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On Attitude and Language in Students' Talk and Their Impact on Students' Texts

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Students' learning is assumed to be promoted through peer-group discussion. Most studies show the presence of qualitative improvements in either oral or written reasoning as a result of such interactions. However, knowledge on the relationship between talk qualities and text qualities is scarce. We adopt an explorative design using statistical analyses of students' talk and texts to estimate the relationships between theoretically-based concepts of attitude and sociolinguistic code. The operationalized concepts can be validated using statistical analyses. Linear regression shows that Elaborated code in students' talk has no impact on students' texts. Furthermore, Restricted code in talk is detrimental to students' use of Elaborated code in texts. This relationship is also found at the group level. Students' expression of open-mindedness in their texts depends on their use of Elaborated code. Teachers must support students in using Elaborated code in their texts and avoiding Restricted code in their talk.

Keywords: group discussion; open-minded; elaborated code; socio-scientific issues; writing

INTRODUCTION

Progressive pedagogy has bolstered the assumption that learning is promoted through student interaction, and subsequently, student-active learning has been an educational goal for decades (Kallos & Lundgren, 1976). Prominent examples of educational practices in this mind-set include Inquiry-Based Learning (IBL) and Problem-Based Learning (PBL). Both instructional approaches concur with the pedagogical ideas of John Dewey (Dewey, 1916; 1933) in that they originate from a question with the purpose to solve ill-structured problems (Savory, 2006). It should be noted that when used in science education, both approaches usually have defined outcomes such as critical thinking with regard to concepts and principles. Resent research shows that PBL is better for long-term knowledge retention, including the elaborate expression of such knowledge, whereas traditional teaching is better for the short-term retention of facts (Stroblem & van Barneveld, 2009). IBL is known to increase conceptual understanding (Minner, Jurist Levy & Century, 2010) and to result in better thinking skills than traditional teaching (Lord & Orkwiszewski, 2006).

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Both IBL and PBL include elements of student interactions in the form of peer discussion. This element was the focus of research that further investigated student-active approaches by letting students work in groups with 'argumentation' to specifically develop reasoning skills related to empirical data as well as scientific concepts (Driver, Newton, & Osborne, 2000; Duschl & Osborne, 2002), and by letting students discuss socio-scientific issues (SSI) (Kolstø, 2000; Ratcliffe, 1997) for the purpose of promoting students' competencies in terms of participation in ethical and democratic discourses.

Teaching designs focused on students' argumentation have promoted the development of reasoning skills regarding scientific concepts. Research on argumentation has given much attention to students' ability to form scientifically correct and structurally sound arguments (Erduran, Simon & Osborne, 2004; Jiménez-Aleixandre, Rodriguez & Duschl, 2000). Moreover, studies on teaching with SSI have also described students' reasoning skills regarding scientific knowledge and other dimensions such as moral reasoning (Sadler & Zeidler, 2004; Zeidler & Sadler, 2008). However, other aspects of group discussion require consideration. Instead of describing students' reasoning skills, a group discussion can be analysed by using the idea of 'social modes of thinking' (Wegerif & Mercer, 1997) using the concepts of explorative, cumulative or disputational talk, which are blends of reasoning skills and attitude. The different manners of active talk appear to be more or less beneficial for group discussions (Evagorou & Osborne, 2013; Lewis & Leach, 2006).

There is still limited knowledge on the beneficial modes of discussion (Howe & Abedin, 2013). Hence, the relationships between aspects of group discussions and any observed positive effects are not well known. Positive effects that can be related to group discussions are usually described on a general level for one or a few classes of students (Alexopoulou & Driver, 1996; Dong, Anderson, Kim & Li, 2008; Evagorou, Jimenez-Aleixandre & Osborne, 2012). In certain cases, these effects can be as low as 26% of larger samples (Lubben, Sadeck, Scholtz, & Braund, 2010); subsequently, there is a need for information on the effects of group discussion on small groups or the individual level to better understand the benefits and the prerequisites to gain from these benefits. Prerequisites such as students' prior knowledge have been given attention (Sadler, 2004; Sadler & Zeidler, 2005; Wu & Tsai, 2007), but only a few studies exist that indicate factors such as cultural background (e.g. Lubben et al., 2010; Morais, Fontinhas & Neves, 1992). Thus, it is necessary to further our knowledge of how students' cultural backgrounds can relate to their school achievements. Such knowledge together with appropriate assessment methods can enrich the means by which teachers design their teaching.

For the purpose of this study, we pay attention to both the students' knowledge-oriented skills, such as argumentation skills, and to other dimensions, such as

State of the literature

- Students' reasoning skills in socio-scientific issues (SSI) contexts have been assessed for various qualities, but there is still a need for a coherent assessment model based on variables that teachers can easily apply in their classroom.
- Qualitative small case studies show that reasoning skills are best developed in small groups where open explorative talk is prevalent, while more closed cumulative talk hampers reasoning.
- A lack of reasoning skills in writing has been found among students across different disciplines, but the impact of student activities on the qualities of students' texts, such as peer-group discussions, remains ambiguous.

Contribution of this paper to the literature

- We have operationalized theoretical concepts of attitude and sociolinguistic code and constructed a model to assess the qualities of students' talk and texts.
- Statistical analyses of our data cannot provide any positive relationship between the qualities of talk and text. Instead, non-elaborated talk can have a negative impact on students' writing.
- There is a well-known relationship between an open attitude and elaborated language in students' texts, but the direction has not yet been established. Students' use of Elaborated code in their writing is shown to be crucial to their potential to produce texts expressing open-mindedness.

attitudes deriving from cultural background. Our point of departure will be the performance of students when they are supposed to develop reasoning skills through participation in a discussion on SSI and writing a reflective and argumentative text. The intention of our study is to construct and validate a model to assess students' talk as well as their written texts, with the aim of exploring the assumed relationship between student group discussions and their performance.

Assessment of students' reasoning

SSI have been shown to provide opportunities for students to engage in complex decision-making processes and develop critical thinking. Studies that utilize different pre- and post-assessment methods have shown that SSI can be beneficial for the development of students' reasoning skills (Grace & Ratcliffe, 2002; Sadler & Zeidler, 2004; Zeidler, Sadler, Applebaum, & Callahan, 2009), moral sensitivity (Fowler, Zeidler, & Sadler, 2009), and scientific content knowledge (Klosterman & Sadler, 2010; Zeidler, Sadler, Simmons, & Howes, 2005). For the purpose of this study, we focus on qualities of students' reasoning skills both in talk and texts.

Assessments of students' reasoning skills have focused on either the structural qualities of students' reasoning or other aspects in order to capture different qualities. For the assessment of structural qualities, the Toulmin Argumentation Pattern (TAP) (Toulmin, 1958) has been widely used to show how well a claim is supported by supplementary phrases or sentences (e.g. Aleixandre-Jimenez, Rodriguez, & Duschl, 2000; Erduran, Simon, & Osborne, 2004; Kolstø, 2006). This method has been used for students' reasoning on SSI, but has been more successfully used for students' logical reasoning on scientific phenomena. Further, TAP has been used in longitudinal studies (Osborne, Simon, & Erduran, 2004) including SSI, as well as in a number of short-term studies to show the development of students' reasoning skills (cf. Aleixandre-Jimenez, Rodriguez, & Duschl, 2000; Erduran, Simon, & Osborne, 2004; Kolstø, 2006; Lubben et al., 2010). Its popularity resists critique regarding the difficulties in defining warrants and data in a classroom discussion (Aleixandre-Jimenez, Rodriguez, & Duschl, 2000; Duschl, 2007) and the necessity to adapt the method to each specific issue (Means & Voss, 1996).

In order to assess other qualities of students' reasoning apart from argument structures, different patterns of students' reasoning have been explored. Sadler and Zeidler (2005b) described students' patterns of informal reasoning as: 1) intuitive, 2) emotive, and 3) rational. Similar patterns have been included along with TAP as a possible route to assess the many aspects of students' socio-scientific reasoning (SSR) (Evagorou, Jimenez-Aleixandre, & Osborne, 2012; Evagorou & Osborne, 2013; Gustafsson & Öhman, 2013). Furthermore, general features such as complexity, perspectives, inquiry, and scepticism have been proposed to better describe the qualities of SSR (Sadler, Barab, & Scott, 2007). Furthermore, students' development of their reasoning regarding reflective judgement has also been assessed (Zeidler et al., 2009). In addition, further explorations of students' reasoning have resulted in the description and use of five cross-cultural epistemological patterns of reasoning on SSI across cultures (Zeidler, Herman, Ruzek, Linder, & Lin, 2013). These patterns include: 1) fairness, 2) pragmatism, 3) emotive reasoning, 4) utility, and 5) theological issues. In spite of the different ways to analyse students' reasoning skills mentioned above, methods to assess students' development of reasoning skills are still required for pedagogical purposes.

The contribution of classroom discourse in promoting students' reasoning skills

As mentioned above, a widely adopted assumption is that learning is promoted through student interactions in small groups. These interactions have been investigated in different ways to develop an understanding of their contribution to students' reasoning skills (Howe & Abedin, 2013). In science education, the importance of producing complex and well-grounded arguments has been emphasized, and there has been interest in describing the key features of successful discussions on scientific content knowledge. One of the benefits of student group discussion is that students are able to share their different ways of understanding. For example, Sampson and Clark (2009) showed that peer interactions resulted in better written arguments in relation to laboratory work in chemistry, since students working in triads performed better than students working independently. Similarly, student groups of four produced more developed explanations for phenomena in physics in their post-tests than those working in pairs (Alexopoulou & Driver, 1996). Additionally, these authors analysed the quality of the group discussions and found that the positive effects greatly depended on whether the group had an explorative attitude and openness towards negotiations. Furthermore, exploratory talk along and explicit references to the structure of arguments and the elaboration of arguments were found to be successful features of group discussions (Chin & Osborne, 2012). While explorative talk (Wegerif & Mercer 1997) appears to be beneficial for students' development of reasoning skills, cumulative talk, i.e. a tendency to prematurely accept propositions and instead seek agreement, has been suggested as hampering students from the benefits of group discussions on physics phenomena (Lubben et al., 2010). Lubben et al. (2010) related such features of group discussions to students' cultural backgrounds, since students from less-resourced areas showed a stronger tendency to seek agreement as well as use claims without justifications.

With regard to discussions on SSI, the use of complex and well-grounded arguments has also been put forward as a desirable feature. However, apart from explaining scientific knowledge in detail, students are supposed to develop their understanding of different perspectives related to the SSI at hand. Hence, when working with SSI, it is even more important that students use explorative talk, i.e. they need to consider alternative views and constructively criticize lines of arguments (Lewis & Leach, 2006). Lewis and Leach were able to show a loose relationship between the quality of students' group discussions and their use of criteria in their justifications. The successful qualities of group discussions were: 1) the number of criteria used; and 2) the use of cumulative/explorative talk. Hence, both the ability to justify claims and the use of explorative talk seem necessary for fruitful discussions on SSI. The importance of explorative talk for the quality of students' discussions was also shown in a small case study using two pairs of students characterized as high-achievers and low-achievers, respectively (Evagorou & Osborne, 2013). The high-achievers were shown to conduct discussions in an elaborated manner – that is, offering more rebuttals, qualifiers and warrants – and their discussion could also be characterized as exploratory talk. In contrast, the discussion of the low-achievers typically included cumulative talk and contained very little elaborated talk. The production of developed arguments is dependent on the skills of the students within the group. Thus, it has been shown that the presence of at least one student with higher order reasoning skills is necessary for the occurrence of complex arguments in students' small group discussions (Grace, 2009). Another important factor appears to be the presence of students who are likely to assume roles with beneficial functions in the group interactions, such as: 1) promoting discussions by provoking questions; 2) adding necessary and correct

scientific knowledge; and 3) keeping the focus of the discussion on the task. In agreement with previous studies (Ratcliffe, 1997), these functions contribute qualities that are necessary for explorative discussions on SSI.

Research on students' talk and texts in educational settings

Students' written texts have been investigated with the focus on both how the academic texts have been written and how the texts reflect the students' reasoning skills, as well as the relationship between talk and text. Such research has been conducted in science education as well as other subjects. A common concern found in research on academic writing is that many students do not appear to write in the expected manner (e.g. Crossley, Weston, McLain Sullivan, & McNamara, 2011; Ferrari, Bouffard, & Rainville 1998). Research in instructional science with a focus on writing skills has found that students with good writing skills planned their writing and elaborated more on the content by making it more explicit (Ferrari et al., 1998). Linguistic studies have shown that good writers consider the intended readers, whereas poor writers do not (Covill, 2010; Crossley et al., 2011). Hence, in order to write good text, the students need to consider perspectives other than their own. A main theme for the above-mentioned studies has been to use different forms of interventions in order to help students improve their skills, such as feedback and instructional models (e.g. Covill, 2010; Kellog & Whiteford, 2009; Perin, Keselman & Monopoli, 2003; Pessoa, Miller & Kaufer, 2014). In general, the results indicate that students need to develop a way of writing that does not reproduce, but rather includes combinations of ideas, (Perin et al., 2003) assumes a position and is supported with arguments (Knudson, 1998), elaborates more on topics and arguments, and creates texts that are more concrete and less ambiguous (Crossley et al., 2011).

Research in different academic disciplines, with a focus on the development of reasoning skills, has mainly used two concepts, namely reflective writing and critical thinking. For example, Chen, Chung, and Wu (2013) have studied reflective writing skills among college students with an emphasis on aspects such as being open ended, questioning, and exploratory. These reflective skills differ from critical thinking, which instead is connected to logic and explicit elaborations, such as justifications. Thus, studies on reflective writing deal with the students' attitude towards the task, while studies on critical thinking deal with elaborations on the text. Some studies have combined the two concepts to show how critical thinking is influenced by reflective writing (Naber & Wyatt, 2013). The best students were those who wrote in an analytical manner, using evidence, and anticipated potential problems. Studies have also been conducted on written online discussions (Cheong & Cheung, 2008); these studies reveal that good texts contained more elaborated justifications, whereas poor texts had more statements that included prejudices or assumptions. Similarly, Liu and Yang (2012) found a lack of critical-thinking skills and argumentative reasoning among senior university students.

Research on writing skills in science education has focused on argumentation skills based on TAP (1958). In accordance with many of the above-mentioned studies, Schen (2013) takes the starting point as the problem of a lack of argumentative skills in text production among university students. Typically, students did not elaborate their texts very much, but mostly made a single claim without other considerations. A particularly troublesome finding was that the creation of alternative explanations and rebuttals was lacking and these qualities did not improve at all over the college years. This problem was also addressed by Yeh and She (2010), who showed that an online scientific argumentation-learning program could be helpful for students to develop argumentation ability in their texts.

The relationship between students' group discussions and their texts is of specific interest in this study. Research on this issue shows some ambiguity concerning the value of group discussions to promote more elaborated texts as showed in different writing tests. Studies in science education have been focusing on critical thinking in order to promote conceptual understanding, whereas the focus in studies of other subjects has been on general reflective thinking. The problem with students' limited skills regarding writing, as well as critical and reflective thinking, has been addressed in research with different approaches. For example, by means of experimental design it was shown that critical thinking skills were enhanced among college students who were assigned tasks including both writing and discussion (Rickles, Schneider, Slusser, Williams & Zipp, 2013). Unfortunately, the authors were unable to conclude whether the improvement was due to writing, discussion or a combination of both. In a study with a comparative design (Linton, Pangle, Wyatt, Powell & Sherwood, 2014), university students' texts on conceptual understanding were improved due to writing tasks but not due to peer discussions. Another study (Lauer & Hendrix, 2009) on university students found that students' understanding was improved to a larger extent by writing than by peer discussion.

The effect of peer discussion has also been investigated, but without comparisons with the effect of writing (Smith, Wood, Adams, Wieman, Knight, Guild & Su, 2009). The authors found that peer discussion favoured the understanding of biological concepts among university students. Peer-discussions have also been shown to improve students' reflective writing. In a study on 4th graders' texts on moral issues, Dong et al. (2008) found that students who participated in oral peer-group discussions elaborated more on their texts and used more arguments than their peers in the control group. Online (chatting) discussion has also been found to improve students' (4th graders) reflective writing (Kim, 2012).

THEORETICAL FRAMEWORK

SSI provides opportunities for discussions in the science classroom aimed at decision-making based on critical thinking. Critical thinking has been described in several ways using definitions similar to Dewey's notion of reflective thinking (Zeidler & Sadler, 2008). Hence, for the purpose of this study, "reflective thinking" and "critical thinking" will be used interchangeably.

According to Dewey (1933), reflective thinking is favoured by certain attitudes that he describes as open-mindedness, whole-heartedness and responsibility. Our theoretical framework builds on Dewey's assumptions regarding this prerequisite for reflective thinking in the classroom. We focus on the attitude Dewey denominates as open-mindedness, as it appears to be particularly important for classroom discussions aimed at exploring and valuing perspectives related to SSI. Open-mindedness is an attitude that favours students' interest in new ways of seeing and understanding, their readiness to consider different perspectives, as well as their willingness to change opinions and stance. The importance of an open attitude has also been indicated by Bernstein (1974), who assumed that an open attitude is prevalent in families where different perspectives are open for discussion. Conversely, in other families, discussion is superfluous since norms are taken for granted. This difference in attitude was described in a theoretical model in which the concepts of open or closed communication codes were used to describe sociolinguistic behaviour, i.e. how meaning is expressed in different families. It is assumed that when a closed communication code predominates, a habit to express general and unequivocal meanings is fostered. Conversely, an open communication code affords many alternative views and fosters the habit of expressing specialized meanings and coping with ambiguities. Hence, when using an open communication

code, nothing is taken for granted and, therefore, all statements call for justifications and explicit ways of talking.

To describe these different habits of talking, Bernstein used another pair of concepts, namely Restricted and Elaborated codes. An orientation to a Restricted code hampers whereas an orientation to an Elaborated code facilitates the possibility of clarifying subjective intentions. The codes describe the syntax by which meanings are expressed in conversation. The Restricted code is described as an implicit manner of talking characterized by a lack of explanations and motives. In contrast, the Elaborated code is explicit and typically includes explanations and justifications. Bernstein also indicated that sociolinguistic behaviour is not to be understood as a capacity, but rather a *linguistic* habit that is related to context. Even if a person is habituated to using Elaborated code, he/she may choose to use Restricted code if an Elaborated code would prevent a fluent conversation. However, a person habituated to using a Restricted code is assumed to have more difficulties using explicit explanations even when required, for example, in a school context (Bernstein, 1974). In our interpretation of Bernstein, Elaborated and Restricted codes would differ in the sense that the former is associated with more developed arguments (c.f. Toulmin's argument pattern; Toulmin, 1958) than the latter.

AIMS AND RESEARCH QUESTIONS

Based on pedagogical philosophy (Dewey, 1933) and sociolinguistic theory (Bernstein, 1974,) we intend to construct and validate a model to assess the qualities of students' talk as well as their written texts. The aim is to explore the assumed relationship between student group discussions and their performance in writing.

Our investigation is informed by the following research questions:

1. How can attitude and sociolinguistic code be operationalized to assess the qualities of students' talk and texts?
2. What relationships can be found between attitude and code in students' talk and texts?
3. How can differences between students' texts be understood on a group level?

METHODS

We adopt an exploratory design using quantitative methods to analyse qualitative data. Our qualitative data comprises students' texts and transcriptions of students' talk. The data is naturalistic in the sense that there is no pre-test that focuses on the students' attention to certain aspects of what is investigated here. The teacher is following his instructional design without any intervention from the researchers and the students' texts are part of the examination process planned by the teacher.

Participants

The participants (N = 22) in this study were 15–16-year-old students enrolled in the 'Social Science Program' (preparation for higher education) and attending a public upper-secondary school with approximately 900 students in a small Swedish city. They participated in 'Science Studies', which is a course that is compulsory for all non-science students in the upper-secondary school in Sweden, and covers aspects of sustainable development, human sexuality and relationships, individual health and lifestyle, and biotechnology and its implications. Prior to the present investigation, the students were divided into groups of 4–6 students. For the purpose of giving the students equal opportunities to express themselves in their

group work, they were assembled into homogeneous groups based on their use of elaborated language, i.e. explanatory justifications, in their first argumentative text on an SSI.

Ethics

The students were given information regarding the project, data collection and data handling. They were given the opportunity to decline from participating with the aid of a written description of the project's purpose and data collection to be discussed with their parents and returned to school signed by both student and parent, with or without consenting to be a participant. One student declined with the consequence that we refrained from recording his and his group's discussions.

Setting

The participants' teacher had four years' experience as a teacher and had participated in a 15 European Credit Transfer and Accumulation System (ECTS) course for practicing teachers on the use of SSI in science education. The course was given by one of the authors of this paper, and was based on 'The role of moral reasoning on SSI and discourse in science education' (Zeidler, 2003). During the school year preceding this study, the teacher had implemented the use of SSI in 'Science Studies' throughout the academic year (approximately 90 hours of instructional time). The classroom can be described as more student-centred than teacher-centred. Data was collected during the second half of the semester.

The SSI project in focus, entitled 'Wolves in Sweden and Biodiversity', was introduced to the students through a short (five-minute) presentation focusing on the inbreeding of the Swedish wolf population (population size 350 wolves), and how the authorities attempted to resolve the problem by importing Russian wolves. The brief introduction covered the conflicting demands from the European Union (EU), the Swedish politicians and their contracted researchers, the demands from the Sami people, the diverse views among scientists, and the opinions of Swedish hunters and ecowarriors concerning the size of the smallest healthy wolf population. In addition, four objectives for the work on biodiversity were presented: ecological variation, species variation, genetic variation, and ethical considerations regarding the extinction of organisms. After the teacher's introduction, the students studied two newspaper articles presenting the views of different parties of interest. The conflicting views were related to the scientific facts indicating that the Swedish wolf population is inbred (the descendants of merely five genetically different wolves). Hence, the controversies involved the introduction of wolves from other gene pools (Russian wolves), the size of the Swedish wolf population, a conceivable impact on reindeer husbandry, as well as the opinions of hunters and ecowarriors. The students' task was to discuss the articles in their groups. The purpose was to share understanding and personal standpoints in order to facilitate the writing of individual argumentative texts, which were to be sent to the teacher. The texts were to be commented on by the teacher for subsequent improvements. To guide the students in their discussion and writing of individual texts, the teacher presented the following questions and suggestion:

- What is your opinion?
- Can you understand the different perspectives of the debate?
- Give your view on the different perspectives.

Data

The two consecutive observed lessons (60 minutes each on two subsequent days) involved information and a lecture by the teacher, students' readings, and classroom discussions. The students sat in their small groups during the two

classroom discussions (20 and 23 minutes, respectively) that were audio-recorded for four out of the five groups. The fifth group was not audiotaped with respect to the only student in the class who did not consent to participate. During both lessons, the classroom discussions occurred first within the small groups and then between the teacher and the student groups. The latter was done with the purpose of, without judgement, making the student groups aware of the presence of presumably different positions adopted in other groups. The texts from the 22 students were partially written in school and partially as homework. Texts were submitted to the teacher approximately two weeks after the introduction of the SSI in focus, with the exception of three students who, for unknown reasons, made late submissions. The texts (word count M = 633; SE = 74; Min = 126; Max = 1,463) used for analysis were the first texts; that is, they had neither been commented on by the teacher nor improved upon by the students.

Analysis of students' talk

Students' talk was analysed according to Lindahl and Folkesson (2016). Students' group discussions were transcribed verbatim. The data, from a total of 80 minutes of group discussions, was analysed with respect to both attitude and code (defined below). Both researchers were found to agree 100% on the sociolinguistic code of the inputs. With regard to attitude, the two researchers initially agreed on 94% of the inputs. However, listening to the audio recordings a second time attained a 100% agreement.

Open-minded talk

Students propose something that is open for discussion. Hence, utterances are probing and exploratory, whether given as new input or as conclusions made on preceding utterances in the conversation. Suggestions are given as alternative views that appear to stimulate further discussion. Example: *'It could be possible in a more controlled way [keeping a healthy wolf population], 'cause those who actually are affected don't want to, can't live a normal life, like they don't dare to let their kids like go to the bus and such, but sort of, I mean if you can do it in a more controlled way'.*

Closed-minded talk

This attitude is the opposite of open-mindedness in talk. Closed-mindedness closes discussions by making other students' inputs superfluous or irrelevant. Closed-mindedness can be observed as *students'* unequivocal statements given as more or less unchallengeable claims or dismissals of other students' inputs. Example: *'If the EU says we should keep them [the wolves], then I think we should do so, absolutely, it would be stupid to argue with the EU about that'.*

Elaborated code

Claims are made with an adjacent explanatory justification for being relevant to the context; that is, the students appear to assume that the meaning and relevance of claims need to be made explicit to other students in order to be understood in the intended manner. Example: *'Why can't we just let it be? I mean nature has like made it work, it's us making those problems'.* Claims expressed with an Elaborated code can also have an apparent relationship with previous utterances by the talking student or by any of the students in the group; that is, there is an explicit relationship with the context of the conversation.

Restricted code

Claims expressed with a Restricted code lack adjacent explanatory justifications for being relevant; that is, the students appear to assume that the meaning and relevance of claims are unambiguous and obvious to everyone. Claims expressed

with a Restricted code are uttered without any apparent relationship to previous utterances by any of the students in the group. Example: *'That's sooo awesome!'* [after students' had discussed when a wolf was seen in the region].

Analysis of students' texts

The texts were divided into paragraphs, if necessary. Many of the students had already made paragraphs in a manner that the paragraphs contained their reasoning beginning from one perspective or suggested solution. Paragraphs containing more than one, apparently disconnected, foci of reasoning were divided. The parts of the texts that were mere repetitions of given facts without being clear parts of any reasoning were omitted from the analysis.

A sentence or groups of sentences describing a problem or a solution were labelled P (problem) or S (solution). To be assigned the problem label, a description of the 'why' or 'how' something can be a problem should be expressed. The solution label was given where descriptions of how to solve or reduce a problem were presented in students' texts. The relationships between problems and solutions and the complexities of such relationships were analysed according to the definitions given below in order to distinguish between different types of attitudes. The initial agreement between the researchers regarding attitude was calculated to be 77.4%. After a discussion on the definitions (as seen below) while re-examining parts of the texts, a 100% agreement was reached.

Closed-minded texts

Closed-minded texts describe a problem from one perspective only with or without a solution to that problem. They may also describe or reject the solution to the problem without consideration of any other stakeholder's interests. Example: *'I think the EU's proposition concerning protective hunting is very good! It sounds like a good solution for keeping our wolf population healthy and as safe as possible'.*

Semi-Open-minded texts

Semi-Open-minded texts describe two or more problems, but consider only the problem from one perspective in the suggested solutions. Example: *'The Government's investigator thinks that 450 wolves is a reasonable figure. Well, that's the upper limit I think. The Minister of Environment, Lena Ek, wants 180 wolves in Sweden, and that will make the EU angry because 180 wolves is way too low. To take that many animals' lives is not okay, I think'.*

Open-minded texts

Open-minded texts describe two or more problems and consider two or more of the perspectives, either by suggesting solutions or by describing an unsolvable dilemma. Example: *'I think we should increase the number of wolves to be in the range of 400–500. If we should import or move our wolves, I think we should place them in an area where there are no reindeers or Sami people. We could invest in fences, but there is a risk that we fence in the wolves together with reindeers and that would be a disaster. If we can't put up fences, then we might need to increase the number of reindeers'.*

Texts were also analysed with respect to sociolinguistic code using the definitions below. Only those parts of the texts regarding the perspectives relevant to the task were included; that is, factual descriptions without an explicit relationship to the described statements were omitted. A 100% agreement was reached after discussing 11.4% of the students' claims that were coded differently.

Elaborated code

A statement supplemented with an explicit precision, explanation, or causal justification was considered as written in an elaborated manner. Example: *'Today there are much more reindeers than wolves. And I think that if we increase the number of wolves and reindeers, then the Sami people would be happy because they get more reindeers'.*

Restricted code

Simple statements *without* explicit precision, explanation, or causal justification were considered as written in a restricted manner. Example: *'I think the wolf has a right to live here in Sweden'.*

It should be noted that the demands regarding Elaborated code are higher for students' texts than students' talk since written language is expected. In their writing, students are expected to use correct punctuation. Hence, a justification or other elaborations added in a new sentence in their writing is considered oral language, which will be considered Restricted code in our analysis. This is in contrast to students' talk, in which students together can elaborate on their own as well as others' input by adding justifications, explanations, etc.

Statistical analyses

Bivariate correlations

Bivariate correlation analyses were made to explore the relationships between attitudes and codes in students' talk and texts. To avoid any possible impact of the length of students' texts on the number of Elaborated and Restricted codes, the quotient Elaborated/Restricted code was also included as a variable.

Stepwise linear regression

Stepwise linear regression calculations were performed using variables for the assessment of text and talk. The variables for text were Close-minded, Semi-Open-minded and Open-minded attitudes as well as Elaborated and Restricted codes. The included variables for talk were Close-minded and Open-minded attitude, and Elaborated code, Restricted code and an Elaborated/Restricted code quotient. It should be noted that when using Elaborated/Restricted code quotient (text) as a dependent variable, Elaborated code (text) and Restricted code (text) were omitted as independent variables since these variables are included in the quotient. Linear regressions were made for the purpose of estimating any causal relationship between students' texts and students' talk.

ANOVA analysis

One-way ANOVA was used with the Groups (1, 2, 3 and 4) as an independent variable to demonstrate any significant differences between texts produced in the student groups with regard to the amount of Closed-minded, Semi-Open-minded and Open-minded attitudes, and Elaborated code, Restricted code and Elaborated/Restricted code quotient (Table 4). Bonferroni post hoc tests were performed for analyses and exhibited homogeneity of variance according to Levene's test. When homogeneity of variance according to Levene's test was not met, Games-Howell post hoc tests were performed, and the Welch test of equality of means was used to assess any significant differences between groups.

RESULTS

The results section is divided into two parts. First, we present the analyses regarding the relationships between attitude and sociolinguistic code in students'

talk and texts. After describing bivariate correlations, we explore the directions of the discovered relationships using linear regression analysis. Second, we describe the differences between students on a group level to create an additional basis for discussing the relationship between qualities of talk and texts.

Relationship between attitude and code in students' talk and texts

The relationship between attitude and code in students' group discussions and students' individual texts were explored by a bivariate correlation analysis. Several correlations were found to be significant between variables regarding attitudes and texts as appearing both within the texts as well as between the talk and the texts (Table 1).

Description of the relationships between attitude and code in students' talk

With regard to talk, the operationalized variables for attitudes and codes in students' group discussions are validated by correlations (Table 1): first, between the attitude variables; second, between the two code variables; and thirdly, between attitudes and codes.

1. A Closed-minded attitude in students' group discussions was found to correlate negatively with an Open-minded attitude in the group. Hence, closed-mindedness and open-mindedness appear as contrasting attitudes.
2. Elaborated code correlates negatively with Restricted code. This relationship validates Elaborated and Restricted codes as contrasting variables for students' group discussions.
3. A Closed-minded attitude in students' talk correlates negatively with Elaborated code and positively with Restricted code in students' discussions. Hence, Restricted code is typical with a Closed-minded attitude in talk. Further, an Open-minded attitude in talk correlates positively with Elaborated code, an observation that is consistent with the theoretical assumption. Thus, it appears feasible to suggest that Elaborated code is typical for students' with an Open-minded attitude.

Description of the relationships between attitude and code in students' texts

With regard to texts, the operationalized variables for attitudes and codes in students' individual texts are validated by correlations (Table 1): first, between the attitude variables; second, between the two code variables; and third, between attitudes and codes.

Table 1. Correlations between qualities of talk in student groups and students' individual texts

Measure	CMtext	SOMtext	OMtext	Ectext	Rctext	Ec/Rctext	OMtalk	CMtalk	Ectalk	Rctalk
CMText	-	.114	-.518*	.302	.327	-.099	.115	.159	-.054	.190
SOMtext		-	-.305	.634**	.420	.254	.354	-.545**	.734**	-.675**
OMtext			-	.090	-.339	.456*	-.347	-.088	.045	-.286
Ectext				-	.425*	.518*	.163	-.479*	.602**	-.645**
Rctext					-	-.439*	.289	-.005	.208	-.008
Ec/Rctext						-	-.033	-.573**	.433*	-.662**
OMtalk							-	-.582**	.610**	-.204
CMtalk								-	-.789**	.804**
Ectalk									-	-.866**
Rctalk										-
Mean	2.09	2.23	0.86	12.68	9.09	1.63	23.73	21.91	19.91	25.73
SD	1.34	2.04	0.94	7.37	5.18	0.96	4.50	3.61	6.45	7.57

** Correlation is significant at the 0.05 level (two-tailed).*

*** Correlation is significant at the 0.01 level (two-tailed).*

CM = Closed-minded attitude; SOM = Semi-Open-minded attitude; OM = Open-minded attitude; Ec = Elaborated code; Rc = Restricted code

1. A Closed-minded attitude was found to have a negative correlation with an Open-minded attitude; that is, students' texts that to a great extent contained closed-minded paragraphs contained few or no open-minded paragraphs.
2. The positive correlation between Elaborated and Restricted codes does not appear to validate Elaborated and Restricted codes as contrasting variables. However, a longer text may, of course, contain both types of sociolinguistic codes, since the use of code can be a matter of text length: the more they write, the more they use both codes. This interpretation is supported by the theoretical assumption that codes are not related to individuals, but to the purpose of the situation at hand. This is further validated by two other correlations (Table 1): the positive correlation between the quotient Elaborated code/Restricted code and Elaborated code, and the negative correlation between the quotient Elaborated code/Restricted code and Restricted code.
3. There is a positive correlation between the quotient Elaborated code/Restricted code and Open-minded attitude, which implies that the higher the proportion of Elaborated code present in the text, the greater the expression of an Open-minded attitude. The assumed relationship between attitude and code is further supported by the correlation between Elaborated code and Semi-Open-minded attitude, a relationship that is also consistent with the theoretical assumption.

Relationships between students' talk and texts with respect to attitude and code

Attitudes and codes in students' talk and texts were found to correlate. First, attitude in talk correlated with code in texts; second, codes in talk and texts were found to correlate; and third, codes in text were found to correlate with attitude in talk (Table 1).

1. Closed-minded talk correlated negatively with an Open-minded attitude in texts; that is, the greater the Closed-minded attitudes the students displayed in the group discussions, the lesser the Open-minded attitude was expressed in the texts.
2. Elaborated talk was also found to correlate positively with Elaborated code in the texts or, in other words, the more the group discussed in an elaborated manner, the more elaborated were their texts. This relationship is further strengthened by the negative correlation between Restricted code in talk and Elaborated code in texts, thereby indicating that the more the students discussed in a restricted manner, the less elaborated were their texts.
3. Elaborated talk was found to correlate positively with an Open-minded attitude in the texts. Thus, students participating in a group discussion with a high proportion of elaborated talk showed an Open-minded attitude to a great extent in their texts. This was further supported by the negative relationship between Restricted code in talk and an Open-minded attitude in texts; that is, students who participated in a group discussion with a high proportion of Restricted code in talk showed a low proportion of Open-minded attitudes in their texts.

Exploring causal relationships between attitudes and codes in students' talk and texts

The Elaborated/Restricted code quotient (students' texts) was found to be counter predicted (Standardized $\beta = -0.66$) by Restricted code (students' group talk) [$F(1,20) = 15.57$, $p = 0.001$; adjusted $R^2 = 0.41$]. This result was obtained by

regression analysis with Elaborated/Restricted code quotient as a dependent variable, and Closed-minded, Semi-Open-minded and Open-minded attitude in text, and Closed-minded attitude, Open-minded attitude, Restricted code, and Elaborated code in talk, as independent variables. The result that the quotient of the amount of Elaborated code and Restricted code in students' texts was counter-predicted by Restricted code in students' talk indicates that talk in a restricted manner can have a negative effect on students' subsequent writing. Elaborated code in students' talk was not found to have any effect on students' texts in any of our calculations.

Exploring causal relationships between attitudes and codes in students' texts

An Open-minded attitude in text was found to be predicted by Elaborated code (text), but counter-predicted by Closed-minded and Semi-Open-minded attitudes in text [$F(3,18) = 9.61$, $p = 0.001$; adjusted $R^2 = 0.55$]. Table 2 presents the regression analysis with Open-minded attitude in text as a dependent variable, and Closed-minded text, Semi-Open-minded text, Elaborated code (text), Restricted code (text), Elaborated/Restricted code quotient (text), Closed-minded talk, Open-minded talk, Elaborated code (talk), and Restricted code (talk) as independent variables. There are two important observations to be made here. First, neither attitude nor code in student group talk could predict an Open-minded attitude in students' texts. Calculations with Closed-minded or Semi-Open-minded attitudes in text (not shown) sustained the observation that group talk cannot predict the quality of students' individually written texts. Second, Elaborated code (text) was a predictor for an Open-minded attitude in text. Among the three attitudes expressed by the students' texts, an Open-minded attitude in text is singled out as the only one that can be predicted by sociolinguistic code (text). This relationship indicates that the use of Elaborated code is a prerequisite for producing an Open-minded attitude in text.

Differences between groups with respect to attitudes and codes in talk and texts

In this section, the differences between Groups 1, 2, 3 and 4 are described with respect to the students' small group discussions as well as to their individual texts in each group. The groups' attitudes and codes are also compared with each other. It should be noted that since there were four to six students in each group, a variance regarding variables is possible only for the texts. Thus, for group discussions, the

Table 2. Standardized weights from linear regression analysis with Open-minded attitude in text as dependent variable

Predictor variables	Standardized beta (β)
Closed-minded attitude (text)	-0.66***
Semi-Open-minded attitude (text)	-0.69**
Elaborated code (text)	0.73**

*Note: ***p < 0.001; **p < 0.01*

Predictor variables: Restricted code (text), Elaborated/Restricted code quotient (text), Closed-minded attitude (talk), Open-minded attitude (talk), Restricted code (talk), and Elaborated code (talk) were not significant.

Table 3. The proportion of inputs within each groups' discussions with respect to attitude and code

Group number	Open-minded attitude (%)	Closed-minded attitude (%)	Elaborated code (%)	Restricted code (%)
1	42	58	42	58
2	63	37	65	35
3	51	49	29	71
4	51	49	37	63

variables for attitudes and codes, respectively, can only be proportional in relation to each other – that is, no variance is possible.

Description of group discussions with respect to attitude and code

In the table below (Table 3), the group discussions are described to show differences and similarities between Groups 1, 2, 3 and 4.

The four groups show differences in their expression of attitudes and use of codes. In Group 1, closed-mindedness is the dominant attitude along with the use of Restricted code. The open-minded inputs are dominant in Group 2. In addition, this group predominantly uses an Elaborated code. With regard to Groups 3 and 4, there is no dominant attitude, but they use a Restricted much more often than an Elaborated code. When comparing Groups 1 and 2, an opposite pattern emerges. Closed-minded attitude and Restricted code are dominant for Group 1, whereas Group 2 talks more often in an open-minded manner and predominantly uses Elaborated code. The use of code shows considerable differences in all groups. The Elaborated code is used much more in Group 2 compared to the other three groups, where the Restricted code is more prevalent, particularly in Group 3.

Summing up, the most apparent differences in the oral assignment can be described in the following manner: first, in Group 2, the discussion is substantially more open-minded and elaborated than in all the others. Second, the discussion in Group 3 is characterized by a more Restricted code than all the others.

Differences between groups with respect to attitude and code in students' texts

For the purpose of demonstrating differences regarding the texts produced by the students in the groups, a one-way ANOVA with Group as an independent variable was conducted (Table 4).

The groups showed significant differences in terms of Semi-Open-minded attitude, Elaborated code and Elaborated/Restricted code quotient. With regard to attitude, the students in Group 2 were found to produce texts with a significantly more Semi-Open-minded attitude than Groups 3 and 5. Group 3 was also found to use significantly less Elaborated code in their texts as compared to the students in Group 2. Furthermore, the mean of the Elaborated/Restricted code quotient in students' texts was found to be significantly less for students in Group 3, compared to those of the other three groups. Considering the results for Semi-Open-minded

Table 4. Attitudes and codes in students' texts associated, or not, with student groups

Variable	Group 1 (n = 6) M ± SE	Group 2 (n = 6) M ± SE	Group 3 (n = 6) M ± SE	Group 4 (n = 4) M ± SE
Closed-minded attitude F(3,18) = 0.61; p = 0.618	2.00 ± 0.36	2.00 ± 0.52	2.67 ± 0.42	1.50 ± 1.19
Semi-Open-minded attitude F(3,18) = 7.46; p = 0.002	2.17 ± 0.83	4.50[a] ± 0.62	0.83[b] ± 0.40	1.00 ± 0.41
Open-minded attitude F(3,18) = 2.11; p = 0.134	1.33 ± 0.49	0.83 ± 0.31	0.17 ± 0.17	1.25 ± 0.48
Elaborated code F(3,18) = 4.59; p = 0.015	13.67 ± 2.01	19.17 ± 2.96	6.67[c] ± 2.54	10.50 ± 2.40
Restricted code F(3,18) = 1.44; p = 0.296	8.50 ± 1.11	10.83 ± 3.20	10.67 ± 1.82	5.00 ± 1.22
Elaborated/Restricted code quotient* F(3,8.656) = 12.56; p = 0.002	1.67 ± 0.20	2.25 ± 0.45	0.56[bcd] ± 0.14	1.62 ± 0.29
Word count F(3,18) = 4.92; p = 0.011	844 ± 159	835 ± 104	363[e] ± 92	419 ± 60

*M = mean; SE = Standard error; * Homogeneity of variance according to Levene's test was not met. Welch test of equality means revealed a significant difference between groups. a) Significant difference (p < 0.05) from Group 4; b) significant difference (p < 0.005) from Group 2; c) significant difference (p < 0.05) from Group 2; d) significant difference (p < 0.005) from Group 1; e) significant difference (p < 0.05) from Group 1.*

attitude in texts, Group 2 expressed more open-mindedness in their texts and Group 3 less open-mindedness. Furthermore, the students in Group 3 not only expressed less open-mindedness in their texts; they also produced less elaborated texts than the other groups.

DISCUSSION

Based on pedagogical philosophy (Dewey, 1933) and sociolinguistic theory (Bernstein, 1974), we constructed a model to assess qualities of students' talk as well as their written texts. In keeping with these ideas, we understand that students' ways of talking are dependent on their previous knowledge and experiences based on their cultural background. Similar suggestions have been put forward on empirical grounds in a science education context (Lubben et al., 2010). We set out to explore the relationships between qualities of group discussions and students' individual texts since there is an assumed relationship between student group discussions and their performance. In particular, we were interested in the direction of any present relationships. Below, we present a methodological discussion followed by the results discussion. The latter deals with: 1) the impact of students' talk on their texts; 2) the impact of sociolinguistic code on attitude in students' texts; and 3) the differences between groups with respect to code and attitude in their texts. Pedagogical implications and suggestions for future research are presented at the end of this section.

Methodological discussion

We were able to validate the measures in the sense that the antithetic codes (Elaborated and Restricted codes) and attitudes (Closed-minded and Open-minded) observed in students' talk showed strong negative correlations. However, the picture was less clear for the code measures in students' texts. The finding that Elaborated and Restricted codes had a significant positive correlation could be interpreted as an effect of the instruction to students to present both their reasoning and solutions. The instruction to present solutions could have influenced the students to use Restricted code. Students habituated to using Elaborated code can also use Restricted code when appropriate, which is in contrast to students habituated to using Restricted code (Bernstein, 1974). Consequently, longer texts constructed by the use of Elaborated code may still include passages using Restricted code. The differences between students can instead be found in the relationship between the codes. Therefore, the quotient Elaborated/Restricted code is a better measure for the dominant code the students use in their texts since it is less dependent on text length.

With regard to students' attitude in their texts, the only significant correlation found indicates a negative relationship between Open-minded and Closed-minded attitudes in the texts. This indicates that a Semi-Open-minded attitude appears to be somewhere between the other two attitudes. This can be considered acceptable since our definition of a Semi-Open-minded attitude is qualitatively between Open-minded and Closed-minded attitudes. Our decision to have three levels of attitude was made in consideration of the possibility to follow the progression of students' attitude development from close-minded to open-minded in the future. It could be argued that five levels could have been chosen instead. In our view, one could argue that five levels would be more suitable for performing quantitative analyses. However, it is difficult to defend a qualitative difference between five levels and such difficulties could result in less reliable interpretations. Furthermore, in spite of the theoretical possibility to define more levels, it appears that only three qualitative levels are applicable (cf. Chin & Osborne, 2010; Evagorou et al., 2012; Zeidler et al., 2009). In addition, three levels are more preferable as they would have more

pragmatic validity for didactical reasons, since more levels could be too demanding to distinguish for students and teachers.

Discussion of results

The impact of students' talk on their texts

In line with the assumption that group discussions are expected to positively affect student performance, it was surprising that regression analysis did not show a significant relationship between Elaborated code in talk and texts, i.e. the quality of the discussion, appears not to have a positive impact on the quality of the texts. Instead, the only significant relationship found indicated a negative impact of Restricted code in talk on Elaborated code in students' texts; that is, the more students talked in a restricted manner, the less they elaborated in their texts. This result can be understood from a theoretical viewpoint, since elaborated talk is not necessary if all participants discuss subjects that are familiar to all of them (Bernstein, 1974). The reason for this is that elaborated talk is crucial only when claims need further development in order to be understood correctly. Due to the complexity of the SSI context used in this study, students would be expected to use Elaborated code in their group discussions.

Our results can also be understood in light of the results of others' research. For example, the opportunity to share conceptual understandings with other students was beneficial for students' ability to produce developed arguments in physics (Alexopolou & Driver, 1996), chemistry (Sampson & Clark, 2009) and biology (Lauer & Hendrix, 2009; Smith et al., 2009). In addition, primary school students produced better arguments in texts on morals after participating in peer-group discussions (Dong et al., 2008). In our interpretation, it is possible that students in the referred situations developed better argumentation skills as a result of sharing claims with justifications. The results reflect a general positive change in experimental settings, something that could not be analysed in our naturalistic setting. Hence, we do not argue against possible improvements of students' texts due to peer discussion. Instead, focusing on the qualities of students' discussions, our results add to previous knowledge in a way that can develop an understanding for the qualities that may have an impact on students' elaboration of texts. The importance of such knowledge is further sustained by the work of Linton et al. (2014) who claimed that peer discussion only had, in general, no effect on students' elaboration of texts. When scrutinizing their results, it becomes clear that there is a strong instructor effect. Hence, it seems that instructional practices in varying degrees stimulate (or fail to stimulate qualities in classroom interactions with the potential to improve students' subsequent writing. Research on the qualities of classroom discussions (c.f. Evagorou & Osborne, 2013) shows that students prone to agreements (cumulative talk), which may indicate restricted talk, produced less developed arguments. Similarly, Lubben et al. (2010) showed that students engaging in cumulative talk used few justifications in their group discussions and showed limited possibilities to form arguments with justifications in their texts. Hence, previous research indicates that elaborated talk is beneficial for students' development of argumentation. The result of their qualitative analyses differs from our statistical analyses, since we cannot show a significant relationship between Elaborated code in talk and texts. Hence, considering our results and methodological design, we are not in the position to assume that group discussions necessarily have a positive effect on students' writing. Instead, we argue that student's development of elaborated writing is at risk if they participate in group discussions that are dominated by restricted talk.

The impact of code on attitude in texts

Regression analysis showed that the Open-minded attitude in texts is dependent on the students' use of Elaborated code in their texts. This result can, of course, be interpreted as merely due to how we defined the measures. However, the relationship between Elaborated code and Open-minded attitude appears inevitable since these variables are theoretically linked to each other. The habit of using Elaborated code is regarded as necessary for expressing Open-minded attitude (Bernstein, 1974). Furthermore, our finding that the production of open-minded text is dependent on the students' use of Elaborated code is supported by other observations. To be considered a text with high qualities, it has to show an open attitude towards perspectives other than those of the author (Covill, 2010). In addition, it should present justifications for given arguments (Knudson, 1998), as well as elaborations of relevant topics (Crossley et al., 2011). Hence, previous research implies that texts judged as being of high quality include both Elaborated code and Open-minded attitude. The contribution of our result is to show the direction of the relationship, which is that Elaborated code predicts Open-minded attitude in students' texts.

Differences regarding attitude and code in texts at the group level

The four groups in our study show a number of differences regarding the use of attitude and code, both in talk and text. In our statistical analyses of students' texts, the differences between Groups 2 and 3 were significant in terms of both sociolinguistic code and attitude. Group 2 was typically more elaborate and showed more open-mindedness in their texts compared to Group 3. Hence, Group 2 can be considered to have written better academic texts in view of research on texts (Crossley et al., 2011; Ferrari et al., 1998; Knudson, 1998).

Due to the profound differences between Groups 2 and 3, they can be seen as comparison groups similar to those described by Evagorou and Osborne (2013), particularly since our groups were formed on the basis of their use of Elaborated code in texts. Group 3 was found to use a much higher frequency of Restricted code in their talk than any other group, whereas the students from Group 2 produced texts with a significantly higher frequency of Elaborated code compared to those of Group 3. These results further strengthen the interpretation that Restricted code in talk can be a limiting factor for students' learning to use Elaborated code and predicts the production of inferior academic texts. The significantly lower value of the Elaborated/Restricted code quotient for Group 3 as compared to the other groups accentuates the difficulties the students in Group 3 have with producing elaborated texts, a finding that is in line with their proclivity to use Restricted code in their group talk. If Restricted code is frequently used in discussions, explorative talk is unlikely to occur (Wegerif & Mercer, 1997). Hence, there will be few opportunities to learn to use justifications (Lubben et al., 2010; Sampson & Clark, 2009) and express nuanced viewpoints (Evagorou & Osborne, 2013; Grace, 2009; Lewis & Leach, 2006).

Considering the differences between Groups 2 and 3 regarding attitude, the significantly less Semi-Open-minded attitude found in the texts of Group 3 can be understood in light of their comparably limited use of Elaborated code. Our theoretical framework supports the interpretation that the use of Elaborated code is a prerequisite for open communication code (Bernstein, 1974). Hence, the students' preference to use Elaborated code can explain how an Open-minded attitude is expressed in the students' texts. Furthermore, our study shows that the students' expression of open-mindedness is still limited. This is not surprising since the data in our study was collected during the students' second attempt to work with SSI. Hence, an Open-minded attitude in their reasoning can still be expected to be somewhat limited.

Pedagogical implications

Our study provides further examples of the usefulness of Bernstein's sociolinguistic theory in an educational context. In particular, we have shown the importance of using Elaborated code to succeed in producing texts with the expected qualities in school, i.e. an elaborated text with nuances and multiple perspectives on an SSI. The pedagogical implications of our study are related to possibilities of teacher interventions regarding students' texts as well as students' talk.

Considering that there are studies showing that students may (Yeh & She, 2010) or may not (Schen, 2013) develop the habit of producing elaborated texts, it appears that students cannot improve their writing without help. Hence, an important task for teachers is to give students instructions and support to utilize Elaborated code in their writing. This is particularly important since Elaborated code is a prerequisite for the expression of an Open-minded attitude. The use of feedback on students' texts as a first choice for interventions is supported by research on writing skills (Crossley et al., 2011; Knudson, 1998; Perin et al., 2003), as well as research in science education using writing tasks (Balgopal & Wallace, 2013; Lauer & Hendrix, 2009). Hence, students' awareness of the importance of using Elaborated code and an Open-minded attitude in their writing is likely to simplify teachers' interventions in students' talk.

Teachers' interventions in students' talk, particularly in an SSI context, is problematic since there is a risk that the students will lose interest if the ownership (Levinson, 2010) of the discussion is lost. In this respect, it is important to minimize interventions and focus on *how* they discuss instead of *what* they bring into the discussion. Hence, interventions related to the students' use of sociolinguistic code is preferable since the students will be asked to justify and elaborate more, instead of being criticized on the views that are actualized. With the help of our model, a teacher can identify students' talk that predominantly consists of restricted talk and make necessary inquiries to indicate what is expected of the students. By making students aware that restricted talk does not help them to produce the required texts, they may be able to avoid restricted manners of talking. As a next step, teachers' interventions can focus on attitude. Our model can also be of help for teachers to distinguish between closed-mindedness and open-mindedness in students' talk and decisions to intervene. Students' talk can be stimulated to use less closed-mindedness if open-mindedness is required – that is, the consideration of alternatives and additional perspectives. Such interventions are of particular importance when working with SSI, since students need help with learning how to benefit from a group discussion to be able to produce the explicit reflections that are expected of them. Knowing that Elaborated code is necessary for their group discussion, students can be stimulated to discuss in a more open-minded manner. Without such help, students are at risk of failing to display the abilities that are expected of them, as well as finding group discussions less meaningful.

In their classrooms, teachers can utilize the concepts in our model. With the help of these definitions, teachers can identify their students' use of sociolinguistic codes and attitudes in their talk and texts. With that knowledge, they can disclose students' difficulties and take necessary actions to support students' development in their communication in texts, as well as in group discussions.

Although our paper provides further insights into the relationships between students' talk and produced texts, we would suggest that more efforts are put into exploring this issue; for example, what, if any, are the qualities of talk that can be developed and have an impact on qualities of texts, and vice versa? Further research is also needed in order to sustain or reject our suggestion regarding the usefulness of the model to monitor students' development during longer periods of time. For

example, can the model be used to monitor students' reasoning skills irrespective of the contents of the SSIs used during a full school year, as well as support suitable teacher interventions? Furthermore, research is needed to validate our model in other contexts. This is based on the discrepancies between our results and those of others' with regard to the impact of Elaborated code in talk on students' performance. The reason for this is that such results can be task dependent. For example, studies indicating the impact of Elaborated code have been typically focussed on the learning of scientific concepts through discussion. This is in contrast to the SSI-context, which does not demand one right answer with the correct justification. Hence, there is a need to investigate whether the discrepancies between previous research studies and ours can be explained by the different learning goals of subject content knowledge and SSI. In addition, there are indications (Chen et al., 2013; Evagorou et al., 2012; Lauer & Hendrix, 2009) that students' performance regarding their ways of talking or writing is dependent on teachers' instruction. Hence, it is suggested that further research be conducted on how students' understandings of given instructions shape their ways of communicating and making meaning in the classroom.

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