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Abstract: The current study examines if the occurence of dynamic variables namely, authentic questions, uptake, high-level evaluation and student questions in primary science classrooms vary by teachers' instructional beliefs. Twelve 4th grade teachers from two different schools volunteered to participate in the study. Data was collected through semi-structured interviews and classroom observations. Both qualitative and quantitative methods were used to determine teachers' instructional beliefs, classroom practices and dynamic variables of classroom discourse. Results showed that teachers were more teacher-centred in their classroom practices than their instructional beliefs. There were no differences among teachers with different instructional beliefs in terms of the frequency of dynamic variables. Implications for education and research were discussed

Introduction

With the aim of improving science reasoning and understanding in classrooms, recent research has focused on classroom discourse (Chin, 2007; Erdogan & Campbell, 2008; Hackling, Smith,& Murcia, 2011; Reinsvold & Cochran, 2012; Scott, Mortimer, & Aguiar, 2006; Smart & Marshall, 2013). Classroom discourse refers to the mechanism of teacher-student interactions in classroom (Nystrand, Wu, Gamoran, Zeiser & Long, 2001). Nystrand and colleagues (2003) argue that "the structure, quality, and flow of classroom discourse are all likely to affect what students learn and how well they learn it" (p.192). Discourse analysis refers to different methods to analysing written and spoken language (Mercer, 2010). Especially classroom talk between teacher and student can be a powerful tool in improving understanding and achievement (Mercer & Howe, 2012).

The current study aimed to analyse classroom talk during primary science lessons through sociocultural discourse analysis where qualitative analysis is integrated with quantitative analysis. The main concern of sociocultural discourse analysis is to examine content and function of spoken language (Mercer, 2010). According to sociocultural theory, ideas and explanations are co-constructed socially during classroom discussions and internalised by individuals (Mortimer & Scott, 2003; Vygotsky, 1978). Mercer (2010) states that in classroom settings, meanings are negotiated through talk over a period of time. Thus, in order to reach some conclusions about classroom interactions repeated observations are necessary. The current study conducted repeated systematic observations in twelve primary classrooms in order to examine classroom talk during science lessons.

Educational research on discourse analysis mainly focuses on the structural organization of classroom talk (Mercer, 2010). In whole-class teaching environments, classroom talk usually starts with a teacher question (Nassaji & Wells, 2000). Teacher questioning in classrooms occurs often in the form of Initiation-Response-Evaluation (IRE) (Mehan, 1979), which is also known as 'triadic dialogue' (Lemke, 1990). In *initiation* the teacher asks a question; in *response*, a student (or students) responds to the question; in *evaluation*, the teacher evaluates the student's response (Mehan, 1979; van Zee & Minstrell, 1997). Researchers state that the IRE pattern could take various forms within the same classroom discourse (Molinari, Mameli & Gnisci, 2013). It could be used for basic knowledge transmission as well as initiating sequences, encouraging a variety of perspectives or stimulating students' reasoning skills (Molinari, et al., 2013; Nassaji & Wells, 2000). Teacher questions can not only guide students' learning but also encourage them to use language as a tool for reasoning (Mercer & Howe, 2012).

Haneda (2005) states that IRE cannot be labelled as 'good' or 'bad'; how it is implemented makes it more or less effective in promoting active student participation. Nystrand et al. (2003) describe certain variables that can make the IRE pattern more effective. They call these variables 'dynamic variables' that can also influence student achievement (Nystrand & Gamoran, 1991). The current study examined if dynamic variables in science classrooms are dependent upon teachers' instructional beliefs. Furthermore, the consistency of instructional beliefs and classroom practices were examined through semi-structured teacher interviews and classroom observations.

Dynamic Variables

Classroom discourse is *dialogic* when students' ideas are exchanged through open discussion and the teacher sets the ground for students to construct knowledge. These sequences of teacher-student interactions influence student achievement positively. On the other hand, the discourse tends to be *monologic* when teacher controls the flow of the lesson with minimum input from the students (Nystrand et al., 2003). In this type of discourse students have limited chance to have an active role in the construction of knowledge.

Nystrand and colleagues (2003) indicate that, authentic questions, uptake, high-level evaluation and, especially, student questions all constitute dialogic elements in a classroom and are substantively engaging for students. They describe these elements as 'dynamic variables' in unfolding the classroom discourse. These variables give clues about the quality of instructional discourse and student engagement in a classroom. They comprise the elements of student-centred, constructivist approach as active student participation is essential for a dynamic discourse. Mercer and colleagues (2009) highlight that students are better motivated and engaged when their views are sought and valued through dialogic discourse.

For a dialogic discourse, teachers need to be aware of the function of talk in education and how it guides and supports children's learning (Alexander, 2008). Even though the significance of dynamic variables in classrooms is emphasised, research shows that 85% of the class time is devoted to monologic elements, namely, lecture, recitation and seatwork (Nystrand, 1997; Nystrand & Gamoran, 1991).

What makes the conversations truly dialogic and discussion-like is the student questions. Students usually ask questions to get additional information or clarification of ideas. Therefore, teachers can easily use this chance to open the ground for discussion rather than answering the question themselves (Nystrand et al., 2003). Unfortunately, research shows that a very small percentage of questions in a classroom are asked by students (Graesser & Parson, 1994; Nystrand et al., 2003). In whole-class instruction, conversations usually start with a teacher question (Nystrand & Gamoran, 1991). This is the initiation part of the IRE pattern. The types and ways of questioning by the teacher influence how students construct scientific knowledge (Chin, 2007). In traditional classrooms teacher questions often serve to evaluate what students know. These are generally information-seeking recall questions that require predetermined short answers (Chin, 2007). On the other hand, in classrooms where constructivist instructional approaches are used, the main purpose of questioning is eliciting and scaffolding students' ideas (Smith, Blakeslee & Anderson, 1993).

The teacher modifies the flow of questioning based on student contributions (van Zee & Minstrel, 1997). Questions are usually open-ended requiring several sentences to answer (Graesser & Persons, 1994). Nystrand and Gamoran (1991) describe these kind of questions as *authentic* and *quasi-authentic*. Authentic questions do not have pre-specified answers and there are an infinite number of right answers. Quasi-authentic questions have a finite range of answers. An inauthentic question, on the other hand, has only one possible right answer. In order to elicit student talk, teachers are expected to use authentic questions more frequently (Graesser & Person, 1994). These questions not only give students more opportunities to construct science knowledge (Erdogan & Campbell, 2008; Nassaji & Wells, 2000) but also help maintain the students' interest and engagement in the topic (Nystrand & Gamoran, 1991).

The second move in an IRE pattern is student response. Frequent and extended student responses are encouraged for the construction of meaning and understanding (Myhill, 2006). As mentioned earlier, one way to elicit student response is to ask authentic questions. Another way is to provide high-level evaluation. Evaluation is the third move of the IRE pattern and it is a very critical part of the triadic dialogue. The teacher's certification of the student response such as 'Good' or 'Yes', or repeating the student's answer, is considered as a low-level of evaluation. However, the teacher's incorporation of the student response in the form of an elaboration or a follow-up question is considered to be a high-level of evaluation (Nystrand & Gamoran, 1991). This can be in the form of *uptake.* An uptake is the teacher's incorporation of student responses in order to validate their ideas (Collins, 1982). To do this, the teacher uses learners' responses in their next question and builds the discourse based on the contributions of students. This process leads to a high-level of evaluation of student responses since it validates the students' ideas and encourages further discussion (Nystrand, 1997). Mortimer and Scott (2003) described an I-R-E-R-E chain, where high-level evaluation is followed by further student response. Through this interactive approach a teacher is able to explore students' ideas deeply.

Mortimer and Machado (2000) have stated that the IRE pattern of discourse is authoritative unless the teacher's evaluation is elaborative, in which case students' responses are extended or new ideas are elicited through student contribution. Even if the sequences start with inauthentic questions, through high-level evaluation in which teacher requests justifications or connections, student contribution and engagement can be achieved (Nassaji & Wells, 2000). Chin (2006) points out that there are several factors determining the level of teacher evaluation. These include the nature of students' responses, the difficulty level of the topic, the curriculum time, students' ability level, and the teacher's epistemology and instructional beliefs.

Instructional Beliefs and Classroom Practices

According to Richardson (1996), beliefs are "psychologically held understandings, premises, or propositions about the world that are felt to be true" (p. 103). Pajares (1992) indicated that beliefs are "the best indicators of the decisions individuals make throughout their lives" (p. 307). Simmons et al. (1999) state that teachers bring their beliefs into classrooms with them and they construct learning environments conducive to their beliefs. Beliefs and practices range from 'teacher-centred' where teacher is the main source of information and responsible for transmitting the knowledge through lectures with minimal student input to 'student-centred' where teacher acts as a facilitator and knowledge is built through hands-on activities, investigations, group work, projects and laboratory activities (Simmons et al., 1999).

According to student-centred, constructivist view, classroom instruction builds upon learners' pre-existing understandings and experiences (Campbell & Tytler, 2007). Thus, what is in students' minds plays a crucial role in making sense of new knowledge (Levitt, 2001). Through social constructivism, which highlights the influence of context and social interactions, learners construct their own understandings (Driver, Asoko, Leach Mortimer, & Scott, 1994). Effective teaching practices should take into account what learners bring into classroom and provide opportunities for "students to talk through their ideas in social contexts" (Fitzgerald, Dawson, & Hackling, 2012, p. 984). Hence, students are able use their ideas to make sense of classroom discussions in relation to their own understanding (Mortimer & Scott, 2003).

Teachers play an important role in restructuring the classroom discourse. Teachers' instructional beliefs have potential influence on how they structure the classroom discourse (Christoph & Nystrand, 2001). Research on teacher beliefs regarding science instruction indicated that teachers' beliefs can be strong predictors of their behaviors in class (Bybee, 1995; Haney, Czerniak, & Lumpe, 1996; Haney, Lumpe, & Czerniak, 2002; Levitt, 2001; Pajares, 1992). Teachers prefer using their belief system as a resource to assist them in classroom situations (Levitt, 2001). The images of science teaching and learning accumulated over years constitute teachers'educationally-based beliefs about science and they influence their classroom practices (Fitzgerald et al., 2012). Educational researchers signified the need for deeper exploration of the relations between teachers' beliefs and practices (Crawford, 2007; Mansour, 2013; Savasci & Berlin, 2012; Uzuntiryaki, Boz, Kirbulut, & Bektas, 2010). Fitzgerald and colleagues (2012) suggest that

> "it is important to acknowledge this interconnectedness between teachers' beliefs, practices and contextual factors as this suggests that effective science teaching is dynamic, consisting of components that interact in unique and changing ways" (p.20).

This sudy therefore was interested to see if teachers who espouse student-centred, constructivist beliefs would use dynamic variables more frequently in their classrooms. Previous research investigated the relations between teacher beliefs and practices in different classroom settings but the quality of classroom talk, namely dynamic variables were rarely examined in relation to beliefs. Furthermore, much of the research on belief-practice relations relied solely on qualitative data. The current study utilized both qualitative and quantitative data to examine classroom talk in science. Thus this study is an attempt to bridge the gap between the complex classroom interactions and the rigidity of quantitative analysis.

Purpose and Research Questions

The current study examined the dynamic variables in primary science classrooms and whether or not the occurence of these variables vary by teachers' instructional beliefs. Firstly, how teacher beliefs are reflected into the classroom practices in science was evaluated. Next, the dynamic variables were examined based on their instructional beliefs. It was expected that there would be some differences in the frequency of authentic questions, uptake, high-level evaluation and student questions based on teachers' beliefs.

1. Are there consistencies between teachers' instructional beliefs regarding science instruction and classroom practices?
2. Are there differences in the occurence of dynamic variables based on teachers' instructional beliefs?

Methodology

Both qualitative and quantitative methods were used to determine teachers' instructional beliefs, classroom practices and dynamic variables. Teacher beliefs were examined in relation to classroom practices and dynamic variables namely, the frequency of authentic questions, high-level evaluation, uptake and student questions in classrooms.

Participants

The participating teachers took part in a larger study about interactions in science classrooms conducted in a northwestern province of Turkey that involved 32 teachers and their students. Twelve of the 4th grade teachers from two different schools volunteered to participate in the current study. Teacher demographics are given in Table 1. Of the participating teachers, three were male and nine were female, with teaching experience ranging from 7 to 34 years.

Teacher	School	Gender	Experience (yrs)
Teacher 1	A	M	34
Teacher 2	A	M	33
Teacher 3	A	F	18
Teacher 4	A	F	25
Teacher 5	B	F	18
Teacher 6	B	F	16
Teacher 7	B	M	25
Teacher 8	B	F	15
Teacher 9	B	F	7
Teacher 10	B	F	15
Teacher 11	B	F	20
Teacher 12	B	F	16

Table 1. Teacher Demographics

Data was collected during the Spring semester of the 2012-2013 school year. Teachers were interviewed first. Then, their classrooms were videotaped three times with one week intervals. Whole-class instruction was a common occurence in all classrooms. School A was an urban school with an average class size of 30; school B was an inner city school with an average class size of 24. In terms of content, teachers taught the *Living Things* and *Electricity* units as specified by the national curriculum. The national science curriculum in Turkey took effect in 2005 and focuses on constructivist student-centred instruction. The schools that participated in the study used the same Science textbook for the 4thgrade.

Data Collection

Data was collected through semi-structured interviews and classroom observations. The qualitative interview data was later quantified and examined in relation to the dynamic variables.

Semi-structured Interviews

The purpose of the semi-structured interviews was to determine the teachers' instructional beliefs regarding science teaching. Interview data was collected before the classroom observation through face-to-face interviews. Interviews lasted 20-30 minutes. All interviews were transcribed verbatim from the audiotapes (See Appendix for interview questions).

Classroom Observations

Classroom observations were conducted through video recording. Video recording dates were scheduled in advance. Lessons were recorded by a professional with wide angle cameras so that one can observe every student and the teacher in each classroom. The duration of the videos ranged from 35 to 40 minutes.

In determining the discourse variables, a systematic observation method was used. This method involves allocating the talk and activities to a set of previously specified categories. "The aim is usually to provide quantitative results which can be subjected to statistical analysis" (Mercer, 2010, p.3). In the case of the current study, teacher questions and evaluations were allocated to certain categories and the frequencies of student questions and uptake were noted.

Data Coding

For interview data coding, teacher responses to individual questions were coded using descriptive themes for teacher beliefs as described by Dancy and Henderson (2005). This provided a validation of the qualitative data analysis and categorising teachers' beliefs. Accordingly, each response was coded as 'teacher-centred' or 'student-centred'. Some of the themes of these categories were shown in Table 2.

Teacher-centred	Student-centred
• Teacher determines the pace of the class.	• Teacher leads discussions among students.
• Teacher is an expert and he/she presents knowledge.	• Teacher develops situations where students can learn.
• Students receive knowledge from teacher or textbook.	• Learners construct knowledge based on prior knowledge.
• All students can learn using the same methods.	• Students think/learn differently, have different needs.
• Understanding is measured by factual recall.	• Understanding is measured by ability to explain or choose correct approach.

Table 2. Descriptive Themes for Instructional Beliefs (Dancy & Henderson, 2005)
***(Detailed examples are given in Table 3)**

The study used 60% as a cut-off point (Mansour, 2013). That is, if 60% or more of a teacher's beliefs were coded into a specific category (teacher-centred or student-centred) then he or she was described as holding those beliefs. Teachers were described as having mixed beliefs when they were 40-60% consistent with each category. A sample coding for interviews is given in Table 3. Interviews were conducted in Turkish and the responses reported below were translated into English by two language experts for language equivalence.

Teacher's Response	Teacher-centred	Student-centred
On Teacher Questions		
"Questions are asked to check what students know, what they have learnt. You should start with easier questions and continue with more difficult ones".	X	
"Questions should be interesting, from everyday life. They should make them [students] really think about the concept".		X
On Class Discussions		
"We don't use it much because they [students] cannot do it. I mean they		

cannot elaborate their ideas. They keep repeating the same things, maybe because of their age. There is not much to discuss in science anyways".	X	
"We do it all the time. When you ask a question there are always different opinions. Through discussion we highlight every opinion and at the end we reach a consensus".		X
On Student Questions		
"Of course students should ask questions whenever they didn't understand something but they should listen to the teacher carefully first"	X	
"I think students should have the absolute freedom to ask any question they have in mind. I have my students ask me or their friends all kinds of questions. Something they heard outside of class, something about the topic, or something about someone else has said".		X
On Evaluation		
"Evaluation is done to assess what students know and whether they understood the topic".	X	
"Evaluation is done to provide students with feedback and to help them deepen their understanding".		X
On Effective Science Instruction		
"An effective science teacher should be well prepared the day before the lesson. She should know the content and be aware of what materials are needed. You cannot do these things just before the lesson starts".	X	
"Science should be hands-on. When you use examples from their everyday life the new knowledge lasts longer. This is true for not only science but for all the other subjects. Students should be involved in the processes".		X
On Constructivism		
"I think it is a good thing but very difficult to implement in our classrooms. Class sizes are big and there are students with special needs, there are autistic students, there are students who cannot read. Meeting the needs of these kids is difficult".	X	
"It is an effective approach. We are teaching how to use knowledge. When knowledge is given through hands-on, everyday life activities it would be long-lasting and the success rate increases. Students use their past experiences when doing these hands-on activities. Students have responsibility and ownership in the classroom. But teacher guidance is important".		X

Table 3. Sample Coding Checklist of Interview Data

Classroom observation data was coded twice for two different purposes: first, to determine the teachers' classroom practices and the second time to determine discourse variables. For the classroom practices, Dancy and Henderson's (2005) descriptive themes for instruction were used. Some of the themes of these categories are shown in Table 4.

Teacher-centred	Student-centred
• Teacher does most of the talking. Few students talk (Lecture).	• Students and teacher share talking, most students talk (Conversation).
• Discourse focuses on teacher's ideas.	• Discourse focuses on students' ideas.
• Students write teacher's ideas (i.e., take notes).	• Students write their own ideas.
• Students are physically passive.	• Students are physically active.
• Lesson progression is basically fixed in advance.	• Lesson progression is adjustable and shaped by student questions/comments.

Table 4. Descriptive Themes for Classroom Practices (Dancy & Henderson, 2005)

Similar to the coding of interviews, a 60% cut-off point was also utilised for the coding of the observation data. As seen in Table 5, a checklist was filled out for the instructional activities. Start and end times of the activity and the type of the activity was noted (teacher-centred or student-centred). If 60% or more of instructional time was spent on a specific category, the teacher was described as using that approach. Teachers were described as using a mixed practice if the ratio was between 40-60% for each category. A sample coding for observation data is shown in Table 5.

Time/Activity	Teacher-centred	Student-centred
0-3:30 min Review of the previous lesson (living and non-living things) through teacher questions. Teacher does most of the talking.	X	
3:30- 11:20min Teacher introduces the new topic: properties of living things. Teacher asks questions about students' everyday life regarding properties of living things.	X	
11:20-15:05 min Brainstorming about the properties of living things in groups. Groups share their ideas with the whole class.		X
15:05-23:50 min Teacher draws a concept map on the board; students copy it in their notebooks. Further discussion of the properties of living things through teacher questioning.	X	
23:50-26:15 min Students read aloud a text about the properties of living things by taking turns.	X	
26:15-29 min Teachers asks text related questions to whole class. Teacher does most of the talking.	X	
29-34:40 min Students complete exercises at the end of the unit. Teacher walks around the classroom, gives individual attention to students.	X	
34:40-40 min Review of the exercise questions. Teacher does most of the talking.	X	

Table 5. Sample Coding Checklist of Observation Data

For the coding of the dynamic variables, all of the content-related questions asked by teachers and students were noted. The authenticity of questions, level of evaluation and whether there is an uptake were determined based on Nystrand et al.'s (2003) specifications. Examples are given in Excerpt 1.

01	T	Where do fish live?	Inauthentic question
02	S1	In water.	Student answer
03	T	In water (+) good.	Low-level evaluation
01	T	What makes plants living things?	Quasi-authentic question
02	S1	They breathe.	Student answer
03	T	Yes they do (++) how do they breathe?	High-level evaluation
01	T	Do plants move?	Inauthentic question
02	S1	Yes they do.	Student answer
03	T	They do (+) you say. I do not see them walking around (++) how do they move?	High-level evaluation, Uptake
04	S1	Some plants turn towards sun (+) like sunflowers	Student answer
05	T	Good.	Low-level evaluation
01	T	What would have happened if we never stopped growing?	Authentic question
02	S1	We would have had to buy new clothes all the time.	Student answer
03	T	Ok (+) what else? I want you to imagine.	High-level evaluation

Excerpt 1: Examples of Authenticity, Evaluation and Uptake

Validity and Reliability

For the validity of interviews, several interview instruments were reviewed to develop an interview protocol. Questions were compiled from The Teacher Pedagogical Philosophy Inventory (TPPI; Richardson & Simmons, 1994) and other studies that examined teachers' beliefs (Ogan-Bekiroglu & Akkoç, 2009; Uzuntiryaki et al., 2010). Two specialists examined the questions and fourteen questions regarding science instruction were included in the final protocol of the Teachers' Instructional Beliefs in Science (see Appendix).

For coding of the interview responses and classroom observations, Dancy and Henderson's (2005) descriptive themes were used. Interview responses were coded by two researchers independently. Results were compared for inter-coder reliability. Regarding instructional beliefs, only one out of twelve teachers was categorised differently by coders. One researcher coded the teacher as 'teacher-centred' while the other coded her as 'mixed'. After the discussion, the teacher was categorised as 'mixed'. Regarding classroom practices, videos were reviewed by researchers independently. Based on the instructional time spent on activities, two teachers were categorised as 'mixed' and nine teachers were categorised as 'teacher-centred' by both researchers.

For the inter-coder reliability of dynamic variables, a sample of six observations (two from each teacher type) that involved 238 questions were coded by two researchers independently. Total agreement on question and evaluation types and uptake were computed in percentages and as Cohen's Kappa statistic. The coding consistency on the authenticity of questions was 85% and Cohen's Kappa value was 0.82. The agreement on the type of evaluation was 94% and Cohen's Kappa value was 0.91. Finally, researchers agreed on uptake 87% of the time and Cohen's Kappa value was 0.83. In order to resolve differences and to reach 100% agreement, all 238 questions were reviewed by researchers.

Data Analysis

Since the study was focused on the IRE pattern in elementary science classrooms, questions that did not follow the IRE pattern were excluded from the analysis. For example, questions that were not answered by students or self-answered by the teacher were not included. The frequencies of teacher and student questions, uptake, different types of questions and different types of evaluation were reported. In order to determine the differences in the frequencies of dynamic variables by types of instructional beliefs and classroom practices, chi-square analyses were conducted since these variables are categorical. For the statistical significance, p=0.05 level was used.

A total of 973 teacher questions that followed the IRE pattern and 80 student questions from 36 video recordings were coded. These questions were separated by teacher type. For a more reliable comparison, the total number of questions in each type was divided by the number of teachers coded in that category.

Results

Table 6 shows the instructional beliefs of each teacher according to the responses that they gave to interview questions and the practices they use in classrooms according to researchers.

Teacher	School	Instructional beliefs	Classroom practices
Teacher 1	A	TC	TC
Teacher 2	A	Mixed	TC
Teacher 3	A	Mixed	Mixed
Teacher 4	A	Mixed	TC
Teacher 5	B	Mixed	TC
Teacher 6	B	Mixed	TC
Teacher 7	B	TC	TC
Teacher 8	B	SC	TC
Teacher 9	B	TC	TC
Teacher 10	B	TC	TC
Teacher 11	B	TC	TC
Teacher 12	B	SC	Mixed

Table 6. Distribution of Teachers' Instructional Beliefs and Classroom Practices

Teachers were generally more teacher-centred in their classroom practices compared to their instructional beliefs. Semi-structured interviews showed that out of twelve teachers, five of them held teacher-centred beliefs, two of them held student-centred beliefs and the remaining five embraced these two types of beliefs equally. It was seen that all the teacher-centred teachers based on their beliefs used a teacher-centred practice. Of the two student-centred teachers, one of them was categorised as teacher-centred and the other one as mixed based on their classroom practices. Among the mixed-beliefs teachers, two of them were coded as using mixed-practices and the other three were categorised as teacher-centred. None of the teachers were categorised as student-centred in terms of their practices.

Table 7 shows the distribution of dynamic variables based on instructional beliefs. Accordingly, a large majority of questions were asked by the teacher. There were 973 teacher questions and 80 student questions in 36 observations. When questions were divided by the number of teachers in each category (teacher-centred, mixed, student-centred), it was found that teachers with teacher-centred beliefs asked 100 questions on average, compared to 63 questions for teachers with mixed beliefs and 80 questions for teachers with student-centred beliefs.

Students asked 6 questions on average in teacher-centred classrooms, compared to 9 questions in mixed-beliefs and 3 questions in student-centred classrooms. Majority of student questions were either procedural or low-level, inauthentic questions. Some examples of student questions are given in Excerpt 2.

01	S1	Does this microscope work with sunlight?
02	S2	What does this number 10 refer to? [on microscope]

03	S3	Don't micro-organizms help soil formation?
04	S4	Are viruses same with bacteria?
05	S5	Do we need to wet the cotton?

Excerpt 2: Examples of Student Questions

In terms of authenticity, large majority of teacher questions were inauthentic that has only one correct answer. Teacher-centred and student-centred teachers asked only one authentic question on average, while teachers with mixed beliefs did not ask any authentic questions. Some examples of classroom talk following authentic questions are shown in Excerpt 3.

01	T	What do you think would happen to this plant in a couple of days? [referring to the plant which was covered with a plactic bag]	Authentic question
02	S1	It would mould.	Student answer
03	T	Hmm, what do you think? [Pointing to another student]	High-level evaluation
04	S2	Plastic would be filled with gas.	Student answer
05	S3	The plant would die.	Student answer
06	T	Ok (++) there are different ideas, I want you to do this experiment at home with the help of your parents. You will write down your observations and later (++) bring your plants to the class.	Low-level evaluation
01	T	There is a living thing in this box. What do you think it is? [After letting students observe the box for a while].	Authentic question
02	S1	I think (+) ants (+) because they are so quiet.	Student answer
03	S2	Earthworms.	Student answer
04	S3	Butterfly.	Student answer
05	S4	No (+) butterfly would die immediately because there is no air.	Student answer
06	T	Can it be a grasshopper?	Quasi-authentic question
07	S5	No (+) because it would make noise (+) we didn't hear any noise.	Student answer

Excerpt 3. Examples of Authentic Questions

In terms of the question format, some questions sounded like authentic questions; however, when classroom talk was examined it was seen that the question was actually quasi-authentic. For instance, in the example below, when teacher asked students to prove that plants were living things, she actually wanted them to list the characteristics of plants that made them alive. Thus, this question was coded as quasi-authentic.

01	T	How can you prove that plants are living things?	Quasi-authentic question
02	S1	They drop their leaves.	Student answer
03	T	They drop their leaves (+) what else?	High-level evaluation
04	S2	Sunflowers turn toward sun .	Student answer
05	T	Yes (+) what else?	High-level evaluation
06	S3	They excrete.	Student answer
07	T	Good.	Low-level evaluation

Excerpt 4. Example of Quasi-authentic Question

The percentage of quasi-authentic questions were between 12-25%. Chi-square test results showed that there were no differences among different types of teachers regarding the frequency of dynamic variables. In other words, teachers used similar numbers of authentic and quasi-authentic questions, high-level evaluation and uptake regardless of their instructional beliefs.

Dynamic Variables	Instructional Beliefs Teacher-centred n=5	Mixed n=5	Student-centred n=2
Source of Question[1]			
Teacher	100 (94.2%)	63 (87.4%)	80 (96.4%)
Student	6 (5.8%)	9 (12.6%)	3 (3.6%)
Authenticity[2]			
IA	87 (86.8%)	47 (74.8%)	67 (84.3%)
QA	12 (12.4%)	15 (24.5%)	12 (14.5%)
A	1 (0.8%)	0	1 (1.2%)
Evaluation[3]			
Low	126 (77.3%)	104 (76.3%)	96 (72.5%)
High	37 (22.7%)	32 (23.7%)	35 (27.5%)
Uptake[4]	12 (12%)	12 (19%)	10 (12.5)

Table 7. Distribution of Dynamic Variables by Instructional Beliefs

The majority of teacher evaluations were low-level and there were no differences among different types of teachers. In other words, for the most part of the evaluation, teachers only said 'Yes', 'Good', 'Good idea' etc., or just repeated the student's answer. High-level teacher evaluations constituted between 23-28 % of teacher evaluations. Some examples of high-level evaluations are given below:

01	T	Can we classify eggs as dormant living things?	Inauthentic question
02	S1	Yes.	Student answer
03	T	How does that happen?	High-level evaluation
04	S2	Because it hasn't come out of its shell yet.	Student answer
05	T	What else?	High-level evaluation
06	S3	There is a chick in the egg and it is asleep.	Student answer
07	T	Yes (+) What else?	High-level evaluation
08	S4	Because it is not moving.	
09	T	Yes (+) What else?	High-level evaluation
10	S5	Instead of eating the eggs (+) if we incubate them they may hatch (++) thus (+) it becomes alive.	
11	T	Good (++) Eggs are living things that are dormant (+) when proper conditions are provided, they show living characteristics. So (+) we can say that there are dormant living things in our refrigerator.	High-level evaluation

Excerpt 5. Examples of High-level Evaluation

When uptake was examined, 10-12% of teacher questions involved teacher uptake and there were no differences among teachers in terms of number of uptakes. Some examples of uptake are given in Excerpt 6.

01	S1	Plants sleep. [On characteristics of plants]	Student Answer
02	T	Plants sleep. How do they sleep? Like humans?	Uptake
03	S2	When you keep the seeds at home, if you don't plant them into the soil they sleep.	Student Answer
04	T	Great (+) That is correct.	Low-level evaluation
01	S1	Living things smell. [On characteristics of living things]	Student answer
02	T	Your friend says all living things smell (++) what do you think? Is that true?	Uptake
03	S2	Yes (+) when lions eat their prey (++) they smell like blood.	Student answer
04	S3	Flowers smell (+) but some of them smell bad.	Student answer
05	S4	No (+) not all of them smell birds don't smell (+) frogs don't smell.	Student answer
06	T	Ok guys (+) smelling is not a common characteristic of living things. Think about something else.	Low-level evaluation

Excerpt 6. Examples of Uptake

Discussion and Conclusions

The current study integrated qualitative and quantitative data to provide researchers and educators with information about the primary science classroom discourse. The main finding of this study was that there were no differences among teachers with different instructional beliefs in terms of the frequency of dynamic variables. Based on the literature it was expected that discourse variables would differ in relation to instructional beliefs. Authentic questions, student questions, high-level evaluation and uptake were expected to be observed more often when teachers espouse student-centred beliefs. However, no differences were found when they were compared based on instructional beliefs. This finding could allude to the fact that beliefs do not necessarily influence the occurence of dynamic variables in science classrooms. However, it is important to draw attention to another finding of this study, that is the classroom practices used by teachers do not necessarily match their instructional beliefs.

In general, teachers were more teacher-centred in their classroom practices than their beliefs. These results are in line with the results of previous research (Brown & Mealar, 2006; Kang & Wallace, 2004; King et al., 2001; Ogan-Bekiroglu& Akkoç, 2009; Savasci & Berlin, 2012; Uzuntiryaki et al., 2010). This finding almost justifies why there were no differences in dynamic variables based on teachers' instructional beliefs. It is recommended that researchers should not solely rely on teachers' beliefs when examining classroom discourse and take into account teachers' classroom behaviuor.

When the incidents of dynamic variables were examined more closely, in other words, when an authentic question was asked or an uptake was provided it was seen that the classroom talk was more fruitful and interactive. In addition, more students were given the opportunities to participate in the classroom talk when dynamic variables were used. Active engagement of students in classroom discussions helps their understanding of what is being studied and prepares them for independent learning (Mercer & Howe, 2012). Nystrand et al. (2003) stated that teachers are usually not aware of the role of discourse in learning; rather, they focus on what they are teaching. For instance, Nystrand and Gamoran (1991) reported that teachers usually refer to discussion as a question-and-answer session led by the teacher. In fact, discussion refers to exchange of in-depth ideas with no interruptions.

Although this study contains rich observational data, it is limited in some respects. An obvious limitation is the small sample size of teachers. The findings drawn from twelve classrooms cannot be generalised to primary science classrooms in Turkey. Another limitation is that teachers and students in the classrooms might not have behaved naturally due to the observer effect. The teachers were informed that their classrooms would be evaluated in terms of teacher and student behaviors and interactions. They were instructed to use their regular classroom practices and not to make any special preparations for the camera. It is not possible to know if teachers and students behaved similarly when there was no observer in their classrooms. This is the main limitation in all observation studies (Daymon & Holloway, 2011). During a video recording, participants may be more anxious about the camera. This anxiety might be reduced by fixing the camera in one place rather than moving it around (Hancock, Ockleford, &Windridge, 2009). That procedure was used in the present study. Also, these teachers were part of a larger study and their classrooms were videotaped multiple times. It is believed that conducting multiple observations in the same classroom reduced the anxiety of teachers and students and helped them to get used to the camera.

Based on findings, it is recommended that future efforts in teacher education and professional development programs inform teachers about what dynamic variables are and their importance in student learning. Authentic questions, student questions, uptake and high-level evaluation play important roles in creating dialogic zones of interaction. Understanding how these variables function in a classroom will help teachers provide engaging instructional environments and foster student learning. The analysis of transcripts and video clips can be used as recources for professional development workshops (Hackling, et al., 2011). Teachers need to be shown and assured that dialogic discourse is an effective way in children's understanding of science; and they need to be aware of their roles in a dialogic discourse (Mercer et al., 2009).

Another important implication is to help teachers by showing the differences between their beliefs and their classroom practices and how they might reflect their beliefs into their classroom behaviour. Simmons et al. (1999) reported that simply altering the variables, such as how teachers feel and act, may not be sufficient to bring about change in classrooms; and changing the teachers' practices is very complex. Despite numerous reforms, classroom instruction tends to be teacher-centred (Kennedy, 2004). Teachers who espouse student-centred beliefs sometimes have difficulties in reflecting their beliefs into classroom instruction (Mansour, 2013; Uzuntiryaki et al., 2010). On the other hand, instructional beliefs and classroom practices become more congruent when it comes to teacher-centred beliefs (Mansour, 2013; Simmons et al., 1999; Uzuntiryaki et al., 2010). A teacher may not be able to implement his/her educational philosophy due to lack of resources (Ogan-Bekiroglu & Akkoç, 2009; Mansour, 2013; Simmons et al., 1999; Uzuntiryaki et al., 2010) or lack of content knowledge (King et al., 2001; Ogan-Bekiroglu & Akkoç, 2009). Cultural factors may also have a role here. In fact, the Turkish education system is known to be highly competitive and whole-class instruction is a common occurence in all levels of schooling. Although a constructivist science programme took effect in 2005 in Turkey, many teachers still prefer teacher-centred methods and they tend to teach to the test (Berberoglu, 2010).

This study showed that even though teachers are more teacher-centred in their classroom practices, teachers with either a student-centred or mixed beliefs have some potential to reflect their beliefs in their classroom instruction. Following on from this research is how teachers can be helped to adopt more student-centred beliefs. To shift their beliefs from teacher-centred to student-centred, teachers might need to be convinced that a student-centred practice is more effective for student learning (Simmons et al., 1999). As well as allowing teachers to explore their instructional beliefs, future studies might need to help teachers compare and contrast different classroom practices and test their effectiveness.

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Appendix A
The Teachers' Instructional Beliefs Interview Protocol

1. Do you like teaching science?
2. What are your thoughts about the primary science program in Turkey (it is a national curriculum):
 -In terms of content?
 -In terms of activities?

3. How would an effective science program be:
   -In terms of content?
   -In terms of activities?
   -In terms of instructional methods?
4. What are your thoughts about different instructional methods?
   -Lecture? Meaningful learning? Discovery learning? Discussion? Group work?
5. How are questions used in the science classroom?
6. What would be effective questioning?
7. What do you think about students asking questions in class?
8. What would be effective evaluation?
9. What are your thoughts about the instructional materials in science?
   -Everyday materials? Lab materials? Videos, slides, cards?
10. What would you base your lesson plan on? Content? Students' level and interest? or Materials?
11. What is the best seating arrangement in science classrooms?
12. What are teachers' roles in science classrooms?
13. What are students' roles in science classrooms?
14. What is constructivism? What are your thoughts about constructivism?