PRIMARY SCHOOL STUDENT TEACHERS´ CLASSROOM TALK DURING INQUIRY-BASED BIOLOGY LESSONS

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Abstract

In schools, classroom talk is often dominated by teachers´ lecturing or asking closed questions followed by teachers' evaluative feedback. When the teacher presents ideas to students or uses the question-response feedback, the talk is considered as authoritative talk. On the other side, during dialogic talk, the teacher reacts to students´ views and responses. The important role of the teachers in promoting dialogic classroom talk has been demonstrated in many previous studies. However, little is known about how student teachers use different talk forms, especially in inquiry-based biology lessons which is the focus of this research. The primary school student teachers' lessons – a total of 14 lessons of five student teachers – were videotaped and audiotaped. The data were analysed using theory-based content analysis. The results show that the primary school student teachers used more authoritative classroom talk than dialogical classroom talk in their inquiry-based lessons. Mainly, non-interactive authoritative talk form was used by all student teachers, and interactive dialogic talk form was used least. Authoritative talk was used in all stages of the inquiry-based lesson. Dialogic talk was used more during introduction and examination stages. The findings suggest that in teacher education, student teachers need scaffold in talking with pupils when carrying out inquiry-based teaching.
Key words: *authoritative talk, dialogic talk, inquiry-based lesson, primary school, teacher education.*

Introduction

Teacher's talk guides the classroom interaction between teacher and students. Teacher's support for students is especially significant during inquiry-based instruction. Talking and interaction between teachers and students directs teacher-student relationship, and a good relationship produces a positive effect on the success of the lesson (Chinn, Anderson, & Waggoner, 2001; Dawes, 2004; Mercer & Littleton, 2007; Murphy, 2007). Researchers have agreed that classroom interaction forms the core in inquiry-based teaching (e.g., Alexander, 2006; Aguiar, Mortimer, & Scott, 2010; Oliveira, 2010), but also that teachers lecturing or asking closed questions are dominant in classrooms (Newton, Driver, & Osborne, 1999; Mercer, Dawes, & Staarman, 2009; Molinari & Mameli, 2010).

Talk is meaningful for sharing, clarifying, and distributing knowledge between peers as well as there are important mechanisms of peer discussion to asking questions, hypothesizing, explaining, and formulating ideas together (Rivard & Straw, 2000). Students' higher-level thinking and talking demands that teacher systematically guides and scaffolds an interactive

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classroom discourse between teacher and students (Gillies, 2011). Findings indicate that it is important to create for students the opportunities to use talk effectively as a tool for reasoning, and talk-based classroom activities may enable development of students' reasoning skills and science understanding (Mercer, Dawes, Wegerif, & Sams, 2004). Student's understanding of science can develop if student understands that spoken language is a meaningful tool for thinking together (Dawes, 2004).

The focus of previous studies concerning science classroom interaction has mainly been on physics as well as on mathematics lessons (e.g., Lehesvuori, Viiri, & Rasku-Puttonen, 2011; Nathan & Knuth, 2003; Viiri & Saari, 2006). The aim of this research is to examine what kind of talk forms primary school student teachers use in their inquiry-based biology teaching.

The Pattern of Classroom Talk

The common interaction pattern in the classroom starts with teacher´s initiation question followed by students' responses and involving teacher feedback (Sinclair & Coulthard, 1975). Initiation and response may also be succeed by teacher evaluation (Mehan, 1979). The pattern may be more dialogic if instead of feedback or evaluation the discussion continues by teacher follow-up initiation, following student response, teacher follow-up, student response etc. (Mortimer & Scott, 2003). Consequently, follow-up chain offers information for the teacher about students´ thinking. Mortimer and Scott (2003) highlight follow-up from the teacher that leads to a further response from a student; this form of interaction supports and may enable a dialogic interaction during lessons. Myhill and Dunkin (2005) observed that teachers often impart factual information and ask factual questions; the dominant interaction pattern was the teacher interacting with students, but there was rarely interaction between the students and other students. The relative proportions of questions used by teachers show that classroom practices are dominated by patterns of discourse which are more concerned with the teacher telling and controlling the interaction, using questions with pre-specified answer or evaluation questions, than with acknowledging or utilizing children's experiential or cognitive prior knowledge elicited by connections or authentic questions (Molinari & Mameli, 2010).

The level of questions the teacher presents for the students is important for classroom interaction. Science student teachers may ask either inappropriate or presupposed questions, and the students would know the answer in advance (Ahtee, Juuti, Lavonen, & Suomela, 2011). Lehesvuori et al. (2011) found that student teachers are able to challenge the traditional forms of teaching more toward dialogic approaches; dialogic teaching program had positive influence on student teachers' awareness of teacher-talk. They suggest that the program which sought to dialogically share a new communicative approach formed a gestalt forum within which the student teachers could collaboratively share their views.

The influence of practicing on teachers talk is stated also by Erdogan and Campbell (2008). After practicing, teachers may ask a significantly greater number of questions, particularly open-ended questions. Findings in the study of Viiri and Saari (2006) indicated the difference between experienced and practicing teacher. The tutor teacher used a highly varying talk pattern but student teacher used rather simple and monotonous talk patterns in classroom. The talk pattern of tutor teacher was related to the aim and content of the episode and lesson. In contrast, the student teacher´s lessons had not a clear relation between the talk type and the content and aim of lesson. The student teacher had no planned talk idea, and did not change the talk type during lesson, even though the lesson required.

Students can be given an opportunity to make questions in a small group before sharing ideas with whole classroom (Baumfield & Mroz, 2002). Students' questions guide each student´s own learning and allow the teacher to appraise students' thinking (Chin & Osborne, 2008). Nathan and Knuth (2003) found based on their analyses of information flow and scaffolding that the teacher dominated both the analytic and social realms of the classroom. Later in their study, the teacher moved away from this central role as the authority in the classroom in an

attempt to provide students more space to hold sustained, student-directed discussions: the teacher saw increased participation and far more peer-based scaffolding, students were talking more, and listening more of their peers' ideas.

Teacher-student discursive interactions in a science classroom can be characterized by the framework presented by Mortimer and Scott (2003). This framework is based on the sociocultural theory of learning and has been developed based on empirical analyses of classroom talk. The concept of communicative approach is central to the framework, in providing a perspective on how the teacher works with students to develop ideas in the classroom (Mortimer & Scott, 2003, p.33). The framework has been used (e.g., Lehesvuori et al., 2011; Scott, Mortimer, & Aguiar, 2006; Viiri & Saari, 2006) to probe how teachers help students construct meanings in science classrooms by using different forms of discourse and patterns of interaction. This communicative approach of Mortimer and Scott (2003, p.39) to categorize the talk forms consists of four talk forms:

1) non-interactive authoritative: the teacher presents one specific point of view;
2) non-interactive dialogic: the teacher considers various points of view, setting out, exploring and working on the different perspectives;
3) interactive authoritative: the teacher leads students through a sequence of questions and answers with the aim of reaching one specific point of view;
4) interactive dialogic: the teacher and students explore ideas, generating new meanings, posing genuine questions and offering, listening to and working on different points of view.

Dialogic teaching has been called a particular kind of interactive experience; dialogic teaching reflects the view of knowledge and understanding that emphasizes testing evidence, analyzing ideas, and exploring values (Alexander, 2006). Even teachers who express an interest in dialogic teaching may need reassurance that dialogic teaching is an effective method to enhance learning and understanding of science: teachers can be helped to develop a more dialogic pedagogy through the use of certain techniques (Mercer et al., 2009). A teacher's task is to create possibilities for dialogic classroom talk and further to strengthen meaningful learning (Scott & Ametller, 2007).

Classroom Talk and Inquiry-Based Teaching

Prior research has indicated the teaching strategies that actively engage students in the learning process through scientific investigations are more likely to increase conceptual understanding than strategies which rely on more passive techniques; there is a clear positive trend favouring inquiry-based instructional practices (Minner, Levy, & Century, 2010; Potvin & Hasni, 2014). Many school curricula advocate an inquiry-based learning in science education and it has particularly been recommended for developing an understanding of the nature of science (AAAS, 2000; NRC, 2000; Rocard, Csermely, Jorde, et al., 2007; Lederman, 1992; Abd-El-Khalick & Lederman, 2000).

National Research Council (NRC) (1996) emphasizes that inquiry consists of process skills as planning of study, collecting and analyzing of data, and understanding about the nature of science as the philosophy and sociology of science. It is elicited science thinking such as asking scientifically oriented questions, responding to knowledge, communicating and justifying explanations (NRC, 2000). Based on their review on 32 inquiry teaching articles, Pedaste, Mäeots, Siiman, and others (2015) identified five distinct general inquiry stages: Orientation, Conceptualization, Investigation, Conclusion, and Discussion. They developed a framework to describe an inquiry cycle. In this framework, inquiry-based learning begins with Orientation and flows through Conceptualization to Investigation, where several cycles are possible. Inquiry-based learning usually ends with the Conclusion stage. Inquiries can be classified according to how much information is provided to students: confirmation, structured, guided, and open level inquiries (Bell, Smetana, & Binns, 2005). In the confirmation inquiry

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students confirm a principle through an activity in which the results are known in advance; in structured inquiry students investigate a teacher-presented question through a prescribed procedure; in guided inquiry students investigate a teacher-presented question using student designed/selected procedures, and in open inquiry students investigate topic-related questions that are student formulated through student designed/selected procedures (Bell, Smetana, & Binns, 2005).

Inquiries have been often teacher-initiated (Capps & Crawford, 2013) even on the other side teachers have emphasized that the teaching and learning of science should be student centered (Levitt, 2002). Teachers can guide their pupils successfully through the process of open inquiry by explicitly addressing the conceptual, epistemic, social and/or procedural domain of scientific knowledge in the subsequent stages of inquiry (van Uum, Verhoeff, & Peeters, 2016). The students with low attitude position needed more support to meet the challenge of an open-inquiry experiment, the support being a clearer explanation of the aims, and feedback from the instructor during the experiment (Berg, Bergendahl, Lundberg, & Tibell, 2003). Teachers and students' inquiry-based questioning have a vital role in classroom interaction; it is known that questioning directs the interaction in classroom (e.g., Chin & Brown, 2002; Chin & Osborne, 2008; Fisher, 2005). Fisher (2007) emphasizes that dialogic inquiry develops children's capacities for cognition and metacognition. However, some results indicate that combining authoritative and dialogic approaches is the most beneficial technique for learning outcomes (Furtak & Shavelson, 2009).

Methodology of Research

Research Questions

This research extends the previous studies on classroom interaction by focusing on biology lessons. The study produces knowledge of the prevalence of talk types (Mortimer & Scott, 2003) which are previously studied in the context of other school subjects. The aim is to examine student teachers' classroom talk during inquiry-based biology lessons. Research questions are as follows:
- Which talk forms do student teachers use during inquiry-based biology lessons?
- Which talk forms do student teachers use in different stages of inquiry?

Participants

The participants were a group of five primary school student teachers in a university's teacher education institution in Finland. Four of the students had basic knowledge in biology acquired in primary school teacher education programme, and one student had completed the advanced studies in the department of biology as a voluntary basis. The student teachers were selected based on their willingness to plan and teach their biology lessons using inquiry teaching.

The student teachers practiced inquiry teaching in teacher training periods in the University Training School. Training periods are part of the teachers' pedagogical studies, which are obligatory for every teacher in Finland. At first, the student teachers familiarized with the inquiry teaching. In this study, the inquiries were planned to be carried out in three stages, the conceptualization stage was integrated in the orientation stage. The student teachers planned the inquiries under the guidance of the supervisor but the final science lesson plans were on each student teacher's own responsibility. Classroom talk was not practiced in advance.

Data Collection

Student teachers' 14 inquiry-based biology lessons (in grades 1-3) were videotaped and audiotaped. The lessons were videotaped and audiotaped for each student teacher as following: Kathy one lesson, Mary three lessons, Sasa six lessons, Linda two lessons, and Susan two lessons. Susan's lessons were in the same day, and Mary's, Sasa's and Linda's lessons were carried out in different days. The duration of one videotaped lesson was approximately 45 minutes. One video camera was used for videotaping. The video camera was directed toward the student teacher, and videotaping did not disturb the lesson; the researcher did not influence the pedagogical relationship between the student teacher and the students. The lessons were performed according to the curriculum. The student teachers had a wireless microphone which captured the voices of the students as well. The student teachers had signed a consent form for this research and the guardians of the students had given permission for research. The names of the participants are pseudonyms and either student teachers or the students cannot be identified.

Description of Lessons

Each inquiry-based lesson included some or all of the three stages: introduction stage, examination stage, and concluding stage. The lesson contents and themes of the student teachers are described in Table 1. In Kathy's lesson, students identified constituent parts of a fish, and in Mary´s lessons, the students examined meal beetle grub (Table 1). Sasa planned and taught a several inquiry-based lessons. Sasa's four lessons were as consecutives lessons with breaks. Sasa used pictures and video materials during the lessons. Students examined among other things hen's eggs, and they made observations of how colored water proceeds through stem of plant. In Linda's lessons, students examined recycling and the different layers of compost. Susan's lessons were as consecutives lessons with break, students examined mainly water fleas (Table 1).

Table 1. Student teachers' lessons (IS=introduction; ES=examination; and CS=concluding stage).

Student teacher (grade)/ topic of lesson/the aim of inquiry	Lesson stage and content
Kathy's lesson 1 (grade 3): examination of fish anatomy/finding and identifying of constituent parts of a fish	IS (time 00.00-05.00): discussion about the content of lesson; distribution of lesson material to the students. ES (A) (time 05.00-10.36): examination of fish anatomy; CS (time 10.36-13.30): discussion about the lesson topic; ES (B) (time 13.30-34.00): continue to examination of fish anatomy; sorting of fish waste (time 34.00-42.00).
Mary's lesson 1 (grade 1): breeding of meal beetle grub /examination of own meal beetle grub	IS(time 00.00-08.00): Mary: What insects do you know? How do insects alive in nature? ES (time 08.00-28.00): Mary asks: Has anybody heard that kind of insect as meal beetle? Every student gets to examine her/his own meal beetle grub in the coming weeks. Mary gives the observation paper to the students. Students draw meal beetle grub. CS (time 28.00-35.00): Mary and students check the observation paper. What words student has ringed from the observation paper? Every student takes away grub box.
Mary's lesson 2 (grade 1): concepts and examination of meal beetle grub/concepts and the examination of own meal beetle grub	IS (time 00.00-09.00): Students read the meal beetle text. Classroom discourse on concepts and scientific terms of lesson content. ES (time 09.00-43.00): Students examine first grub skin of meal beetle. Students read the text. Students examine their own meal beetle grub. Has the grub eaten the piece of apple? Results are written in the observation paper. Students examine meal beetle grub by microscope. Students take away grub box.
Mary's lesson 3 (grade 1): examination of meal beetle grub/examination of students´ own meal beetle grub	ES (time 00.00-42.00): Students take the observation paper, meal beetle text, and colored pencils from desk, draw whether the meal beetle grub has casted off its skin. Some students examine meal beetle grub by microscope while others fill in the observation paper. Mary and students examine meal beetle grub together. How many grubs have casted off their skin? Students read the text. Students take away grub box.
Sasa's lesson 1 (grade 2): classification of animals, plants, and mushrooms /classification of species	IS/ES (time 00.00-21.00): Students move to sit down to the front of classroom. Students identify the pictures on the blackboard. ES (time 21.00-37.20): puzzle. Pictures from different figures. Students clip the figures out of a paper; and they think about to which class the figure belongs: A: animals, B: plants, or C: mushrooms. CS (time 37.20-40.00): feedback discourse.
Sasa's lesson 2 (grade 2): preconceptions of students in relation to species classification/determination of preconceptions of students	IS/ES (time 00.00-31.00): exercise that determines the preconceptions of students containing claim exercises (right or wrong). Students return the exercise. CS (time 31.00-43.00): Preconception exercise is checked together with class. It is discussed together with class. Cleaning up the classroom.
Sasa's lesson 3 (grade 2): How are pictures connected: egg, hen, and cock? Students examine hens´ eggs/examination of hens´ eggs	IS (time 00.00-25.00): How are pictures connected: egg, hen, and cock? ES (time 25.00-43.00): Students examine hen´s egg by means of observation paper.
Sasa's lesson 4 (grade 2): Students examine hen´s egg. Video: development stages of chicken/ examination of hen´s egg and identifying of development stages of chicken	ES (time 00.00-38.20): Students examine hen´s egg. Students watch on video: development stages of chicken. CS (time 38.20-41.00): Students´ feelings on lesson. Classroom discourse.

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Sasa's lesson 5 (grade 2): how plants thrive in different habitats (dry climate/ humid climate). How pink (plant) thrives in different water samples/ comparison of plants habitat and what will happen in pink (plant) trial.	IS (time 00.00-09.00): What things do students observe from picture A (dry climate/plants) and picture B (humid climate/plants)? ES (time 09.00-33.00): Students examine the flower and stem of pink (plant) -> What do you observe? Three different colors of water on the ground of plants (A: normal water, B: red water, C: green water). What will happen to the plants? Students write the hypotheses to the observation paper before science trial. CS/ES (time 33.00-42.00): Classroom discusses together what will happen for the science trial.
Sasa's lesson 6 (grade 2): observation of pink (plant) trial/ What will happen in pink (plant) trial?	ES (time 00.00-25.32): Students make observations for pink (plant) trial. Three pink are in a different water samples (A: normal water, B: red water, C: green water). Students watch video about spreading of water in plants. Discourse from video. CS (time 25.32-33.00): Students fill in an observation paper. What happened in pink (plant) trial?
Linda's lesson 1 (grade 2): examination of the collection boxes/what the collection boxes in the classroom contain.	IS (time 00.00-11.00): Linda asks what is happening in a picture. Does this classroom have recycling? Linda and students discuss themes. ES (time 11.00-29.00): The observation paper is distributed to students. Has recycling been worked on the right way in this classroom? Students examine the collection boxes in classroom and fill in the observation paper. CS (time 29.00-43.00): Linda and students together check the observation paper.
Linda's lesson 2 (grade 2): examination of the different layers of compost/what do the different layers of compost contain.	At the beginning Linda repeats a question: What did you learn the last lesson? IS (time 00.00-08.00): Linda asks: What do you see in the picture (compost)? ES (A) (time 08.00-14.40): The observation paper is distributed to students (preconceptions of students). What happens in the compost? ES (B) (time 14.40-24.40): Linda displays the compost terrarium in classroom. Students observe separate layers of compost terrarium and fill in the observation paper. CS (time 24.40-45.00): Linda and students check the observation paper (separate layers of compost). Classroom discussion on lesson theme. Demonstration of the rotation of compost on the blackboard is shown by Linda.
Susan's lesson 1 (grade 2): examination of water flea/ identification of constituent parts of a water flea and observation of movement of water flea.	IS (time 00.00-05.00): Susan asks the preconceptions of students on water. ES (A) (time 05.00-30.00): Students examine water sample (water fleas). Students watch video about water. Students fill in the observation paper. Susan displays the picture of water flea on the document camera. Students identify the constituent parts of a water flea.
Susan's lesson 2 (grade 2): examination of water flea and gastropod in the same petri dish/ how do a water flea and a gastropod react to each other.	Susan and students check the observation paper (filled in previous lesson). ES (B) (time 00.00-30.00): Water flea and gastropod swim freely on the petri dish, and Susan displays the petri dish on the screen using document camera. Susan and students observe what happens on the petri dish. CS (time 30.00-46.00): Susan and students repeat the action of food chain. Summary of lesson. Catching of water flea and transferring to fish tank.

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Data Analysis

Data analysis was mainly theory-based content analysis (Patton, 2002; Roth, 2005; Krippendorff, 2013). First, videotapes and audiotapes were watched and listened several times following by an analysis of the video data. The talk form of student teacher was identified in every 20 seconds; 20-second intervals (three codes/min) are standard in this kind of talk analysis (e.g., Lehesvuori et al., 2011). At first the main analyzer (first author) performed the analysis independently according to the categories of Mortimer and Scott (2003) shown in the Table 2. Finally, it was found that slightly different descriptions of the categories were needed to describe students' talk during inquiry-based lessons. The characterization is modified from Mortimer and Scott (2003).

Table 2. Characterizations of talk forms.

Talk forms	Characterization by Mortimer and Scott (2003)	Characterization describing the talk forms in this study
Authoritative talk		
Non-Interactive Authoritative (NI/A)	The teacher presents one specific point of view.	Teacher talks alone to students and presents only own opinions. Teacher dominates the classroom talk. Student only listens to the teacher.
Interactive Authoritative (I/A)	The teacher leads students through a sequence of questions and answers with the aim of reaching one specific point of view.	Teacher initiates the conversation, presents a question, student responses to the question, and teacher evaluates the response.
Dialogic talk		
Non-Interactive Dialogic (NI/D)	The teacher considers various points of view, setting out, exploring and working on the different perspectives.	Teacher briefly takes notice of a student's views or opinions without deeper interactive discussion. Student present her/his own views or opinions for lesson theme. Teacher gradually goes toward more profound interactive classroom discussion (=low dialogic).
Interactive Dialogic (I/D)	The teacher and students explore ideas, generating new meanings, posing genuine questions and offering, listening to and working on different points of view.	Teacher provokes students' ideas/questions, and teacher does not evaluate profoundly students' responses except on words as yes or no (=high dialogic). Teacher or student brings up a question(s) and asks a well-grounded explanation to question.

Other: other classroom discourse, discourse is not connected to the theme of lesson, for example general instructions concerning the school day.

The main analyzer and the second analyzer observed together several different talk forms of three student teachers from the videotape and discussed the analysis and the definitions of talk forms. After this, the second analyzer checked at random a total of 189 talk forms (13% of the total) in videotape data. The classification of the second analyzer was convergent with the main analyzer. In the results, talk forms are shown at intervals of one minute (maximum three different talk forms), and a graphic representation of talk forms is produced. One minute interval of talk forms is an adequate information to represent the talk forms in graphic; both authoritative and dialogic talk forms may occur during the same minute.

Results of Research

Distribution of student teachers' classroom talk to authoritative and dialogic talk forms is shown in Table 3.

Table 3. Distribution of student teachers' classroom talk between authoritative and dialogic talk.

Talk forms	Percentage
Authoritative	**62**
Non-Interactive Authoritative (NI/A)	38
Interactive Authoritative (I/A)	24
Dialogic	**22**
Non-Interactive Dialogic (NI/D)	18
Interactive Dialogic (I/D)	4
Other	**16**
Total	

Student teachers' talk was mainly authoritative (62%), then dialogic (22%). Talk which could not be classified in these forms accounts for 16% of all categorized talks. From student teachers' authoritative talk form, Non-Interactive Authoritative (NI/A) talk formed 38%, and Interactive Authoritative (I/A) talk formed 24% of categorized talks. From dialogic talk, Non-Interactive Dialogic (NI/D) talk accounted for 18% of all talk, and Interactive Dialogic (I/D) talk accounted for 4% (Table 3).

Kathy´s Talk Forms

During the first lesson, Kathy used non-interactive talk forms about the same amount (Figure 1): Non-Interactive Authoritative (NI/A) talk forms were used 19 times (30.65%) and Non-Interactive Dialogic (NI/D) talk forms were used 21 times (33.87%). Kathy used many fewer interactive talk forms: Interactive Authoritative (I/A) talk forms were used eight times (12.90%) and Interactive Dialogic (I/D) talk forms were used one time (1.61%). Other talk forms were used were 13 times (20.97%). Non-interactive talk forms (NI/A, NI/D) were clearly the dominant talk forms during Kathy´s first lesson.
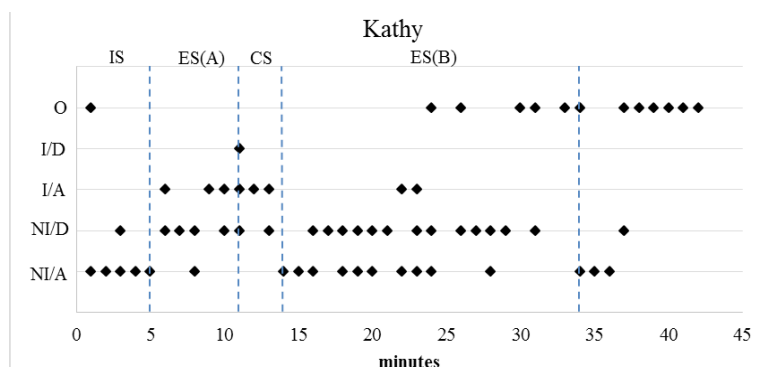
Figure 1: Kathy´s talk forms during the first lesson: NI/A=non-interactive authoritative; NI/D=non-interactive dialogic; I/A=interactive authoritative; I/D=interactive dialogic; O=other talk. The inquiry stages are: IS=introduction; ES=examination; and CS=concluding stage. The last about ten minutes were general discussion related to the finishing of the lesson.

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Kathy´s talk during the introduction stage (0-5 minutes) was mainly Non-Interactive Authoritative. During the examination stage (5-11 minutes), there was more Non-Interactive Dialogic talk. Students opened the perch and studied the anatomy of fish. Kathy guided the students through the examination of fish anatomy. Kathy took into account the opinions and views of students without more profound interactive discussion (NI/D). The talk was often a mutual talk between Kathy and students but without deep interactive discourse:

> (time: 07.00-07.20; ES; NI/D)
> Kathy: These have not been opened yet.
> Boy 1: It will be opened soon.
> Kathy: Here you can see these gills [fish].
> Boy 1: Interesting. Can I look at them?
> Kathy: Look at it freely. Gills [fish] are just a red.
> Boy 1: Exciting.

> (time: 07.40-08.00; ES; NI/D)
> Kathy: What is there? There are the spawns. Oh. It comes out here. That´s a lot.
>   Soon, you can see it open.
> Boy 2: Spawn is delicious.
> Kathy: What other functions does it have?

At the end of the first examination stage there was one period for Interactive Dialogic talk between Kathy and a student. Kathy brought up a question and Kathy demanded a reasonable explanation to her question. The talk was mutual talk between Kathy and students. Kathy did not evaluate profoundly student's response except on word as yes:

> (time: 10.40-11.00; ES; I/D)
> Kathy: Can anyone tell why the perch has the thorns in its´ fins?
> Boy 4: I can.
> Kathy: Okay. [Boy 4], tell us.
> Boy 4: Is it for a protection?
> Kathy: Yes, it defends. It protects itself. It defends. Did anyone find these thorns from fins?

During the following examination stage (14-34 minutes), Non-Interactive Authoritative and Non-Interactive Dialogic talk were mainly used. At the end of the lesson, other talk forms dominated when the students sorted fish waste. Kathy dominated classroom talk, but also took into consideration the views of the students. Interactive Dialogic (I/D) talk was found only once at the beginning of the lesson.

Mary´s Talk Forms

Mary´s talk during the second lesson was dominated by Non-Interactive Authoritative talk: 28 times (40.58%) and Non-Interactive Dialogic talk: 15 times (21.74%) (Figure 2). Mary used less interactive talk forms: Interactive Authoritative talk was used eight times (11.59%) and Interactive Dialogic talk was used one time (1.45%). Other talk forms she used 17 times (24.64%). Mary used all talk forms evenly through lesson, but Interactive Dialogic (I/D) talk form only once during the introduction stage of the lesson.
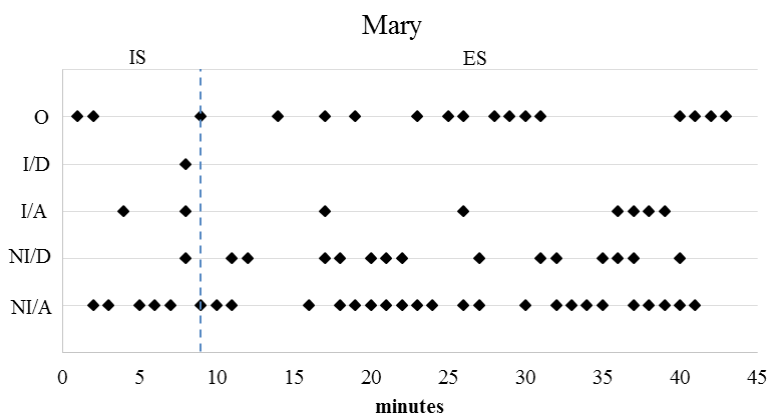
Figure 2: Mary´s talk forms during the second lesson: NI/A=non-interactive authoritative; NI/D=non-interactive dialogic; I/A=interactive authoritative; I/D=interactive dialogic; O=other talk. The inquiry stages are: IS=introduction; ES=examination; and CS=concluding stage.

During the introduction stage (0-9 minutes), talk was mainly Non-Interactive Authoritative. Non-Interactive Dialogic (NI/D) talk between Mary and students also existed. Students read the meal beetle text. Mary and students discussed concepts and scientific terms. Girl 5 and girl 6 presented their own views for lesson theme without interactive discussion between Mary and students. The talk was a mutual talk between Mary and students, and they presented their own views without interactive discussion:

> (time: 07.00-07.20; IS; NI/D)
> Girl 5: It is a pupa.
> Mary: Let´s interrupt this.
> Mary: Last time, we examined our larvae, and we observed that they are a metamerics. It´s body.
> Mary: [Girl 2].
> Girl 6: My larva does not eat any more.

Interactive Dialogic talk between Mary and student was also found during the introduction stage. Mary brought up a question and demanded a reasonable explanation to question. The talk was mutual talk between Mary and students. Mary did not evaluate profoundly student's response except on word as yes:

> (time: 07.40-08.00; IS; I/D)
> Mary: When is said that it creates it´s skin. Why does it create it skin again?
> Mary: [Boy 7].
> Boy 7: Because the skin stays too small for the larvae.
> Mary: Yes.

The rest of the lesson was reserved for the examination stage. Non-Interactive Authoritative talk still dominated, but there was also Non-Interactive Dialogic (NI/D) talk between Mary and students. Students examined first grub skin of the meal beetle while Mary guided students. Boy 8 and boy 11 presented enthusiastically their own views for larva skin and Mary briefly took notice of a student´s view without deeper interactive discussion. The direction of classroom talk was a mutual talk between Mary and students but did not include deep interactive discussion:

(time: 10.40-11.00; IS; NI/D)
Mary: Now, here is an empty skin.
Boy 8: All are not empty.
Mary: What is not an empty [larva skin]?
Boy 8: For example, that, it has the feet.
Mary: I´m sure it is the skin.
Boy 8: It is not, it is a dead [larva].

(time: 16.40-17.00; ES; NI/D)
Mary: Where is it?
Boy 11: It is there inside [larva].
Mary: Hmm.
Mary: You can´t see clearly [larva skin].
Mary: When I look at this so I can see that hole. It is a little difficult to identify from here. Hmm.

Mary dominated classroom talk, but took into consideration the views of the students.

Sasa´s Talk Forms

Sasa´s talk forms in the third lesson during the introduction stage was mainly Non-Interactive Authoritative, Non-Interactive Dialogic and Interactive Authoritative. Between 20-25 minutes, Interactive Authoritative talk stopped (Figure 3). Sasa used Non-Interactive Authoritative talk forms 30 times (39.47%) and Non-Interactive Dialogic talk forms 22 times (28.95%). Sasa used much less Interactive talk forms: Interactive Authoritative talk forms were used 12 times (15.79%) and Interactive Dialogic talk forms were used six times (7.89%). Other talk forms which Sasa used were six (7.89%).
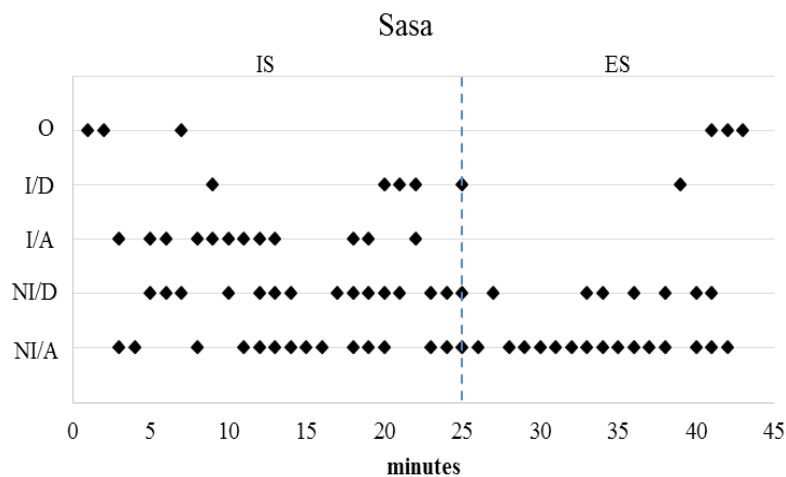
Figure 3: Sasa´s talk forms during the third lesson: NI/A=non-interactive authoritative; NI/D=non-interactive dialogic; I/A=interactive authoritative; I/D=interactive dialogic; O=other talk. The lesson stages: IS=introduction; ES=examination; and CS=concluding stage.

During the rather long introduction stage (0-25 minutes), Non-Interactive Authoritative, Non-Interactive Dialogic and Interactive Authoritative talk were used mostly. In addition, Sasa used Interactive Dialogic talk five times. Sasa and students examined how egg, hen, and cock pictures are connected. Sasa took notice of a student´s views, and used the names of the students in the talk. Sasa talked to student:

(time: 13.40-14.00; IS; NI/D)
Sasa: I could not explain better, it is concerning with man, when [student l3] just explained. And the hens just do not deviate from that. In other words, we have as [student l3] just said … we have … male has spermatozoon by it …

At the end of the lesson there was other talk. Sasa asked for students to follow the directions.

(time: 41.00-41.20; ES; O)
Sasa: Jeah. [student 14], what it was talked about whipping [students examine hen´s egg]? Do you remember what it was talked about whipping? All right.

(time: 42.00-42.20; ES; O)
Sasa: Okey. Let´s listen a moment before we are going to break. Before you are going to break, don´t forget to wash yours hands. We will continue lesson after a break.

Sasa used also Interactive Authoritative talk form during the introduction stage, but in the examination stage, Interactive Authoritative talk was not used.

Linda´s Talk Forms

During the second lesson, Linda used authoritative talk forms about the same amount: Non-Interactive Authoritative talk forms: 26 times (35.62%) and Interactive Authoritative talk forms: 25 times (34.25%). Linda used much less dialogic talk forms: Non-Interactive Dialogic talk forms: six times (8.22%) and Interactive Dialogic talk forms: two times (2.74%). Other talk forms which Linda used were 14 (19.18%). Distribution of the talk forms on Linda´s second lesson is shown in Figure 4.
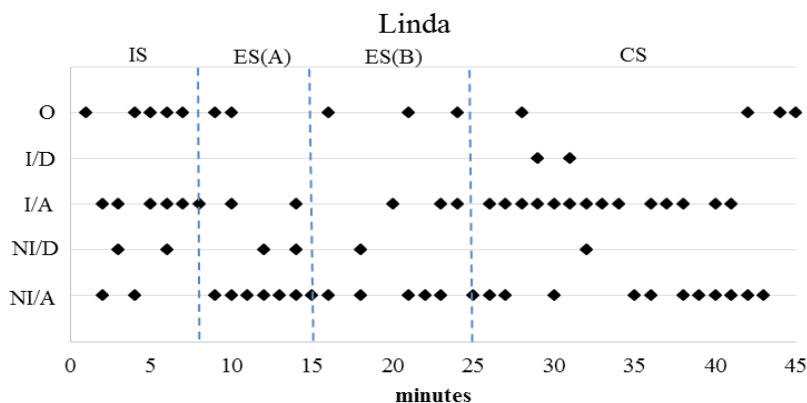
Figure 4: Linda´s talk forms during the second lesson: NI/A=non-interactive authoritative; NI/D=non-interactive dialogic; I/A=interactive authoritative; I/D=interactive dialogic; O=other talk. The lesson stages: IS=introduction, ES=examination; and CS=concluding stage.

During the introduction stage (0-8 minutes), Interactive Authoritative talk dominated. During the examination stage (8-25 minutes), talk was mainly Non-Interactive Authoritative. During the long conclusion stage (25-45 minutes), there was lot of Interactive Authoritative talk, and the only short period of Interactive Dialogic talk was in this stage. During the only and short period of Non-Interactive Dialogic talk, students examined the different layers of compost. Linda told what organic waste is meant. Girl 3 presented emphatically her own view

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and Linda briefly took notice of a student´s view, after this, Linda continued her own talk without deeper interactive discussion with student. The talk was from student to Linda, student presented powerfully her view:

(time: 31.00-31.20; CS; NI/D)
Linda: Organic waste means that it has lived, reproduced, and died.
Girl 3: From that plastic dish yet …
Linda: So, [girl 3].
Girl 3: That plastic dish can not be [organic waste] because it is an oil.
Linda: Hmm, you are right.
Linda: So, then …

Linda strongly dominated classroom talk and used the question-response method nearly through the whole lesson.

Susan´s Talk Forms

During the second lesson, Susan used Non-Interactive Authoritative talk forms 30 times (37.97%) and Non-Interactive Dialogic talk forms 17 times (21.52%) (Figure 5). Interactive talk forms were as follows: Interactive Authoritative talk forms: 20 times (25.32%) and Interactive Dialogic talk form: one time (1.27%). Other talk forms were used 11 times (13.92%).
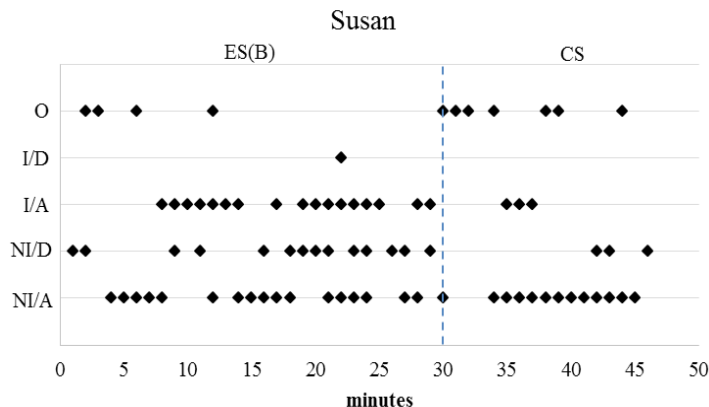
Figure 5: Susan´s talk forms during the second lesson: The talk forms: NI/ A=non-interactive authoritative; NI/D=non-interactive dialogic; I/ A=interactive authoritative; I/D=interactive dialogic; O=other talk. The lesson stages: IS=introduction; ES=examination; CS=concluding stage.

Susan used different talk forms often but Interactive Dialogic talk only once in the lesson. The lesson included the examination and the concluding stages. At the beginning of the examination stage, students observed how water flea and gastropod behave in the same petri dish. Later, Susan put a water fleas and a gastropod in the same petri dish. Students examined how water fleas and gastropod behave with each other. There was Non-Interactive Dialogic classroom talk. Susan initiated a discussion and students became enthusiastic for water fleas and gastropod. Students made enthusiastically observations and presented their observations for Susan. Susan took notice of a students´ views nonverbally.
(time: 18.00-18.20; ES; NI/D)

Susan: These gastropods are a divergent species.
Girl 22: What is that gastropod?
Girl 23: That looks like a slug.
Girl 24: What is inside of that gastropod?
Boy 20: It looks like a man [students giggle].
Girl 25: A slug.
Girl 26: No, it is a gastropod.
Girl 27: It looks quite as a slug enough.

During the examination stage (0-30 minutes), there was only one period of Interactive Dialogic talk between Susan and a student. Susan brought up a question and demanded a reasonable explanation to question. The talk was mutual talk between Susan and students including more depth interactive discussion:

(time: 21.20-21.40; ES; I/D)
Susan: Why, somebody said it already, why the intestine of that water flea is a green?
Susan: What affects to it?
Susan: Why through water flea it goes the green stripe [Susan repeats a question]?
Susan: [Boy 30].
Boy 30: Because it eats so much the algae.

In the conclusion stage (30-46 minutes), talk was mainly Non-Interactive Authoritative.

Talk Forms in the Different Stages of the Inquiry-Based Lesson

The student teachers used authoritative talk through all lesson stages. Dialogic talk was used proportionally more during introduction and examination stages, and other talk was used equally during all lesson stages. The amount of talk forms was the highest during examination stage because a lot of time was spent in examination stage compared to introduction and concluding stages (Table 4).

Table 4. Distribution of authoritative, dialogic and other classroom talk during different lesson stages through all lessons (IS=introduction stage; ES=examination stage; CS=concluding stage).

Talk form	Introduction Stage Number of talk form (Percentage of talk form)	Examination Stage Number of talk form (Percentage of talk form)	Concluding Stage Number of talk form (Percentage of talk form)
Authoritative	136 (64)	382 (62)	98 (66)
Dialogic	51 (24)	138 (22)	24 (16)
Other	26 (12)	98 (16)	27 (18)
Total	213 (100)	618 (100)	149 (100)

During the introduction stage, Sasa used all different talk forms. Sasa also used Interactive Dialogic talk form, especially during the lessons 3 and 5. Sasa used pictures often and discussed the content of the pictures with students during the lesson´s introduction stage. Linda asked students a lot of questions, especially during the introduction stage of the first lesson; Linda showed a picture to students and asked questions.

During the examination stage of the lesson, student teachers used mostly Non-Interactive Authoritative and Interactive Authoritative talk forms, and also Non-Interactive Dialogic talk

form was preferred. Interactive Dialogic talk form was used least of all. Mary preferred Non-Interactive Authoritative talk form during the examination stage of all lessons. Sasa often used Non-Interactive Authoritative talk form during the examination stage of the lessons and Interactive Dialogic talk form, especially during the examination stage of the lessons 4 and 6. During the examination stage of lesson four, Sasa and students examined hens´ eggs, and students watched a video on the development stages of chicken. During lesson 6, Sasa and students made observations of a pink trial.

During the concluding stage of the lessons, the student teachers used Non-Interactive Authoritative and Interactive Authoritative talk forms as well as Interactive Dialogic talk form was used. Linda and Susan preferred Non-Interactive Authoritative talk form during the concluding stage, and Linda also asked the students a lot of questions. Sasa preferred Interactive Dialogic talk form, especially during the second lesson. Preconception exercise was checked together with the class, and Sasa discoursed with students during the concluding stage of the second lesson.

Discussion

Primary school student teachers´ classroom talk patterns were examined in the context of inquiry-based biology lessons. Over half of the student teachers´ talk was authoritative talk and less than a quarter was dialogic talk. Using authoritative talk the student teachers talked and presented their own opinions to students by lecturing, or the student teachers used question-answer feedback, even when the teaching was based on the inquiries (c.f., Nathan & Knuth, 2003). Mainly the interaction pattern in the classroom started with student teacher's initiation question which was followed by students' responses and in some cases followed by student teacher's evaluation. According to the study of Sinclair and Coulthard (1975) and Mehan (1979), this is a common situation in classrooms. The student teachers used simple talk pattern in classroom and the talk was mainly related to content of the teaching this finding being in agreement with the findings of Viiri and Saari (2006).

The student teachers were also able to use dialogic approach (c.f., Lehesvuori et al., 2011). For example, Mary used Interactive Dialogic talk in the introduction stage of the second lesson. Student teachers' dialogic classroom talk was rather superficial without profound interactive dialogic classroom talk; the direction of talk was often between student teacher and students but there rarely appeared interaction between students (c.f., Myhill & Dunkin, 2005). The student teachers had an active role during classroom discourse, but they seldom demanded students' reasoning and thinking (c.f., Hogan, Nastasi, & Pressley, 1999). Further, the student teachers asked seldom inappropriate or presupposed questions that students would know the answer in advance contrary to the findings of Ahtee, Juuti, Lavonen, and Suomela (2011). The student teachers did not systematically guide and scaffold an interactive classroom discourse (Gillies, 2011) or create for students the opportunities to use talk effectively as a tool for reasoning (c.f., Mercer, Dawes, Wegerif, & Sams, 2004).

Sasa's six lessons were analysed and it can be concluded that Sasa used all talk forms during all lessons. But Sasa used for example, in the second lesson clearly dialogic talk and later preferred more dialogic talk in the lessons. After practising inquiry-based learning Sasa seems to be more capable for dialogical talk. Sasa was also more knowledgeable in biology than other student teachers which probably makes Sasa more comfortable with the content and gives space for more dialogical talk. Previous research has also shown that students teachers need in inquiry-based teaching practise in guiding (Viiri & Saari, 2006; Erdogan & Campbell, 2008; Mercer et al., 2009). The student teachers may experience challenge for their skills and understanding of inquiry, and the student teachers´ presentation of inquiry was usually as teacher-initiated also during the initiation of dialogic talk (c.f., Capps & Crawford, 2013). The challenge of student teachers toward inquiry-based instruction may lessen the dialogic talk as well as more profound dialogic interaction in science classroom. Inquiries were guided

by the student teachers and students' questioning, which is typical (e.g., Chin & Brown, 2002; Chin & Osborne, 2008; Fisher, 2005). The student teachers created, in some cases possibilities for dialogic classroom talk and moved towards to strengthen meaningful learning (Scott & Ametller, 2007).

Students worked in small groups thus they had opportunities to make questions in a small group (Baumfield & Mroz, 2002) and their guestions could guide their own learning and allow the teacher to appraise students' thinking (Chin & Osborne, 2008). In the classrooms, there was less discussion between peers even this discussion could be useful in inquiry-based learning (see Rivard & Straw, 2000). The minor talk between peers does not foster collaborative or peer learning and may affect the success of the lesson (c.f., Chinn, Anderson, & Waggoner, 2001; Dawes, 2004; Mercer & Littleton, 2007; Murphy, 2007). Students' understanding of science needs more thinking together (Dawes, 2004; Alexander, 2006) than was observed in this study.

Inquiries were carried out in three stages (c.f., Pegaste, Mäeots, Siiman, & others, 2015). The inquiries varied between structured and guided inquiries (Bell, Smetana, & Binns, 2005). Inquiries often were teacher-initiated (Capps & Crawford, 2013) but the examination stage was often student centered as well (Levitt, 2002): the student teachers were able to plan student-centred teaching. They were able to guide their students successfully through the process of inquiry (see van Uum, Verhoeff, & Peeters, 2016). The student teachers supported students during the experimentation (c.f., Berg, Bergendahl, & Lundberg, 2003). The student teachers questioning directed the interaction in classroom (e.g., Chin & Brown, 2002; Chin & Osborne, 2008; Fisher, 2005). The student teachers generally combined authoritative and dialogic approaches, which has been found to be the most beneficial for learning outcomes by Furtak and Shavelson (2009).

In this study authoritative talk was used during all lesson stages. However, also dialogic talk was used during all lesson stages, a little more during the introduction and the examination stages. For example, Mary used Interactive Dialogic talk in the introduction and examination stages. More profound interactive dialogic talk appeared in some cases during the concluding stage. Particularly in the introduction and examination stages, the student teachers provoked students' thoughts and did not evaluate students' responses, showing that they are capable for dialogic talk. This finding may be due that the conceptualization was integrated in the introduction stage. During examination stage, students used organic material which probably lead to Non Interactive Dialogic talk; when using organic material the examinations needed to be well structured. After examination stage, in the concluding stage, students were more free to discuss interesting issues related the organic material.

Conclusions and Limitations

The student teachers' biology lessons consisted mainly of structured or closed inquiries. The student teachers used different talk forms, however the authoritative talk was dominant. During the inquiry-based lessons, the talk in the examination stage often was dialogic, however also during the concluding stage the talk was dialogic. The organic material may have raised students' interest and they started to discuss about the issue.

This study has been carried out in an authentic school context as a part of normal school work in the Training School. The study cannot produce results which are controlled by particular variables, but this study does bring to up topics for debate concerning inquiry-based biology lessons. To some extent, the study results are limited from the viewpoint of controlled study design, but on the other hand, this study has been conducted using methods that can be transferred to any school settings.

In this study, videos have been valuable as source of information about student teachers´ talk form use. To increase the internal validity and authenticity in this study, the context was emphasized, and the study design was set in terms of the context in which the study was conducted. The plausibility and integrity of the research was made explicit by giving authentic

data and interpreting this data in a transparent manner. The validity of research results was principally based on the process of data analysis and data analysis by two different researchers to increase confidence in the research data.

The results of this study show that in science teacher education, there is a need to focus more on student teachers´ talk forms, particularly in inquiry-based teaching. Further research is needed to clarify the nature of the classroom discourse in detailed particularly in the inquiry-based biology lessons.

Acknowledgements

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