploring roles in drama may produce a limited part of what could be learned. A change of roles and perspectives, an important part of process drama (Landy & Montgomery, 2012), may thus allow the creation of a more complete learning process.

While such process drama is constructed from the bottom, another form of roles, or perhaps positions as this phenomenon is more widely known, are an important feature of any classroom. Harré and van Langenhove (1999) explained that, in general, there are three domains that regulate a person's actions: what one can do, what one does, and what one is permitted or forbidden to do. The last part, what one is permitted or forbidden to do, is the domain of positioning theory. When joining an activity or discourse, such as solving a mathematical task with others, the participants position themselves and each other based on a complex mix of personal preferences and social interactions. On the personal level, there might be dispositions that guide their preferences, such as trying to keep silent because of insecurity or a feeling of safety and curiosity in mathematics making them active participants. On the social level, such positioning is a reciprocal, and sometimes competitive, process in which participants not only choose a position but might be positioned by others' positions or actions or might position others through their own position or actions. Both Harré and van Langenhove (1999) and Wagner and Herbel-Eisenmann (2009) described how positioning relates to the actual utterances of a discourse. First-order positioning is the first utterance or suggestion on what to do, which defines the storyline. Second-order positioning occurs when someone challenges this, suggesting something else and thereby disputing the storyline. Third-order positioning involves explicit meta-level utterances, talking about the talk. In this way, positioning theory offers concepts for understanding positioning related to personal preferences, social interaction, and the single utterances related to a storyline. In the classroom context, a teacher typically positions students all the time. According to Harré and van Langenhove (1999), such positioning can be based on beliefs regarding the competency and personality of the student and the category to which this person is seen as belonging (such as knowledge, gender, race, or disabilities). The positioning can be apparent from the type of questions asked, the types of tasks given, and who the teacher puts together in groups. This positioning of others, by the teachers or by fellow students, might or might not be intentional (Harré & van Langenhove, 1999). With an emphasis on positions related to authority, Zazkis, Sinclair, and Liljedahl (2013) introduce Lesson Play as a way of planning for instruction that emphasizes the dialogue between the teacher and the students, using scripts and featuring imagined interactions between a teacher and the students. The dialog draws attention to the process through which mathematical content will be communicated in the classroom. This approach is influenced by research that focuses on improvisation and the importance of role-playing in education. Lesson Play offers a mode of planning through in which the attention of prospective teachers is drawn to considering the different possibilities occasioned by a question or task, the different responses a student might offer, the different conceptions a student might build, and the different effects a certain response by the teacher might produce. In this way, Lesson Play offers a tool for thinking through what each interaction means related to both positions and roles.

Fiction is the element that separates roles in drama from positioning. Positions can be seen as the more or less conscious roles that we take, or accept, in our daily life. However, while positions are not fiction, drama roles are about fiction. Still, when starting a process drama from the creation of role cards, one should not believe that student's approach this openly and just follow what the role cards and scenes tell them, as if they are in a vacuum. Naturally, within a process drama, there will also be personal preferences regarding how to play the role, and these will be affected by social or reciprocal positioning and by the way in which the process drama is framed. The role cards often include information on how to act or what to do, which will be part of the reciprocal or competitive positioning related to the roles, authority, and storyline, but, while process drama brings positioning into the play, it also has the power to address positioning by working on a meta-level, revealing the possibility to choose more deliberately, experience different types of roles, and change perspective. Such meta-awareness might also be helpful in mathematics when one wants to change the discourse. After all, as both Harré and van Langenhove (1999) and Wagner and Herbel-Eisenmann (2009) described, positions can be either given or taken.

Concepts Describing Teacher Interactions

Scholars have developed a range of concepts and frameworks describing interactions on a turn-by-turn level. Some such concepts describe how teachers *tell or inform students* about something. Da Ponte and Quaresma (2016) described teacher interactions called *informing and suggesting*, the aim of which is to introduce information, make suggestions, present arguments, or evaluate responses. Drageset (2014) explained in a similar way how teachers sometimes *demonstrate* how something should be performed. These are interactions in which the teacher shares insights into how something is undertaken or why or tells students what is correct and what is not. It is also typical for this type of interaction to be conclusive, to be clarifying, and to end discussions.

Other concepts describe how teachers try to *support or lead students toward an answer*. Da Ponte and Quaresma (2016) described one side of this as *supporting and guiding* students through questions and observations that point out a route that they might follow. One feature here is the balance between supporting and more active guiding. Related to this, Drageset (2014) emphasized the difference between asking *open questions*, that is, presenting a question and problem without leading the students to any preferred path, and *simplification*, meaning the provision of information through hints or leading questions that reduce the complexity of the task. The latter is related to teacher-dominated patterns, as described above (funneling, guided algorithmic reasoning, and Topaze). Unlike the *tell or inform* approach, these comments typically do not conclude or end but help the students to progress toward an answer.

Further concepts describe how teachers *focus on details of importance*. For example, a teacher can *revoice* (O'Connor & Michaels, 1993) a student interaction to emphasize its importance, either exactly or slightly adjusted to be more precise, *reformulate*, or *point out* parts of the utterance or dialogue as particularly important using *reminders* and *recaps* (Drageset, 2014). Related to both focusing on important details and the interaction of pointing out important utterances is the concept of *connecting*, such as making connections between concepts and between procedures (Rowland et al., 2005). All these are examples of how teachers emphasize what they find to be important during a dialogue.

As an alternative to helping a student to progress or focusing on details of importance, a teacher can try to *access and share student thinking*. In an article about a particularly talented teacher, Fraivillig et al. (1999) described how this teacher *elicits student thinking*, while Drageset (2014) explained how teachers sometimes ask students to *enlighten details* of how an answer or idea was reached or to *justify* their answer. Related to this, da Ponte and Quaresma (2016) talked about *inviting* students to come up with suggestions or ideas, which is also a way of gaining access to student thinking. An important effect of such a focus on accessing student ideas during a plenary talk is that these ideas are also shared.

In addition to accessing ideas, it is possible to *use or extend student ideas*. Fraivillig et al. (1999) described how teachers *extend student thinking*, and Cengiz et al. (2011) suggested three ways in which this could be achieved: *encouraging reflection, encouraging reasoning*, and *going beyond the initial method by pushing for alternative methods*. Bjerkeli et al. (2020) described this approach being taken one step further by another talented teacher who uses and *develops student ideas in plenary* in an exploratory discourse with students and thereby extends the student ideas together with the students.

Sometimes teachers *challenge ideas*. Drageset (2014) reported that teachers adopt this approach to change the direction of the work or solution process by *correcting questions* or *advising a new strategy*. Both Alrø and Skovsmose (2002) and da Ponte and Quaresma (2016) described purer challenges as "seeking that the students produce new representations, interpret a statement, establish connections, or formulate a reasoning or an evaluation" (p. 54). In this way, challenges might lead to both discussions and reflection.

Based on the above literature, we argue that teacher interactions during plenary talk with students can be summed up in six main types: *tell or inform students*, *support or lead students toward an answer*, *focus on details of importance, access and share student thinking, use or extend student ideas,* and *challenge ideas* (see Attachment 1).

Concepts Describing Student Interactions

Based on the knowledge that a turn is thoroughly dependent on previous turns (Linell, 1998), it is possible to argue that student interactions are often formed by the teacher. This claim is especially strong for classrooms where the teacher initiates all the questions and speaks every second time, such as in the Initative-Response-Evaluation (IRE) pattern. However, there is more to communication than responding to the prior turn. Other factors are in play, such as social and socio-mathematical norms (Yackel & Cobb, 1996). What the teacher expects might not be obvious or explicit in the question, but the student might still know what will be accepted as an answer and what will not. Socio-mathematical norms are developed through negotiation over time during a process similar to what Newman (1990) described as appropriation. This means that the teacher adjusts and reformulates questions based on how the students answer, and students gradually learn what is acceptable and what is not in different situations based on feedback (the following turn).

While teachers are the leaders of the discourse, the initiator of activities, the authority, and the framer in most classrooms, students also participate in the discourse in various ways. Clearly, students *answer mathematical questions*. In an IRE pattern, answering questions is the main type of student contribution to the dialogue. Naturally, the answers might be of different types. Sometimes, they are very easy or essentially provided by the teacher. Drageset (2015) described these as teacher-led responses, the answer being more or less given through hints in the question or because it is so simple. However, answers might also emerge as a response to more demanding tasks, and in such cases Drageset (2015) distinguished between unexplained answers, which are mere answers to a question with no information about how this answer was found or why the student thinks it is correct, and partial answers, which are answers that range from rather incomplete to nearly complete.

Arguably, nearly all student responses might be seen as answers, but, instead, we want to separate *mere answers* from other types of responses and interactions. By *mere answers*, we mean answers to mathematical questions that do not contain further information about the thinking, logic, or process behind the answer. The word mere does not imply a lack of value as, for example, an unexplained answer might reveal deep insights or be given on the basis of a complex reasoning process. Naturally, though, this leads us to another kind of interactions that include such information about the method or reason, and these can be called *student explanations* of different types. Alrø and Skovsmose (2002) described one type of interaction, called *advocating*, which involves defending a stance, such as one's own suggestion or someone else's, as part of a discourse. Varhol et al. (2020) further divided *advocating* into two different types, one in which the advocating is in the form of arguments and another that consists of not giving up without offering arguments. Clearly, arguing for something is a form of explanation. Another interaction presented by Alrø and Skovsmose (2002) is *thinking aloud*, which might be seen as a less formal and more explorative way of sharing one's thinking than *advocating*. Still, *thinking aloud* can be viewed as a form of explanation as this in principle gives information about student understanding, reasoning, or solution processes. Drageset (2020) suggested dividing student explanations into three types. The first, explaining action, is the interaction whereby the student reports the steps taken to arrive at an answer, which has a clear focus on conducting the process or method. The second, explaining reason, is the interaction in which the student argues why the answer or the chosen method is correct or will give a correct answer, which involves a clear focus on justification. The third, explaining concept, is the interaction whereby the student articulates what a concept or an idea means.

Students' contributions of *mere answers to mathematical questions* and *explanations* constitute the dominating part of student contributions in the five IRE classrooms reported by Drageset (2015), with the different types of answers clearly forming the largest part. Both of these types might fit well within IRE, which indicates how different students can respond within this pattern. However, there are also other types, mainly related to the I and E of IRE, which can then also serve as examples of student interactions that break the IRE pattern. One type is *student initiatives*, described by Drageset (2015) as interactions in which students clearly break the flow of speech or work by suggesting a new idea, pointing out something that they find important during the dialogue, correcting somebody, requesting clarification, or asking what or how to do something. A related type of initiative is to *challenge*, which Alrø and Skovsmose (2002) referred to as attempts to move the discussion along a new path or to question the knowledge gained or fixed perspectives. Together, student initiatives and challenges describe breaks in the flow initiated by students (the I of IRE).

We can also sometimes see students *evaluating* (the E of IRE), which, according to Alrø and Skovsmose (2002), can take place in a variety of forms, such as support, advice, critique, and correction of mistakes. This might look similar to the initiatives just described, but, while the initiatives bring in something new and are not a response, evaluations are a direct response to an idea or explanation from another person. Drageset (2014) stated that such an evaluation can also emerge following a request from the teacher to assess another student's idea or solution.

Based on the above, we suggest that student interactions can be summed up in four broad types: *(mere) answers to mathematical questions*, *explanations*, *initiatives*, and *evaluations* (see Attachment 2).

Classroom Cultures Related to Different Types of Interactions

It has been well established that conversations are social practices in which each turn is thoroughly dependent on the previous turns (Linell, 1998). This is evident within the IRE pattern (Cazden, 1988; Mehan, 1979), in which the teacher *initiates* a task or discussion, the student *responds*, and the teacher *evaluates*. Often, IRE is seen as a rather teacher-dominated pattern with little emphasis on student thinking and explanation (Franke et al., 2007), even though Wells (1993) demonstrated that there is room for considerable variation and quality within this pattern.

However, classroom dialogue is much more than teacher domination and IRE. Wood et al. (2006) suggested four classroom cultures to highlight the variation in approaches to teaching mathematics. The first, the *conventional textbook classroom culture*, is a culture in which the major interaction pattern is a very strict form of IRE, the teacher just acting like the textbook by setting the task and responding whether the answer is correct, like a solution key. This means that typical teacher interactions are intended to *tell or inform students* while students contribute *(mere) answers to mathematical questions*.

The second, *the conventional problem-solving classroom culture*, is characterized by the teacher giving hints. In this culture, the tasks might be challenging, and the hints aim to help the students find a solution. While being a useful way to help students advance in many different ways, there is also the possibility that a culture in which the main interaction pattern involves the teacher giving hints might be characterized by different patterns. One is funneling (Wood, 1998), whereby the teacher accepts only what was planned to be accepted and sometimes leads the students to guess what the teacher is thinking about instead of thinking mathematically. Another is guided algorithmic reasoning (Lithner, 2008), in which the teacher points out what should be done at every difficult moment and students only perform the easier calculations. A third might even be the Topaze effect (Brousseau & Balacheff, 1997), which involves the teacher simplifying the task until it is totally different. This means that the typical teacher interaction types are *support or lead students toward an answer* and *focus on details of importance*. As this is a rather teacher-dominated culture, the typical student interaction type is still *(mere) answers to mathematical questions*. This classroom culture can also be characterized as a simple form of dialogic dramaturgy that barely challenges the students but tries to remind them of something that they already know or have already experienced.

The third, *the strategy-reporting classroom culture*, clearly differs from the first two by giving room for students to share ideas and suggest methods or solutions. While the focus on sharing will create opportunities to learn from each other, this classroom culture might still be achieved within the more open IRE pattern that Wells (1993) described, in which the teacher asks questions that challenge or promote ideas and then responds to the ideas in ways that might close the discussion or provoke thought. Alternatively, this might be undertaken without the IRE pattern, possibly by letting students ask questions or respond. However, this third classroom culture is more focused on sharing than on using the shared ideas for discussion. This means that the typical teacher interactions are *focus on details of importance* and *access and share student thinking*. These interactions show a greater focus on student thinking, which means that a typical student interaction type is *explanations*. This classroom culture can be characterized as a problem-solving dramaturgy, which means that the dialogue is more real in the sense of opening up for students' involvement.

In the fourth, *the inquiry/argument classroom culture*, the goal of sharing is for other listeners to ask questions for further understanding or clarification. When the aim of sharing is for the next response to be a question from a fellow student, it is difficult to see how this can be achieved within even the most open interpretation of the IRE pattern. However, even though three of the four cultures might be enacted within IRE, this also highlights the limitations of the IRE concept. Mercer and Littleton (2007) argued that, instead of focusing on the number of questions (or initiatives or responses) that a teacher asks, one should instead consider the function of these questions and, accordingly, move on from a rather shallow focus of characterizing a discourse as inside or outside of IRE. The typical teacher interactions in this culture will be to *use and extend student ideas* and *challenge ideas*. Consequently, typical student interactions will be *explanations*, *evaluations*, and *initiatives*. This classroom culture can also be characterized as an interactive dramaturgy that is open to initiatives and the development of common meaning.

In addition, a culture is related not only to what is typical but also to what is not seen as often and to variation versus conformity. In Table 1, we have limited the overview to what is most typical and what is not.

Table 1

Typical Interactions Related to Classroom Cultures

Classroom cultures (Wood et al., 2006)					
		Conventional textbook	Conventional problem solving	Strategy reporting	Inquiry/ argument
Teacher interactions	*Tell or inform students*	x			
	Support/ lead students toward an answer		x		
	Focus on details of importance		x	x	
	Access and share student thinking			x	
	Use or extend student ideas				x
	Challenge ideas				x
Student interactions	*(Mere) answers to mathematical questions*	x	x		
	Explanations			x	x
	Evaluations				x
	Initiatives				x

Method

This research is part of the European Erasmus+ project "Theatre in Mathematics" (TIM). The project is based on well-known challenges related to mathematics, such as teacher-dominated teaching, passive students, and students' tendency to worry about the consequences of their contribution to the classroom conversation. The aim of the TIM-project is to develop a mathematics methodology for the deeper involvement of students in mathematics lessons., similar to student involvement in an inquiry/argument classroom. The TIM methodology is based on two approaches. One approach is the process drama where the aim is to use roles and positions to change the classroom dialogue towards more engaged students. The other is Mathemart, which intends to address the fear of mathematics by providing a set of teaching techniques from a theatre workshop. The TIM methodology has defined five key elements for the work with drama. The first element is the setting, as a good theatrical setting can help students to forget their fear of mathematics and enjoy learning by playing. The second element is the body as drama uses many techniques to stimulate self-perception and awareness of the body. The third element is the group since creating a trusting group is important for acceptance and free expression of diversity without judgment. The fourth consists of play and ritual as playfulness directs the focus to the process rather than the result, leaving no room for judgment and the fear of it. The fifth is aesthetics and pleasure, as the aesthetic dimension brings engagement, and the higher the quality, the greater the pleasure (if a song is well sung, if a story is beautifully written, or if the scenery is attractive). Furthermore, the project intends to develop students' life skills and students' and teachers' self-efficacy. The project has participants from, and is carried out in, four EU countries: Italy, Norway, Greece, and Portugal.

This article reports from the approach of using process drama and roles to change the classroom dialogue towards an inquiry/argument classroom culture. In particular, the research question that was developed was the following: How can a teacher facilitate student's roles to develop classrooms interactions toward an inquiry/argument classroom culture in mathematics? In drama, an inquiry/argument classroom culture would be seen as interactive dramaturgy that is open to initiatives and the development of common meaning. In order to find an answer to this question, we decided to compare teaching with and without the use of roles in two case studies (two classrooms), with an intervention in-between (a process drama).

For this purpose, we selected two fifth grade classrooms with 15 to 20 students in each, and most students were aged 11, with only a few aged 10. The two teachers were both educated, general topic teachers with a four-year teacher education, which is typical of Norwegian teachers at this grade. One teacher (classroom X) had more than 1 year of mathematics education study, while the other teacher (classroom Y) had not studied mathematics at all. The norm for this grade is to have studied some mathematics, typically around one semester (30 ECTS, half a year). The two classes were at the same school, and the teachers in these two classrooms cooperated closely in planning and, sometimes, teaching

To study the differences between ordinary lessons and lessons using roles, we videotaped ordinary mathematics lessons (before the process drama) and lessons using roles (after the process drama). The process drama was conducted for 3 days in each class in consecutive weeks (see figure 5).

The ordinary lessons were mathematics lessons as they used to be carried out in these classrooms. The students used textbooks and worked on tasks according to the year plan that the teachers had made. There were plenary discussions, plenary presentations, individual work on tasks, and work in pairs. No roles were used, and neither the teacher nor the students knew about the method at the time.

The lessons using roles were designed to use what we call role categories to learn mathematics through plenary discussions based on the sharing of ideas (see figure 6 below for the nuance between roles and role categories). To achieve this, it was necessary to pick tasks and problems that were beyond the level that most students had mastered. If they all knew the answer or the same method to find an answer, there would be little to discuss. The teachers' role in these lessons was to encourage the students to use the role categories to share, ask questions, explain and clarify, and evaluate each other's ideas. In this way, the teacher stimulated an inquiry/argument classroom culture.

In the lessons after the process drama, we chose to use three role categories developed by Allern & Drageset (2017). The first was the curious, the one who asks until he or she understands. The second was the sceptic, the one who is critical and challenges or makes alternative suggestions. The third was the elder, a democratic authority who listens to all and wants different perspectives clarified before evaluating. Using these roles, we aimed to encourage students to ask questions (the curious), be critical (the sceptic), and evaluate (the elder), which are characteristics of an inquiry/argument classroom culture.

The process drama itself played a major role in our design. As norms and positions strongly affect students' participation in mathematics lessons, we saw a need to create a different context to help them become familiar with and establish the role categories. As a result of these considerations, a process drama called *Out of Syria* was developed. It was designed as a travel or escape drama (see figure 5)

Figure 5

Description of the process drama *Out of Syria*

We arranged the students into Syrian families, all of which had one elder and one or two sons, daughters, or wives. Typically, a family consisted of five persons playing different roles. We chose to start the process drama in Damascus and allocated the students to families engaging in different sorts of business, such as a café, bookshop, tool trade, or second-hand shop. This illustrated the relatively affluent society of Damascus before the war. We used music, sound effects, pictures, and an installation to tell the students that the war had come. Using the teacher-in-role method, we created a dialogue on whether to escape and tried to convince them to flee to Europe through Egypt and by crossing the Mediterranean.

During a process drama lasting for 3 days, the students were given tasks in different episodes, such as selling their belongings to collect money for the trip, crossing borders, negotiating prices with smugglers to board a boat, and meeting the coastguard of Italy in the final episode. The use of refugees from Syria might seem insensitive but was undertaken with great care and connected to other areas, such as religion, ethics, and social studies.

To develop flexibility in the use of roles, we created a change of perspective several times. One such change of perspective occurred when the students' changed roles from refugees to smugglers, having to decide the price imposed for helping the families. Another change of perspective and roles was created when the participants changed roles from families in a refugee boat to the coastguard, deciding whom to take aboard and whom to leave. The aim was to provide a meta-perspective (read more about findings related to how students managed this in Allern & Drageset, 2017).

Experiencing and comprehending roles and role categories was a vital part of our project (see figure 6). In the tradition of mathematics education, one would use the word rehearsing, but, in drama, rehearsing is a concept used to describe the learning of fixed lines. In this project, there were no fixed lines. Instead, the students experienced the use of roles related to the family (such as father, mother, son, or daughter), the profession (such as a bookshop, café, or tool shop), and role categories (curious, sceptic, or elder) during the process drama. This means that no students were given lines but, instead, played together and solved challenges within their roles and in relation to the other roles. The intention was to prepare them to adopt similar roles during regular mathematics teaching after the process drama.

Figure 6

Explaining role categories

A role in drama is not only one thing. There are individual roles of persons, trying to create complex and real personalities. There are also narrower roles, like a thief in a child's play who is just evil or small roles that show off specific traits. Furthermore, there are collective roles, frequently used in process drama, in which many persons receive the same role, such as villagers or refugees. Sometimes, though, collective roles can be a starting point, and then different personal traits are added. When we talk about role categories in this article, we mean such traits that are added to a more complete or collective role, and the curious, sceptic, and elder are personal traits and not the full role of a person. These are traits that we want to develop for use in ordinary classroom discourse to emphasize curiosity, critical thinking (sceptic), and student evaluation (elder).

The lessons were videotaped, transcribed, and analyzed. The analysis was performed on a turn-by-turn basis, studying individual interactions and categorizing them. The categorization process was carried out in parallel to a theoretical analysis that resulted in the categorization system presented in Table 1. The main source for the categories in Table 1 was theoretical and thus was introduced during the literature review. But the analysis revealed that there was an aspect that was not covered by the theoretical categories, and a seventh type of teacher interaction was develop (see table 2 below). In the next chapter, we will present the findings related to teacher interactions, student interactions, and how these can be used to characterize the classrooms when using and not using role categories. We also include a description and reflection on the work of developing this change.

Findings

Teacher Role and Interactions

First, we will investigate the changes in the teacher role and interactions. Those changes were deliberately made to support and encourage students in using the role categories during the mathematics discourse.

A major difference in teacher interactions between normal lessons and lessons using role categories is related to the increased length of student turns. The teacher turns became shorter, mostly very short and typically consisting of just a few words. This is clearly visible when coloring student turns, and teacher turns in different colors (Figure 1) and reveals a pattern that is almost the reverse of that before the process drama.

Figure 1

Description of the Differences in the Transcripts before (Left) and after (Right) the Process Drama

Excerpt from a lesson not using role categories	Excerpt from a lesson using role categories
– But…what was most usual? What was most typical…here (– Ehm…to have one sibling – To have one sibling, how do you see that? – Because I can see that it is… is most heads. – It is most heads there. Yes. And what is it then that is **typetallet,** is it zero, one, two or three? Anna, which number is **typetallet**? – ….one – Then one becomes typetallet. Then that is typetallet. Do you folow us, Andre? Yes. One becomes typetallet. Because that us the most usual. Ehrm… what is least usual here then, Mona? – Threr – Three is least usual. And that was the same here also, wasn't it? – Yes it was three – No it was four – No it was three that was the least usual. So there we had the same as the others. But we did not have the same regrding one and two. But then we did like this, we grouped together and we had no zeros. Then we placed all the zeros, all the ones, all the twos, all the threes, all the fours. If we had been five, where should we have continued then, Eva?. – Continue – Continue to the right. And then…. We picked away one and one until we came to the middle. OR divided by two. – Can you find the middle there? – Can we find the middle? Shall we find the middle? – Yes – These goes away, these goes away, these goes away, these goes away…. – ….these goes away, these goes away, these goes away – Good rythm. And what is the median then? Johnny – That girl that you…. – How many, how many siblings does she have? – Ehm….she has….one – She has one sibling and then one is the median. But if…. What if I had these numbers then….of siblings, if I had zero, zero, zero, one, one, one, one, two, two, two, three, four, five, six, seven, ten, ten, ten – What? Ten siblings?	– OK. Ehm. Do we have any, can we ask him some questions about….if we use the same type of questions, those were really good questions – Why did you choose just that strategy? – Because, well, the two tasks were similarly easyt hen, but well this task number two had much larger numbers and I thought the jump-method was easy to use, so then I thought that could be easiest to use this method on task number two…since the numbers were largest….that is why I used the number line on task number one. – Because it was the largest numbers you used that as that can be most difficult to calculate – I could have tried that, but…. – Yes? (to another student) – Ehm, but you said that…that you thought that it was three, not that….when you should find the answer to the task then it was said it should be three there – Zero point three – Yes. But I got another answer – What did you get? – Zero point six – Me too, but then I realized that I was wrong – Zero point three – Why did you get zero point three? – Because I counted on both sides – I did the same – Yes, yes, but the middle. When you jump with both then you shall not count with that one also, because, it asked how….it did not ask how much it was between them, it asked how much it actually was, how many litres Omar had to give to Samara. You was not supposed to count how far, but instead just when they mset. Where they meet you should stop counting, you should not continue counting….and then downwards. It was just because of that. – Yes? (to another student) – Actually one can not actualle start with actually this first and then count as if there is ten between them. One must actually start at 26, or two point six then, and count all the way up, or make a number line that goes all the way up to three point 2 If not then it becomes, or then the answer becomes wrong. – Yes that one have to start, one have to write the entire number line? – Yes, but actually not from zero to ten. – No – From something, from twentysix to… – Yes – Yes from to, from to point six to… – Yes, one can just write the number line from two point six to three point 2 – How much did you jump with, how much did you jump with each time? – Ehm, zero pint one. I could have written that. – Ye. Okey? Can I ask about one thing? Yes? When oyu jumped on one side, when you jumped with one, why did you have to jump on the other side also?

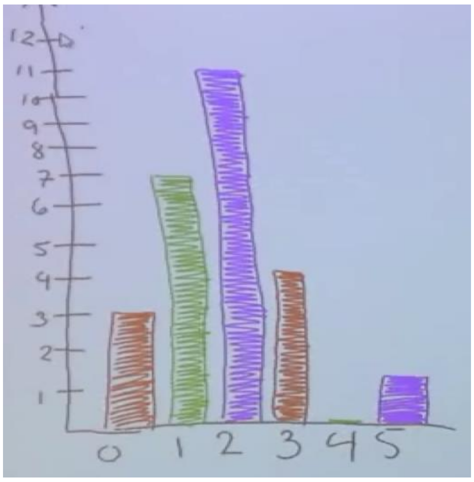
Note. All teacher turns marked; all student turns unmarked.

To explore this in greater depth, all the teacher turns were characterized and categorized using the six main types of teacher interactions from Table 1: *tell or inform students*, *support or lead students to progress toward finding an answer*, *focus on details of importance*, *access and share student thinking*, *use or extend student ideas*, and *challenge student ideas*. This process resulted in three main differences in teacher interactions between the ordinary lessons and the lessons using role categories.

The first main difference relates to the frequency of the two types of teacher interactions: *supporting or leading students to progress toward an answer* and *tell or inform students*. In the ordinary lessons, 63% (X) and 67% (Y) of all the teacher interactions involved supporting or telling students, while, in the lessons using role categories, only 16% (X) and 13% (Y) were these types of interactions. This means that the dominating types of teacher interactions in the ordinary lessons were rather rare in the lessons using role categories. In one example of this, the teacher drew a diagram and asked for the mode:

Figure 2

A Diagram in which the Students Should Find the Mode



Teacher: What is the mode here? Just mark it on the top.

(A student marks the tallest post amid some other talk)

Student: ... the mode is there (points out the number 2).

(Excerpt 5)

In this case, the teacher might help the student to find the answer by talking about marking the top. It is also a closed one-step question. In addition, all the teacher interactions in excerpts 3 and 4 (above) show how the teacher supports or leads the students toward the answer by asking closed one-step questions.

The second main difference relates to the frequency of teacher interactions to *access and share student thinking*. In both classrooms, the frequency was around 15% of all teacher interactions in the ordinary lessons and around 35% in the lessons using role categories. Here are four examples of such teacher interactions:

1) *You chose the method of jumping. Yes. Do you want to show us how you did that?*
2) *Can you show us on the table? Yes, how you did it.*
3) *And that is what we are going to discuss now. Why did you choose the method you used?*
4) *Yes. Why?*

(Excerpt 6)

The first two examples are requests to explain the action or method used, while numbers three and four are requests to explain why a method was chosen or why an answer is correct.

The third main difference relates to a type of teacher interaction that was frequent in the lessons using role categories (41% of all teacher interactions in classroom X and 31% in classroom Y) but non-existent in the ordinary lessons. One example of such an interaction is the following:

Student 1: Is there a reason why you used that particular method on that task?

Student 2: Not really, I just took it. I forgot that I could use the other one.

Teacher: Yes (to another student with raised arm)?

Student 3: Well, ehm … how did you know that you could take 0.3 first, that you should not take something else first?

(Excerpt 7)

In this case, the teacher only says one word (yes) to let a new student talk. During the lessons with role categories, there are many short teacher interactions: saying yes, nodding, and pointing out the next student to talk. All these teacher interactions are about choosing who will speak next. At other times, the students could explain, more or less clearly, and the teacher could ask questions like the following:

1) *Does anyone want to ask her a question?*
2) *Okay. Does anyone have questions?*
3) *And then you have to remember that it is important to ask good questions. Now you can start to ask him.*
4) *Anyone have more input to this method?*
5) *Okay, do we have any, can we ask any questions?*

(Excerpt 8)

In these five examples, we can see that the teacher requested students to ask questions. This typically came after student explanations, to prompt fellow students to ask questions for clarification. As example four illustrates, we practiced different types of questions related to the role categories of the curious and the sceptic. At other times, the teacher could ask questions like the following:

1) *Did anyone use another method in this task?*
2) *Did anyone solve it in another way?*
3) *Did anyone look at this and then start to think, did anyone think that I should have used that method instead?*

(Excerpt 9)

In the first two examples, we can see that the teacher asked for alternative methods, and in the third, the teacher asked for reflections around the choice of method. Typically, after a student had explained a method and fellow students had finished asking about that method, the teacher tried to find alternative methods, as shown in excerpt 9.

These three examples (excerpts 7, 8, and 9) exemplify different types of what we came to call *facilitating*. The first is facilitating by choosing who to speak, the second is facilitating by requesting student questions on fellow students' ideas, and the third is facilitating by requesting alternative methods (or reflecting on them). As mentioned, no such examples of facilitating were found in the ordinary lessons. Even in the literature, there seems to have been little emphasis on describing teacher interactions that facilitate discussions between students. Looking at the six main types of teacher interactions in Table 1, the focus is on how the teacher tells or supports students, how the teacher selects details of importance, and how the teacher accesses student thinking, uses the ideas, and challenges the ideas. However, none of these focus on facilitating student discourse in plenary. This means that facilitating should be the seventh main type of teacher interaction (Table 2) with the three mentioned types as supporting concepts (choosing who to speak, requesting student questions on fellow students' ideas, and requesting alternative methods). In addition, what da Ponte and Quaresma (2016) called inviting belongs to *facilitating*.

The three supporting concepts (Table 2) were planned as separate interactions to encourage students to use the role categories to support the development of an inquiry/argument classroom culture in which students ask questions, explain, and evaluate. However, only during the analysis did we see that these three together should be described as facilitating. This can be viewed as the seventh type of teacher interaction, in which the teacher orchestrates the discussion without participating in the dialogue of mathematical content.

Table 2

The Seventh Type of Teacher Interaction

Seventh type of teacher interaction	Supporting concepts
Facilitating	Choosing who to speak Requesting student questions on fellow students' ideas Requesting alternative methods (and reflections on these)

The core of *facilitating* is that the teacher actively forms the discussion while letting the students ask questions, explain, and suggest alternative methods, creating opportunities for discussions with questions and arguments—that is, not just letting them but in fact positioning them as speakers, active questioners, and knowers of alternative methods. This positioning involves not only allowing them to do this but also expecting and requesting them to take new positions. While such positioning is a reciprocal process, the students in these classrooms seemed to accept the positions and act accordingly. In addition, while Harré and van Langenhove (1999) talked about positioning as often unintentional and based on teacher beliefs, this positioning is intentional, collective, and related to the three role categories (curious, sceptic, and elder).

As this part of the study about teacher interactions has shown, the teacher interactions during the ordinary lessons differed from the teacher interactions during the role category lessons in important ways. First, there was much less use of *supporting or leading students to progress toward an answer* and *tell or inform students* during the lessons using role categories than in the ordinary lessons. Secondly, there was considerably more use of teacher interactions to *access and share student thinking* during the lessons with role categories than in the ordinary lessons. Thirdly, the concept of facilitating occurred frequently during the role category lessons and was non-existent in the ordinary lessons.

Student Participation

After categorizing each student turn using the four types of student interventions from Table 1 (*mere answers to mathematical questions*, *explanations*, *initiatives*, and *evaluations*), we found two main differences. The first main difference is related to the frequency of *student explanations*. In classroom X, the frequency was 16% of all student interactions in normal lessons and 58% in the lessons with role categories; in classroom Y, the frequency was 8% in normal lessons and 48% in the lessons with role categories. Of the explanations used during role category lessons, two main types were dominant. The first one is exemplified by the following excerpt in which the students discuss whether 1.12 is larger or smaller than 1.6 and subsequently whether 1.6 is similar to 1.60:

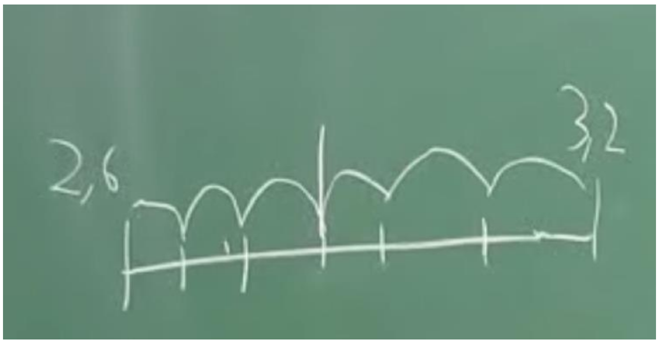
> *Student: I think that Andre was correct because they wrote one point six instead of one point sixty to make it easier. In most calculations it becomes easier to write one point six because one can add as many zeros as one wants behind one point six.*
>
> *(Excerpt 1)*

This is an explanation for why one student thinks that 1.6 equals 1.60. It is by no means a complete explanation, but it is an attempt to explain the issue. The second typical type of explanation follows, in which the students should find how much one student would have to give to the other to have equal amounts when one has 2.6 and the other has 3.2. First, the student wrote 2.6 and 3.2 and an empty number line between the numbers, and then the student said:

> *Student: Then I took as many lines as there were between … the two (points at 2.6 and 3.2 and draws vertical lines for each tenth) … three point zero, three point one, and then comes three point two (points out 3.2) … and then … and then I jumped like this, this, this, there (draws three jumps from each side toward the middle, adds a longer vertical line where both meet after three jumps). Then I saw how much it was from the middle to there (3.2), and it was three … or it was three to the middle. And then I just thought that it was zero point three.*
>
> *(Excerpt 2)*

Figure 3

Student Illustration of the Solution



In this case, the student explained the steps taken to reach the solution. This is an explanation of the actions performed or the method used, which differs from an explanation of why a method is correct. Just over half of the student explanations in both classrooms were explanations of action, while the rest were explanations of reason.

Excerpts 1 and 2 are also examples of how the role categories were used. Just before excerpt 1, two different solutions had been presented by different students. The students were asked which solution they thought was correct. Such a question is about positioning the student as the one who knows, the authority. Just before excerpt 2, the student had given an answer to the question but no explanation. Then the teacher facilitated the discourse by encouraging other students to be curious. One of the students then asked how this answer was found, and excerpt 2 was the response.

The second main difference was related to the frequency of *(mere) answers to mathematical questions*. During the ordinary lessons, the frequency was 42% (X) and 25% (Y) of all student interactions. During the lessons using role categories from the process drama, the frequency was only 3% (X) and 7% (Y). Typically, these are answers to simple questions or one-step calculations. One example occurred when the teacher, counting how many preferred to have cheese on their bread, drew five counting lines and asked:

Teacher: Then we have cheese. Can anyone see how many lines I have drawn for cheese (points out the lines in the table)?

Student: Five.

(Excerpt 3)

On another occasion in the same lesson, they counted the number of siblings of all the students, and the teacher drew a table on the blackboard with the number of students with zero siblings, one sibling, two siblings, and so on. Then, the teacher asked:

Teacher: What is most frequent? What is most typical?

Student: Ehm … to have one sibling.

(some other talk)

Teacher: What is the least typical then?

Another student: Three.

(Excerpt 4)

Both the examples above show how students often answer quite simple, one-step questions. The first example is about counting to five lines, and the second concerns identifying the largest number and the smallest number in a table. This type of discourse is often part of a pattern whereby the teacher navigates by making all the major decisions and leaving the students to undertake easier calculations or just confirm that they agree. This is the pattern that Lithner (2008) named guided algorithmic reasoning.

This means that the study of student interactions in these two classrooms resulted in the description of two main differences. One is the large difference in the frequency of *student explanations*: many more in the role category lessons than in the normal lessons. The other is the opposite difference in the number of *(mere) answers to mathematical questions*: far fewer in the role category lessons than in the normal lessons.

Given that each turn is thoroughly dependent on the previous one (Linell, 1998), the differences in teacher interactions might explain the differences in student participation. There also seem to be some connections in the data. Students giving *(mere) answers to mathematical questions* typically follow a teacher *supporting or leading students toward an answer* (see excerpts 3, 4, and 5 for examples of this connection). In the lessons using role categories, there is almost no *supporting or leading toward an answer* and very few student interactions in the category of *(mere) answers to mathematical questions*. At the same time, *student explanations* typically result from requests for explanations, either directly from the teacher by using interactions to *access and share student ideas* (as in excerpt 6) or indirectly by *facilitating by requesting student questions for fellow students*. As both these types of teacher interactions are much more frequent in the lessons using role categories, it is no surprise that the frequency of student explanations is also much higher.

The differences between the ordinary lessons and the lessons using role categories are clear, even when looking at the transcripts, in which the length and number of teacher and student interactions seem to be close to opposite (Figure 4). This relates to the way in which students participate, particularly the differences in the frequency of (mere) answers and student explanations. It also relates to how the teacher acts, particularly regarding the frequency of interactions for supporting and leading, accessing and sharing student ideas, and facilitating.

By considering what was typical interaction in the classrooms, it is possible to characterize the discourse. Accordingly, the lessons using role categories were characterized by:

- considerably more student talk than teacher talk, student turns being both longer and more frequent (Figure 4)
- a high frequency of *student explanations* (more than half of all student interactions)
- students requesting explanations from each other
- teacher interactions to *access and share student ideas*
- teacher *facilitation* (by choosing who to speak, requesting student questions for fellow students, and requesting alternative methods)

Looking at these characteristics and Figure 4, the lessons using role categories mainly fall within the inquiry/argument classroom culture.

On the other hand, the ordinary lessons were characterized by:

- the teacher talking much more than the students
- a high frequency of students' *(mere) answers to mathematical questions*
- frequent use of teacher interactions categorized as *tell and inform* and *support or lead students toward an answer*

Comparing these characteristics in Figure 4, the ordinary lessons mainly fall within conventional problem solving.

Figure 4

Typical Interactions Related to Classroom Cultures, Including Facilitating

<table>
<tr><td rowspan="2">Type of student interaction</td><td colspan="2" rowspan="2">(Mere) answers to mathematical questions</td><td colspan="4">Explanations</td></tr>
<tr><td></td><td colspan="2">Evaluations</td><td>Initiatives</td></tr>
<tr><td>Classroom culture</td><td>Conventional textbook</td><td>Conventional problem-solving</td><td>Strategy-reporting</td><td colspan="3">Inquiry/argument</td></tr>
<tr><td rowspan="2">Type of teacher interaction</td><td rowspan="2">Tell or inform students</td><td>Support/lead towards answers</td><td>Access/share student thinking</td><td rowspan="2">Use or extend student ideas</td><td rowspan="2">Challenge ideas</td><td rowspan="2">Facilitate</td></tr>
<tr><td colspan="2">Focus on details of importance</td></tr>
</table>

A Reflection on the Work of Developing two classroom's towards an Inquiry/Argument pattern

The difference in types and frequencies of teacher interactions between the ordinary lessons and the lessons using role categories explains how the teaching differs between these two approaches. The differences presented above are substantial, related to both student and teacher interactions. However, how did we work to create a discourse characterized by students requesting and giving explanations and teachers focusing on accessing, sharing, and facilitating student ideas, an approach that is so different from their normal discourse? In the following, we will examine the work that created such a dialogue using role categories. We found that this work consisted of four main parts.

The first part was related to how students can learn to participate in the classroom in new ways. To achieve this, the students explored and used role categories, the elder (authority), the curious, and the sceptic, as part of a three-day process drama. To develop flexibility using role categories, we applied a change of perspective several times (Allern & Drageset, 2017). Consequently, the work included planning and facilitating the systematic experience of the use of role categories and deliberate changes of perspective. An important part of this was the use of fiction, whereby students could play someone else and through this try out new ways of participating in a role.

The second part was related to how the use of certain types of teacher interactions were much less frequent than in their ordinary lessons. The teacher interactions in classrooms X and Y when using role categories showed that the teachers opened a space in the discourse by not asking all the questions and mostly avoiding evaluating (not carrying out the I and E of IRE). This was a deliberate choice, and the implementation formed a key part of the work of changing the teaching. By almost entirely avoiding asking questions or evaluating, the teachers provided room for students to use the role categories to question (curious), challenge (sceptic), and evaluate (elder). This means that we had opened a discourse space for students to apply role categories in the regular mathematics classroom by letting the teacher change role.

The third part is related to how we actively helped the students to fill the open discourse space using role categories. It was not sufficient just to open the space as the students did not fill the discourse space using role categories by themselves. During the mathematics lessons in classrooms X and Y after the process drama, the teachers focused on students explaining their methods and making the other students use the role categories of the elder (authority), the curious, and the sceptic. As this study was exploratory, we had no prescription dictating how to use role categories to create discussions during mathematical work. We focused on using the role categories, requesting students to ask questions (being curious), challenge (being a sceptic), and assess with reason (being the elder). Only afterward, when analyzing the teacher interactions during the lessons with role categories, did we realize that a large part of the teacher interactions could be described as *facilitating* in three different ways: *facilitating by choosing who to speak*, *facilitating by requesting student questions*, and *facilitating by requesting alternative methods*. Therefore, while removing the I and E from IRE and facilitating the use of role categories were deliberate actions, the use of *facilitating* was not planned and instead was a result of exploring how to activate the students in using their role categories. Part of this was to give them a task in the form of a role category, which can also be seen as intentional and collective positioning of the students by the teacher.

The fourth part is the planned use of well-known teacher interactions related to *assessing and sharing student ideas*, such as requesting that students explain their thinking, method, and reason. Together with *facilitating*, this shows that the teacher still has an active role in the discourse, albeit a role that helps students to participate (explaining and asking fellow students questions) instead of dominating the discourse.

The most visible role category during the lessons after the process drama was the curious, which was also clearly encouraged by *facilitating* requests for questions. Sometimes, the elder was visible through student recaps while trying to present arguments that concluded the discussion. The sceptic, who challenged, was also observed but not often and typically only when there was real disagreement. This might be because asking curious questions (like how, what, and why) is rather easy, while to be a sceptic and challenge, one needs to see an alternative solution or method or observe an error and argue for the view.

Altogether, the four key parts of the development of the dialogue in the lessons using role categories were the following:

1) Experiencing and comprehending role categories during a process drama
2) Opening a discourse space by limiting the number of teacher questions (particularly related to *tell and inform* and *support or lead students toward an answer*)
3) Facilitating and positioning students to use the role categories to fill this discourse space (*choosing who to speak*, *requesting students to question fellow students' ideas*, *requesting alternative methods (and reflections on these)*)
4) Asking deliberate questions (to *access and share student ideas*)

The second, opening a discourse space, was about leaving the standard teacher role of asking all the questions and evaluating all the answers through an IRE pattern. Reducing the use of this approach seems necessary to create a space for meaningful student contributions, and it is a key difference between the ordinary lessons and the role category lessons. The third and fourth parts concerned creating a new teacher role that facilitates discourse between students and tries to access and share their ideas. A key part of this is to create curiosity by facilitating student curiosity (asking each other) and teacher curiosity (accessing student ideas). Such curiosity can be seen as the opposite of teacher telling and leading. In this way, the lessons using role categories can be called curious classrooms. At the same time, the ordinary lessons can be called teacher-centered classrooms because the teacher asks the questions, evaluates the answers, and tells, supports, and leads students toward answers and ideas.

Conclusion

The aim of this article was to find out how teachers can use tools from drama to develop a mathematical discourse that emphasizes student ideas through student questions, explanations, and evaluations. To achieve this aim, we first developed a process drama so that students could experience role categories and perspective change. An important part of this was defining the role categories to be used. From a pool of observed role categories, we found that the curious, the sceptic, and the elder had particular potential related to the creation of a discourse with a high frequency of student questions, explanations, and evaluations. Then, we conducted the process drama in two fifth-grade classrooms and afterward used the role categories actively in ordinary mathematics lessons.

Then, we compared the discourse in the ordinary lessons before the process drama with the lessons using role categories after the process drama and found considerable differences. The ordinary lessons were characterized by teacher talk, a high frequency of *(mere) answers to mathematical questions*, and frequent use of teacher interactions categorized as *tell and inform* and *support or lead students toward an answer*. The lessons using role categories were characterized by student talk, in which students requested and gave explanations, and by teacher interactions, which *facilitated* and sought to *access and share student ideas*.

However, the difference observed was not the only point of the article. Instead, we sought to describe key elements of the process of developing this new discourse pattern in the classrooms. The first part was to conduct a process drama so that the students could learn about roles and create a meta-reflection related to positions in the classroom. The second part was undertaken when returning to the classroom and ordinary lessons in mathematics, when we worked on opening the discourse to more active student participation. This was achieved by making sure that the teacher avoided asking all the questions and evaluating all the answers, which meant reducing the frequency of teacher interactions of the types *tell and inform* and *support and lead students toward an answer*. This opened up the dialogue by making room for students to ask questions and evaluate each other. Nevertheless, opening up is not enough. We realized that we had to help the students to use their role categories actively and in that way change their participation. This was the third part, and it was undertaken exploratively by teacher interactions that we came to call *facilitating* students by choosing who to speak, requesting questions for fellow students, and requesting alternative methods. Accordingly, we also intentionally positioned them collectively in the role categories of the curious, the sceptic, and the elder. In fact, it was a mix of positioning and drama as we sometimes used fiction from the process drama during these lessons. The fourth part involved, when the teacher asked questions, the focus being on interactions that *accessed and shared student ideas*. In this way, the teacher also acted curiously and became a model for how to ask questions. As the curious seemed to be an easier position to adopt than the sceptic and the elder, curious questions (like how, what, and why) came to characterize the dialogue to such an extent that we called it a curious classroom.

This article makes four main contributions to the literature. The first contribution is the development of role categories based on the combination of drama theory about roles in process drama and the needs of certain positions to create explorative talk in mathematics. The three role categories (curious, sceptic, and elder) represent useful positions to help create exploratory talk in mathematics, with a focus on student questions, explanations, and evaluations. In addition, these roles can serve as more general examples of how one can create role categories to foster any type of discourse.

The second contribution is the theoretical development, both the synthesis of different concepts into more general types of interactions and the use of these to develop further the characteristics of Wood et al.'s (2006) four classroom cultures. The usefulness of the types of interactions is shown by the capability to characterize the lessons related to classroom cultures and to categorize all the utterances related to mathematics in these rather different lessons.

The third contribution is the development of new theoretical concepts related to teacher interactions. The idea of *facilitating* a discourse is not new, but our contribution is the definition of what facilitation can look like when the teacher creates a discussion between students without interfering with the mathematics. We also have related the definition of facilitation to theories of both drama and positioning.

The fourth contribution is the drama approach to mathematics teaching and learning. The entire project exemplifies how tools and insights from other fields can be used to develop both theoretical ideas and classroom practice. We combined ideas related to roles with the positions needed to develop a discourse focused on students' ideas and positioned them into the role categories that they knew from the process drama. The process drama seemed to be necessary to enable students to take the role categories and to see the need for them on a meta-level (change of roles and positions).

This project is also an example of how a study limited to two grade-five classrooms can develop new knowledge for teachers and researchers. Nevertheless, there is more to be undertaken. Researchers should inspect other ways to explore roles and search for other productive role categories and more ways in which a teacher can facilitate or position students to help them participate actively to create a more dialogic mathematical discourse. Further study should investigate how such use of role categories can bring about social and socio-mathematical norms that establish exploratory talk in the long term.

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Attachment 1

Six Main Types of Teacher Interactions

Type of teacher interaction	**Supporting concepts**
Tell or inform students	Informing and suggesting (da Ponte & Quaresma, 2016) Demonstrating (Drageset, 2014)
Support or lead students toward an answer	Supporting and guiding (da Ponte & Quaresma, 2016) Open questions (Drageset, 2014) Simplification (Drageset, 2014) Closed progress details (Drageset, 2014) Guided algorithmic reasoning (Lithner, 2008) Funneling (Wood, 1998) Topaze effect (Brousseau & Balacheff, 1997)
Focus on details of importance	Revoice (O'Connor & Michaels, 1993) Point out to notice (Drageset, 2014) Recap (Drageset, 2014) Connection (Rowland et al., 2005)
Access and share student thinking	Eliciting student thinking (Fraivillig et al., 1999) Enlightening details (Drageset, 2014) Justifying (Drageset, 2014) Inviting (da Ponte & Quaresma, 2016)
Use or extend student ideas	Extending student thinking (Fraivillig et al., 1999) Encouraging reflection (Cengiz et al., 2011) Encouraging reasoning (Cengiz et al., 2011) Moving beyond the initial method by pushing for alternative methods (Cengiz et al., 2011) Developing student ideas in plenary (Bjerkeli et al., 2020)
Challenge ideas	Correcting questions (Drageset, 2014) Advising on a new strategy (Drageset, 2014) Challenging (Alrø & Skovsmose, 2002) Challenging (da Ponte & Quaresma, 2016)

Attachment 2

Four Main Types of Student Interactions

Type of student interaction	**Supporting concepts**
(*Mere) answers to mathematical questions*	Teacher-led responses (Drageset, 2015) Unexplained answers (Drageset, 2015) Partial answers (Drageset, 2015)
Explanations	Advocating (Alrø & Skovsmose, 2002) Thinking aloud (Alrø & Skovsmose, 2002) Explaining actions (Drageset, 2020) Explaining reasons (Drageset, 2020) Explaining concepts (Drageset, 2020)
Initiatives	Challenging (Alrø & Skovsmose, 2002) Student initiatives (Drageset, 2015)
Evaluations	Evaluating (Alrø & Skovsmose, 2002) Requesting assessment from other students (Drageset, 2014)