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Title: University Students´ Knowledge Construction during Face to Face Collaborative Writing

Year: 2014

Version:

Please cite the original version:

Nykopp, M., Marttunen, M., & Laurinen, L. (2014). University Students´ Knowledge Construction during Face to Face Collaborative Writing. In P. Klein, P. Boscolo, L. Kirkpatrick, & C. Gelati (Eds.), Writing as a Learning Activity (pp. 277-299). Brill. Studies in Writing, 28. https://doi.org/10.1163/9789004265011_013

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University Students' Knowledge Construction during Face-to-Face Collaborative Writing

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Abstract

Collaborative writing combines social processes of writing with cognitive knowledge construction processes, and thus may lead to deeper learning than individual working. This study examined students' knowledge construction during face-to-face collaborative writing.

University students (*n* = 21) prepared themselves for the collaborative task by reading about developmental theories in a course book and writing individual summaries of them. In small groups, the students discussed each others' summaries and wrote a joint essay on one of the theories. The data comprise the students' individual summaries (*n* = 21), the students' discussions during the essay writing (8177 speech turns), and the students' joint essays (*n* = 6).

The utterances from the students' discussions indicating knowledge construction (n = 3865) were broadly categorized under the headings of collaborative interaction (Asking questions, Answers to questions, Collaborative completion, Expressing disagreement or conflict, Quick agreement, Quick disagreement and Discussing edits) and content processing (Conceptualizing ideas; Clarifying ideas and Expressing an idea or a thought).

When constructing knowledge during collaborative writing, the students mainly completed each others' ideas and asked questions. They rarely expressed disagreement or conflict. A

collaborative writing task that combines reading, summary writing and group discussion seems to assist students in their construction of knowledge.
Keywords: collaborative writing, knowledge construction, source-based writing, university students

At university, writing is a mode of communication as well as a means for learning. Although writing is often an individual activity, students are increasingly writing texts collaboratively with other students in order to learn subject content. In working life, in turn, employees are often required to compose texts together with colleagues.

Some studies on individual writing have shown that writing has an important effect on both the knowledge construction and cognitive development of the writer (Bereiter & Scardamalia, 1987; Klein, 1999), while other studies have found such effects to be weak or even non-existent (Bangert-Drowns, Hurley, & Wilkinson, 2004). It has been argued that writing is a useful tool in learning because it enables one to make his/her thoughts visible which in turn provide possibilities to review one's thinking processes (e.g. Emig, 1977; Klein, 1999).

Collaborative writing can be considered as a specific learning task in which two or more learners participate equally in constructing and writing a text (Giroud, 1999). Collaborative writing provides opportunities for writers to interact with each other during the writing process. Interaction with other writers may promote writing skills (Daiute & Dalton, 1988; Dale, 1994; Storch, 2005), conceptual comprehension (Andriessen, Erkens, van de Laak, Peters, & Coirier, 2003; van Boxtel, van der Linden, & Kanselaar, 2000), understanding of content knowledge (Andriessen et al., 2003) and reflective thinking, particularly if students are engaged in the act of explaining and defining their ideas to their peers (Storch, 2005). In collaborative writing, the partners exchange ideas, plans and suggestions for the composition of the joint text, and together solve the problems that arise during writing (Giroud, 1999). During interaction, students are also able to observe how other learners think and can model their own thinking after their peers' thinking strategies (Dale, 1994). Collaborative writing has been studied widely in the domain of computer-supported collaborative learning (Barile & Durso, 2002; Erkens, Jaspers, Prangsma, & Kanselaar, 2005; Onrubia & Engel, 2009; Pragman, 2003). It has also been studied from different perspectives, such as its effects on argumentation (Andriessen et al., 2003; Erkens

et al., 2005; Munneke & Andriessen, 2000) and second language learning (Storch, 2005; Yong, 2010). However, studies on knowledge construction during collaborative writing face to face remain few. This study focuses on how students write collaboratively and how they construct knowledge during writing face to face.

Literature Review

Collaborative Writing Process

In their model of the cognitive processes of writing, Flower and Hayes (1981) represent what a writer actually does during writing. They state that "writing is best understood as a set of distinctive thinking processes which the writer orchestrates or organizes during the act of composing" (p. 366). The model of the cognitive processes of writing distinguishes three main processes: planning, translating and reviewing. These processes include a number of sub-processes guided by the task environment, the writer's long-term memory and the writing process.

Although in the model of the cognitive processes of writing the focus is on individual writing, the same processes apply in the case of collaborative writing. In the *planning* process, the writers generate ideas by retrieving relevant information from long-term memory, set goals for writing, organize ideas into a meaningful text, and may also take the reader into account. Generating ideas may also include reading source texts and making notes on them. In collaborative writing, planning is emphasized, as setting the goals and framing the guidelines of the text need to be negotiated in order for the participants' ideas to be put into writing (Erkens, Prangsma, & Jaspers, 2006). During *translation*, the writers translate their ideas into visible language. In collaborative writing, students may have different ways of dividing the translating work among the participants according to their skills (Marttunen & Laurinen, 2012). Depending on group size, one or two may be writers while the others dictate sentences. Students may also rotate the different duties. Although the translating work is distributed, all the participants are held equally responsible for the outcome. The *reviewing* process consists of evaluating and revising the text. According to Flower and Hayes (1981), the reviewing process is a conscious process in which the writers read what they have written and systematically revise and evaluate the text. Reviewing may occur throughout the writing process and it may also be a stimulus to further writing. In order to compose a coherent text

collaboratively the writers need to engage in negotiations on their evaluations relating to both the content and grammatical correctness of the text. To conclude, it should be noted that planning, translating and revising can occur at any moment during writing. Interaction between planning, translating and revising is an indication of the recursive nature of the writing process (Galbraith, 2009).

Collaborative Writing as a Problem-Solving Process

Bereiter and Scardamalia (1987, p. 10) emphasize the importance of the knowledge-transforming process during writing. According to them, in the knowledge-transforming process, ideas that are initially inchoate develop by dint of being rethought and restated throughout the composition process, finally taking the form of fully developed thoughts in the finished product. Hence, writing can play an important role in the development of the individual writer's knowledge, since by using knowledge-transforming strategies writers consider not only changes in the text but also changes in what they want to say. Thus, the writing process involves interaction between text processing and knowledge processing. The problem-solving process in knowledge transforming involves two different kinds of problem spaces: content space and rhetorical space (Bereiter & Scardamalia, 1987, p. 11). In the content space, the writer works out problems of belief and knowledge; in the rhetorical space, the writer is concerned with the problem of achieving the goals of the composition. Knowledge transforming usually involves parallel activities in these two spaces. Interaction between these spaces means that solutions in one space serve as contributions to the other. When collaboratively writing a text, the writers need to negotiate on both the content and the rhetorical structure of the text (Erkens et al., 2006).

Scardamalia and Bereiter (2006, 2010) have since introduced the concept of knowledge building, where students are seen as active knowledge creators. According to the principle of knowledge building, writers recognize the importance of both personal and collective responsibility for a successful knowledge-building effort. When collaboratively writing a text, the writers need to negotiate a fit between their personal ideas and the ideas of others (Scardamalia & Bereiter, 2010). Composing a coherent high quality text involves taking into account the hierarchy of goals and sub-goals that determine the explicit representation of the rhetorical problems of the text, and the active transformation of knowledge to satisfy its communicative goals (Tynjälä, Mason, & Lonka, 2001). In

collaborative writing, the problem-solving processes become explicit and amenable to study as the writers attempt to reconcile different perspectives and the prior knowledge of individual writers in order to reach mutual understanding on the joint text.

Knowledge Construction During Collaborative Writing

Writing offers a readily available means for composing abstract formulations of ideas (Emig, 1977) as well as for critical thinking and the construction of new knowledge (Klein, 1999). In the following sections, we examine knowledge construction from two perspectives. First, we consider how interaction may promote knowledge construction when writing collaboratively, and second, how integrating reading and writing practices may enhance knowledge construction.

Interaction promoting knowledge construction. Kreijns, Kirschner, and Jochems (2003) emphasize that social interaction is a key element of collaborative learning. However, placing students in groups does not necessarily ensure collaboration; individuals should make a conscious, continued effort to coordinate their activity with respect to the construction of knowledge (Kreijns et al., 2003; Teasley & Roschelle; 1993). One such effort is that students should be willing to make their relevant knowledge and skills available for the use of the group (Erkens et al., 2005; Yong, 2010). Moreover, during joint writing, when they contribute an idea, students expect a response from their co-authors. One example of responding to another person's idea is called "collaborative completion" which means that one student begins a sentence or an idea, and another student completes it (Teasley & Roschelle, 1993). Collaborative completion indicates that students further elaborate their thoughts and ideas together, which in turn may promote their understanding of the issue at hand. This can make their learning processes more meaningful and productive both for themselves and their collaborators (Erkens et al., 2005; Yong, 2010).

Other interactional features, such as presenting questions and expressing disagreement, may also promote knowledge construction during collaborative writing. King (1994, 2002) has studied guided and structured interaction in the peer learning task. She found that, in particular, structured questions designed to prompt group members to explain the idea, relate new material to former knowledge or draw conclusions can promote students' knowledge construction and enhance their comprehension and retention of the material to be learned. She states that high-level complex learning demands that

interaction within the group should also be cognitively high-level, including the exchange of ideas, different information perspectives, attitudes, and opinions toward the issue at hand. Interaction of this kind generates thought-provoking questions, explanations, inferences, hypotheses and conclusions. By applying King's (2002) ideas to collaborative writing, asking thought-provoking questions and answering them can compel students to think more deeply about the material, integrate it with prior knowledge and construct new knowledge. Moreover, by asking questions in a collaborative writing group, students have a chance to use their learning partners as an information resource (Weinberger & Fisher, 2006).

In her study on collaborative writing interactions in the ninth-grade classroom Dale (1994) found that writing together places students in a learning environment which encourages disagreement between group members. When writing collaboratively, disagreement will emerge when students offer alternative ideas during writing. Disagreement is an important element in maintaining student engagement in the writing process. Further, Dale (1994) states that for the experience of collaborative writing to be successful, students must feel comfortable with disagreement. Hence, a positive social environment is essential to ensure that students can challenge group members' ideas. This requires that students trust each other and the collaborative experience.

Expressing disagreement can lead to cognitive conflict, which arises when an individual realizes that his or her conceptions, thoughts, or efforts are inconsistent with new information or another person's point of view (Daiute & Dalton, 1988). Earlier studies (Dale, 1994; Munneke & Andriessen, 2000; Yong, 2010) have shown that cognitive conflict facilitates knowledge construction during collaborative writing. Attempts to solve the conflict engage students in reflective thinking, when they compare opposed meanings or opinions, justify their arguments and generate alternative ideas. However, Dale (1993) points out that some collaborative writing groups may avoid cognitive conflicts by merely agreeing to the suggested text. These groups would be less involved in the writing process than a group that challenges each others' ideas to the extent that the speaker is obliged to clarify his/her reasoning and to support his/her ideas. The more conflict a group generates, the richer the interaction (Dale, 1994).

Collaborative writing as a source-based activity. Knowledge construction during collaborative writing requires that students engage in cognitive processing such as sharing information and clarification of understanding. These cognitive processes may occur when

students are preparing themselves for an upcoming collaborative writing assignment by reading source materials in order to gain familiarity with the topic (Volet, Summers & Thurman, 2009). Cognitive processing can also emerge when ideas are outlined at the beginning of the collaborative writing process. Writers may also engage in even more demanding cognitive processing (Volet et al., 2009) when they construct meanings during reading by integrating content from source texts with previously acquired knowledge. This may take place through selecting, organizing and drawing relations from source materials in order to produce new texts (Spivey & King, 1989; see also Bazerman, Simon & Yoon, this volume).

Students can use different study strategies, such as underlining, note-taking and summary writing, in order to understand and integrate information from multiple textual sources as well as to prepare for a writing assignment (Lahtinen, Lonka, & Lindblom-Ylänne, 1997; Lonka, Lindblom-Ylänne, & Maury, 1994; see also Cisotto & Del Longo, this volume). Summarizing, which requires elaboration of the idea of the text by writing an abridged version in one's own words during reading may foster deeper comprehension and learning than, for example, simply underlining texts, as well as contribute to the construction of conceptual knowledge (Gil et al., 2010; Lonka et al., 1994; Slotte & Lonka, 1999; Wade-Stein & Kintsch, 2004).

According to Tynjälä (2001), students occupy multiple roles when reading and writing from sources in order to compose a joint essay. They are readers of the source article, summary writers and summary readers, essay writers, and readers of their own draft. In these changing roles, students engage in internal dialogue with themselves. This internal dialogue can also be extended to the collaborative planning process when the plan and drafts of the text are shared with other students. The different roles may be occupied by a single writer, but in a collaborative writing group, these tasks may be shared among the participants according their abilities: some students may be good writers while others may be better at understanding concepts in source texts (Marttunen & Laurinen, 2012).

Monitoring and Regulation During Collaborative Writing

Metacognition is seen as "knowing about knowing", which is parallel with descriptions of knowledge about one's own or others' knowledge and cognitive processes (Flavell, 1976; Metcalfe & Shimamura, 1994). "Metacognition refers to the active monitoring and consequent regulation and orchestration of these processes in relation to

the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective" (Flavell, 1976, p. 232). Metacognition consist of two components: knowledge about cognition and regulation of cognition (Brown, 1978; Flavell, 1979). Knowledge about cognition refers to an individual's knowledge about general cognitive processes and strategies. Regulation of cognition refers to active tracking of mental processes and use of regulatory strategies to facilitate cognitive performance. Monitoring, affiliated to regulation, means one's awareness of comprehension and task performance. In collaborative writing, students use the metacognitive strategies of monitoring and regulating in order to express their understanding of an issue or specific concepts and to evaluate other student's contribution. Monitoring is important for students' learning because it helps students keep track of their ongoing cognitive processes and use regulatory strategies to solve problems (Nietfeld et al., 2005).

Although metacognition is usually considered an individual process, it has recently also been considered a social process (e.g. Iiskala, Vauras, Lehtinen, & Salonen, 2011; Salonen, Vauras, & Efklides, 2005). According to Kiili, Laurinen, and Marttunen (2011), students' monitoring and regulation may concern their own activities, others' activities, or joint activities. For example, students can express their difficulty in understanding, detect misunderstanding by their partners, or pay attention to the progress of a joint task. These monitoring activities will trigger different kinds of regulative processes. The study by Volet et al. (2009) showed that collaborative work, in which students actively monitor and regulate their joint processes, supports the construction of meaningful knowledge.

Research Questions

This study focused on university students' knowledge construction during collaborative writing in a face-to-face situation. The task assignment included a combination of reading, writing and group discussion, and it was carried out by applying source-based summary writing. The particular interest of the study was on the elements of the students' discussions that can be interpreted as supporting knowledge construction. The research questions were the following:

1. How does university students' knowledge construction emerge during collaborative writing?
2. Are there differences in students' knowledge construction when they
   a) reformulate their previous text from source-based individual summaries?
   b) write ideas on the basis of a course book?
   c) create new text during writing?

Method

Participants

Twenty-one Finnish university students (19 females and 2 males; aged 20–41 years), enrolled in a course on educational psychology, were divided into 6 groups of 3–4 persons to perform a collaborative writing task. Because one student dropped out, one group offended up with just two students. Moreover, the students could choose their fellow collaborators. Since the course on educational psychology formed part of the curriculum of the Department of Education and was mandatory for all students, the ecological validity of the study was guaranteed. The aim of the course was to acquaint the students with theories of learning and development in a way which could help them relate the content of the course book (Crain, 2005) to their own experiences. However, participation in the present study was optional for the students and refusal to participate did not affect their final grades.

Task Assignment and Data

The course involved writing tasks the purpose of which was to practice academic discussion and writing conventions as a preparation for working life. The writing task,

similar to tasks normally used in the course, included working both individually at home and collaboratively in a group in the classroom (Table 1).The students prepared themselves for the group task by reading six chapters on developmental theories from a course book individually at home. During their reading, the students were to list the key concepts of each theory, and, after reading, to write summaries including at least three of the essential ideas contained in each theory by utilizing the key concepts they had noted. The students were asked to bring their concept lists and summaries with them to the seminar, where their task was to write a joint essay. In the collaborative writing situation, the teacher assigned each group one theory as their essay topic. First, the students were asked to silently read each other's summaries on their topic theory. Second, they were asked to discuss the theory on the basis of their individual summaries, and third, to collaboratively write an essay on that theory. The individual summaries and the course book were both available to the students as resource materials during the collaborative writing process. Moreover, the students were instructed to employ a scholarly writing style in their joint essay. As is common practice in Finnish universities, the course book was written in English whereas the individual summaries and the joint essays were in Finnish. The group discussions during writing were tape-recorded and transcribed. The study design is illustrated in Table 1.

Table 1

Study design and data

Task assignment	Data
Working individually at home	
1. The students read 6 chapters on developmental theories from the course book individually at home and write summaries of each chapter.	Individual summaries (n = 21)
Working in groups in a collaborative writing situation	
2. The teacher assigns one theory to each group.	
3. The students silently read each other's summaries.	
4. The students discuss their topic theory on the basis of their summaries.	The students' group discussions (8177 speech turns in total)
5. The students collaboratively write an essay on the theory.	Joint essays (n = 6)

Data Analysis

The analysis proceeded in three phases. First, the students' joint essays were analyzed sentence by sentence to determine whether a sentence as such or an idea included in it was present in one or more students' individual summaries. Second, discussion fragments dealing with the ideas included in the sentences of the joint essays were tracked from the students' group discussions. Third, utterances which were interpreted as expressing knowledge construction inside the discussion fragments were analyzed.

Analysis of the joint essays. The students' joint essays consisted of 179 sentences in total (*M* = 29.8 sentences per essay). Each sentence was classified on the basis of how and from which source it was composed. The analysis included four data-driven categories, as presented in Table 2.

Table 2

Analysis of the sentences

Category	Description of the category
1. Literally copied	A sentence was copied literally from one student's individual summary
2. Reformulated	A sentence was reformulated from one or more students' individual summaries
3. Book-based	A sentence was composed by utilizing the course book
4. New text	A sentence consists of new text which was created during the group discussion

As the students had access to both the individual summaries and the course book during writing, some of the sentences were composed by utilizing both of these sources simultaneously. These sentences were categorized according to the main source utilized during writing. The main source was identified by determining which source the students primarily used: for example a student may have composed a sentence on the basis of an idea taken from his/her individual summary (main source), and then checked the idea from the course book.

Analysis of the group discussions. The students' group discussions were analyzed by searching for and categorizing discussion fragments in which the students discussed the ideas included in the sentences of their joint essays. In this study, a discussion fragment was defined as a thematic text entity where the students composed sentences through discussion. Discussion fragments where the students literally copied sentences from the individual summaries were omitted from the analysis, as the purpose of the analysis was to concentrate on discussion fragments reflecting knowledge construction. These discussion fragments were: 1) *Fragments of text reformulation*, where the idea was reformulated from an idea presented in one or more students' individual summaries; 2) *Fragments of book-based ideas*, where students formulated ideas by utilizing the course book; and 3) *Fragments of new texts*, where new text was created through discussion.

Analysis of the utterances indicating knowledge construction. The fragments of the students' group discussions were further analyzed by investigating utterances interpreted as indicating knowledge construction. In this study, an utterance is a complete unit of speech (Bakhtin, 1987, p. 67) which can be located in the transcription. Such an utterance can be a speech turn or a part of a speech turn and it originates from the experience and/or thoughts of the speaker. Utterances (n = 3865 in total) were classified into four main categories: Collaborative interaction, which is social in nature; Content processing, which is cognitive in nature; Monitoring and regulating, which is metacognitive in nature; and Off task. In collaborative interaction, we emphasize such social interaction that maintained students' engagement in the learning activities. In content processing, we concentrate on such cognitive processes through which the students both broadened and deepened their understanding on the issues studied. In monitoring and regulating, we concentrate on such metacognitive processes through which the students evaluated their understanding and progress in the task or discussed how to proceed with the task. *Collaborative interaction* comprised several sub-categories: *Asking questions*, *Answers to questions*, *Collaborative completion*, *Expressing disagreement or conflict*, *Quick agreement*, *Quick disagreement and Discussing edits*. The sub-categories of *Content processing* were: *Expressing an idea or a thought*, *Conceptualizing ideas*, and *Clarifying ideas*. The utterance categories were mutually exclusive in nature within but not between the main categories. Due to the nature of the collaborative writing process, content processing was intertwined with and overlapped collaborative interaction. Thus, the same utterance could be assigned simultaneously to both the categories of Collaborative

interaction and Content processing. This is expressed in the next extract where two students (Anna and Eva) talk about Piaget's theory (utterances 76–77). In the extract, they try to clarify the idea that most adults do not reach the stage of formal operational thinking. First, Anna (utterance 76) phrases an example concerning an issue (tribal societies) discussed in the course book. Next Eva engages in collaborative interaction (*Collaborative completion*) by completing (in bold) Anna's thought of "tribal societies" (utterance 77). The same utterance also indicates content processing (*Clarification of an idea)*, as Eva clarifies Anna's idea by pondering how Piaget's theory is manifested in the context of a tribal society.

Anna	I just thought about it that it was some….Tribal societies, yeah.
Eva	Yeah, it was that.. you know.. **in tribal societies, people don't necessarily reach the level of formal operational thinking, because they don't need it in their daily life.** And, there was…

The utterance categories are based on both theory and data-driven analysis. The length of utterances in words was also measured. The analytical categories are presented in more detail below.

Categories of collaborative interaction. *Asking questions.* Questions indicate collaboration, simply because participants are expected to answer them (Weinberger & Fischer, 2006). In this study, questions are related to the content of the issue at hand. For example, one student may ask another student to describe more precisely the content of the sentence they are writing. Questions may also be related to the writing process. Students may, for example, ask how or in what order ideas should be written down. Questions of this kind are very close to suggestions, which can be expressed interrogatively: for example: *"Should we continue this in the same sentence or...?"* (utterance 3411). Hence suggestions of this kind were classified as questions because the other students were either expected to answer or express agreement to them.

Answers to questions. Answering thought-provoking questions requires students to make connections among ideas and generate explanations, elaborations, speculations, inferences, and other forms of knowledge (King, 1994, 2002). In this study, two types of answers were found: answers relating to the content of the issue (often rather long explanations), and answers relating to the writing process (often short answers).

Collaborative completion. Collaborative completion occurs when one student begins a sentence or an idea and another student completes it by taking over, integrating or applying the ideas or perspective of their learning partners (Teasley & Roschelle, 1993; Weinberger & Fischer, 2006). Sometimes Collaborative completion touches upon answers, which are related to explanation-seeking questions. In that case, the answerer completes the fuzzy idea or thought which the other student has presented.

Collaborative completion is described in the following extract (in bold) in which two students (Nina and Mia) are talking about the idea of the universal principle in Kohlberg's theory (utterances 3923–3926). In the first utterance, Nina is reformulating a sentence which Paula (a third student in the group) is going to write down. Next, Mia first agrees with Nina's formulation and then completes the idea of the sentence by stating what she thinks the word "principle" means. Finally, Nina further completes Mia's idea.

Nina	[Nina dictates the sentence which Paula is writing] Most individuals do not reach this sixth phase.
Mia	Yeah.
Mia	**I think "principle" means, that in the sixth, also known as the phase of universal principles, the individual…er…assumes… or , well, the individual, individual, individual wants…**
Nina	**to respect the basic dignity of all people as individuals. That is, you know, that tolerance…**

Expressing disagreement or conflict. In a collaborative writing situation, students may express conflicting points of view. Students draw attention to such conflict by expressing their thoughts out loud to each other (Dale 1994). This enables the other students to evaluate how relevant the thought is to their joint essay and either agree or disagree accordingly. Interaction with other students fosters the probability that conflict will occur during discussion (Daiute & Dalton, 1998). The next text extract (utterances 358–360) highlights a cognitive conflict (in bold) between two students (Nico and Maria). First, Nico puts forward the idea that Kohlberg's stages of moral development are based on Piaget's cognitive developmental theory. Maria disagrees (erroneously) with Nico by saying that the stages do not originate from Piaget but are based on Kohlberg's own thinking. At the end, Nico disagrees with Maria's previous statement.

Nico I think that we could put there, that like, you know, like Piaget, you know, that intelligence..or …I mean the stages of thinking in the cognitive-developmental theory, so in the same way, these stages of moral development are based on Piaget's concepts of the five stages which have the following characteristics: qualitative differences, structured wholes, invariant sequence, hierarchic integration, and universal sequence and in addition…

Maria **I think these are not Piaget's ideas since these are presented in Kohlberg's theory…**

Nico **No, they are not**.

Quick disagreement. In this study, quick disagreement means a rapid rejection of another students' contribution without giving a reason for this. Quick disagreement is often related to a situation where one student wants to stop another student from going off on the wrong track.

Quick agreement. Quick agreement is used as a means by students to accept the contributions of their learning partners in order to move on with the task (see Weinberger & Fischer, 2006). The contribution can be either a question or an interrogative suggestion related either to the content of the issue, the sentence at hand, or the writing process. Quick agreement can thus be considered as a coordinating discourse move. Quick agreement can also be defined as a form of unmodified rephrasing of a learning partner's statement (Weinberger & Fischer, 2006). In the following text extract, two students (Elisa and Tia) coordinate the writing process by indicating Quick agreement (utterances 1734–1735). In the first utterance, Elisa interrogatively suggests that they should go forward. Tia agrees with Elisa's suggestion.

Elisa Yeah. Should we go forward?

Tia Let's do that.

Discussing edits. This category includes utterances in which the students discussed edits of the text, e.g. grammatical corrections, wordings and typos.

Categories of content processing. When students write collaboratively, in addition to interaction, they also have to concentrate on the content of their writing. The categories which indicate knowledge construction during content processing are the following.

Expressing an idea or a thought. Discussions typically start with an expression of an idea or a thought, or the topic changes with the expression of an idea. Expressing an idea or a thought means that students make a contribution to the discussion without referring to other students' contributions, i.e., the learners externalize what they know about the topic at hand (Weinberger & Fischer, 2006). In the next speech turn (utterance 2724), Jenny expresses an idea to the other participants in order to make a new contribution to the discussion.

Jenny Hey…. Should we put… you know… at the beginning there is, well, hm...there is…that Darwin ...the old theory… you know, creationism…or something like this, what is it?…the theory anyway…

Conceptualizing ideas. Conceptualizing ideas can be defined as expressing one's ideas in an abstract way. In this study, students were instructed to employ a scientific writing style in their joint essay, and consequently in some cases they reformulated the concrete ideas presented in their individual summaries into a more scientific form for their joint essay. Moreover, the theories and the concepts in the course book were conceptual in nature and they were also written in a foreign language (English). Hence, the students had, first, to translate and form the ideas in their own words, often at a somewhat concrete level in order to understand the theory or concept, and then, to incorporate it into the text in an abstract and scientific way. According to van Boxtel et al. (2000), students' conceptual understanding may be promoted through participation in writing practices which require the use of scientific concepts to describe and explain theoretical principles in the domain of interest. Conceptualizing ideas (in bold) is described in the next extract (utterances 3903–3906) in which the students (Mia and Nina) are formulating the concept 'equity' in Kohlberg's theory of moral development. First, they express the relevant concepts i.e.

‘equity’ and ‘universal ethical principles’ and then Mia describe the concept in an abstract way.

Mia: I think it is only sort of…all …equity. Equity….is
Nina Yeah, universal ethical principles.
Mia **Universal ethical principles for all. It’s, you know, the idea in a nutshell. Personally acquired, naturally universal, and consistent…Principle of equity, equality, reciprocal, and human rights.**

Clarifying ideas. When students clarified an idea they either explained it to each other or gave an example of it. By clarification through examples, an abstract concept, presented for example in a course book, becomes more comprehensible. Because the course book was written in a foreign language, clarification was needed in order to understand the concepts or theoretical principles presented in it. Clarification can be related to explanation-seeking questions (van Aalst, 2009), which involve sufficient accurate clarification on the issue in question. Volet et al. (2009) have suggested that clarifying understanding may refer to low-level cognitive processing. However, clarification has an important role with respect to the goal of improving students’ comprehension on a particular issue. The following utterances (utterances 213–214) are taken from rather a long discussion where the students pondered the concepts presented in Piaget’s theory. As the concepts seemed to be difficult for the students, clarification was needed. First, Helena offers the group an example of Piaget’s concept ‘assimilation’. Then Olivia presents her own example of assimilation (in bold) in order to improve the comprehension of the concept.

Helena So, is it (assimilation) something, you know, you can imagine that if you put two different substances into a glass, which will be blended together, cocoa powder and milk?
Olivia Or I think it is more like, that your old knowledge is here, it is what you already know. **The sponge cake and then cream will be added to it. So, it is, you know, the same, but then a little bit more is added to it.**

Monitoring and regulating. Students observed their understanding of the issue at stake, but also scanned their textual products for mistakes, by the metacognitive strategies of monitoring and regulating. During collaborative writing, monitoring can help students to attend to ongoing cognitive processes and to use regulatory strategies to solve problems (Nietfeld et al., 2005). Students can monitor their comprehension of concepts which they have incorporated into their joint essay and regulate their writing style in order to adhere to the scholarly style of the joint essay. Monitoring also assists in managing the writing process through the effective allocation of attention, memory and time, when writing together in order to complete an academic writing assignment (Nietfeld et al., 2005). In this study, Monitoring and regulating occurred during content processing and collaborative interaction alike. In collaborative writing, monitoring provided not only for self-generated feedback but also feedback from other students to control their performance and comprehension (Nietfeld, et al., 2005). An example of monitoring here is the idiom *I am completely at sea* (utterance 1179) that one student used in a situation where the students were translating the stages of Kohlberg's theory of moral development from English into Finnish. When regulating their activities students, for example, checked difficult concepts and ideas from the course book.

Off task. The fragments also contained utterances not related to the task, such as references to different editions of a book or the capacity of the computer.

Reliability Measuring and Statistical Analysis

In determining the reliability of the analysis, 13% of the utterances (520 in total) were examined by two judges. The inter-rater reliability (Cohen's Kappa) of the analysis on the categories of Collaborative interaction was .86; on the categories of Content processing .94; and on Monitoring and regulating .85.

The associations between the fragment types and the categories of collaborative interaction, content processing, monitoring and regulating and off task were analyzed by using the nonparametric $\chi 2$ test. In order to describe the nature of the associations found by the $\chi 2$ test more deeply, adjusted residuals were used (Bewick, Cheek & Ball, 2004).

Results

Fragment Types in the Students' Group Discussions

The students' group discussions were divided into 142 discussion fragments on the basis of the analysis of the sentences in the students' joint essays. The two most common sentence categories in the essays were *Literally copied* (73, 41%) and *Reformulated* (71, 40%; Table 2). Further, 28 (16%) sentences were composed by utilizing the course book and 7 (4%) sentences included *new text* created during the discussions.

The discussion fragments were formed on the basis of the sentence categories *Reformulated*, *Book based* and *New texts*. The most common fragment type was "Text reformulation": in 100 (70%) fragments, the students reformulated a sentence first presented in one or more students' individual summaries. The students wrote book-based ideas in 32 (23%) fragments, i.e., they translated and formulated sentences for their joint essay on the basis of the course book. In 10 (7%) fragments, the students created new text.

Collaborative Interaction

The total amount of utterances included in the discussion fragments was 3 865. The number of utterances indicating collaborative interaction was 3 555, and the rest of the utterances (n = 310) belonged to the other categories: Content processing, Monitoring and Regulating, and Off task**.** The most common utterance categories which described students' knowledge construction during their collaborative interaction in the joint writing process were *Collaborative completion* (32%), *Quick agreement* (22%), *Asking questions* (18%), and *Discussing edits* (13%) (Table 3). The students *Expressed disagreement or conflict* (4%) and *Quick disagreement* (4%) far more rarely (Table 3).

When the number of words in the collaborative interaction utterances was counted, it was found that the students most commonly engaged in *Collaborative completion:* 42% of words were used for this purpose (Table 3.). Other common categories of collaborative interaction as counted by the number of words were *Asking questions* (21%) and *Discussing edits* (16%). The students asked rather a lot of questions, but *Answering* the questions was more rarely observed (5%). *Expressions of disagreement or conflict* (6%) and *Quick disagreement* (3%) were also rare (Table 3).

Table 3

Distribution of collaborative interaction utterances by category

Utterance categories	Distribution of utterances		Number of words		Length of utterances in words			
	f	*%*	*f*	*%*	*Min*	*Max*	*M*	*Std.*
Collaborative completion	1149	32	10248	42	1	63	8.9	7.2
Asking questions	629	18	5030	21	1	46	8.0	6.2
Answers to questions	257	7	1258	5	1	41	4.9	5.8
Quick agreement	798	22	1647	7	1	9	2.1	1.6
Expressing disagreement or conflict	137	4	1495	6	4	28	11.0	5.5
Quick disagreement	125	4	642	3	1	20	5.1	3.6
Discussing edits	460	13	3898	16	1	40	8.5	5.9
Total	3555	100	24 218	100				

When the association between the categories of collaborative interaction and the different text fragments was tested (Table 4) a significant association was found ($\chi 2$ = 56.88; *df* = 14; *p* = .000). Examination of the adjusted standardized residuals (*z*) showed that when the students wrote ideas on the basis of the course book, Collaborative completion (*n* = 394, 33%, *z* = 3.2), in particular, was commonly engaged in. Although expression of disagreement or conflict was infrequent across the discussion, it was associated both with the text fragments in which the students reformulated previous text from their source-based individual summaries (*n* = 106, 4%, *z* = 3.1) and with fragments where the students created new ideas (*n* = 12, 7%, *z* = 2.6) for the joint essay. However, the students very seldom expressed disagreement or conflict (*n* = 19, 2%, *z* = -4.3) when writing ideas on the basis of the text book. The students often discussed edits of their joint text in the text reformulation fragments (*n* = 333, 13%, *z* = 3.5) but hardly ever when writing book-based ideas (*n* = 105, 9%, *z* = -3.9).

Table 4

Proportions of the three different types of discussion fragments in the collaborative interaction utterances by category

Utterance categories	Fragments of text reformulation			Fragments of book based ideas			Fragments of new texts			Total	
	f	*%*	*z**	*f*	*%*	*z*	*f*	*%*	*z*	*f*	*%*
Collaborative completion	702	28	**-3.3**	394	33	**3.2**	53	32	0.5	1149	30
Asking questions	423	17	1.3	181	15	-1.1	25	15	-0.5	629	16
Answers to questions	162	6	-0.7	80	7	0.2	15	9	1.2	257	7
Quick agreement	509	20	-0.8	258	22	1.1	31	19	-0.7	799	21
Expressing disagreement or conflict	106	4	**3.1**	19	2	**-4.3**	12	7	**2.6**	137	3
Quick disagreement	87	4	1.1	34	3	-0.9	4	2	-0.6	125	3
Discussing edits	333	13	**3.5**	105	9	**-3.9**	22	13	0.5	459	12
Other categories[1]	190	8		114	10		6	4		310	8
Total	2512	100		1185	100		168	100		3865	100

*z = Adjusted standardized residual
[1]*Note*: Other than collaborative interaction categories.

Content Processing

The amount of utterances which indicated content processing was 1 442 of total utterances (*n* = 3 865). The rest of the utterances (*n* = 2 423) belonged to categories other than content processing: Collaborative interaction, Monitoring and Regulating, and Off task. The most common utterance categories describing the students' knowledge construction during content processing when they were writing their joint text were *Conceptualizing ideas* (54%) and *Clarifying ideas* (40%) (Table 5). When knowledge construction during content processing was examined by using the number of words as a measure, the ranking of the most common categories was somewhat different: *Clarifying ideas* (48%) and *Conceptualizing ideas* (47%). The association between the categories of content processing and the different text fragments (Table 6) was not significant. ($\chi 2$ = 4.27; *df* = 6; *p* = .640).

Table 5

Distribution of content processing utterances by category

Utterance categories	Distribution of utterances		Number of words		Length of utterances in words			
	f	*%*	*f*	*%*	*Min*	*Max*	*M*	*Std.*
Conceptualizing ideas	785	54	7239	47	3	44	9.2	5.9
Clarifying ideas	580	40	7400	48	2	63	12.6	7.7
Expressing an idea or a thought	77	5	813	5	4	30	10.6	6.2
Total	1442	100	15452	100				

Table 6

Proportions of the different types of discussion fragments in content processing utterances by category.

Utterance categories	Fragments of text reformulation			Fragments of book based ideas			Fragments of new texts			Total	
	f	*%*	*z**	*f*	*%*	*z*	*f*	*%*	*z*	*f*	*%*
Conceptua-lizing ideas	527	21	1.4	221	19	-1.7	37	22	0.6	785	20
Clarifying ideas	363	14	-1.3	192	16	1.4	25	15	0.0	580	15
Expressing an idea or a thought	49	2	-0.3	25	2	0.3	3	2	-0.2	77	2
Other categories[1]	1573	63		747	63		103	61		2423	63
Total	2512	100		1185	100		168	100		3865	100

**z* = Adjusted standardized residual
[1]*Note:* Other than content processing categories.

Monitoring and Regulating, and Off-Task Discussion

Metacognitive activities during the students' discussions were rare: only 320 (8%, 3 219 words in total) of all utterances were assigned to the category *Monitoring and regulating*. The association between Monitoring and regulating and the different text fragments was not significant ($\chi 2$ = 2.34; *df* = 2; *p* = .310). The students also very rarely engaged in *Off-task* discussion (53 utterances, 358 words in total), although somewhat more typically when they wrote book based ideas (*n* = 27%, *z* = 2.7) and particularly infrequently when reformulating previous text (*n* = 25, 1%, *z* = -2.7).

Discussion

During collaborative writing, the students often completed each other's ideas and asked questions. According to Teasley and Roschelle (1993), collaborative completion is an effective expedient in knowledge construction, because it spreads the interrelated goals, features, and actions related to knowledge elements across the discussion. This provides multiple opportunities for students to contribute to the construction and verification of the new piece of shared knowledge. High-level interaction, characterized by the exchange of ideas, information and perspectives, generates thought-provoking questions, explanations and conclusions (King, 2002). Questions have an important role in knowledge construction during collaborative writing, because they may direct students to think more profoundly about the issue at hand instead of retrieving and regurgitating information. Presenting questions may promote deeper learning regarding the topic which the students are writing about. Teasley and Roschelle (1993) point out that collaboration does not happen just because individuals are co-presenting information; instead, individuals need to make a conscious, continued effort to coordinate their interaction and activity with respect to shared knowledge.

Although the students asked a lot of questions, the number of answers was small. This may partly be due to the nature of collaborative writing. During collaborative writing, questions that have been asked may be left unanswered either because their content needs to be examined more closely or the questioner does not expect an answer but is contemplating the issue interrogatively. We noticed that the students more often left questions unanswered in groups containing more than two students. In those groups, students floated ideas by means of questions and suggestions, without waiting for direct answers to them. Sometimes the answers that the students gave were interpreted here as collaborative completion. Furthermore, unanswered questions may also be related to the students' writing process method. As Healy (1980) points out, constructive criticism is often given in the form of questions. Then the intention is not to answer these questions, but to take them into account in writing the next draft of the text.

Cognitive conflict has been found to facilitate knowledge construction among collaboratively writing students (Dale, 1994; Hmelo-Silver, 2003; Yong, 2010). However, in this study the students rarely expressed disagreement or conflict during this task. This may be explained by reference to the culture of Finnish higher education: Finnish

university students often confine themselves to passive knowledge acquisition, trusting authority, for example course books or the teacher, instead of engaging in critical collaboration with their discussion partner (Marttunen, 1994). Moreover, the small amount of cognitive conflicts in the students' discussion is not necessarily a sign of reduced collaboration, but may rather refer to a different way of engaging in collaborative activities. Weinberger, Laurinen, Stegman and Marttunen (2009) compared Finnish and German university students in a collaborative study context and found that while the German students typically engages in conflict-oriented collaborative work, the Finnish students tended to integrate the arguments of their learning partners in their own line of reasoning. Another reason for the scarcity of conflicting interaction among the students in this study might be that almost all the participants were females. Carr et al. (2004; see also Herring, 1996) have found that male students, compared to females, tend to have a more assertive and competitive discussion style, and hence are more inclined to engage in conflict.

In the present instance, disagreement surfaced during discussions where the students were reformulating sentences on the basis of one or more student's individual summaries and when they were creating new text during a discussion. There are three possible reasons for this. First, when individuals are working together, their collaborative activity often produces periods of conflict, for example when individual ideas are negotiated with respect to the joint task. According to Teasley and Roschelle (1993), such periods of conflict signify a breakdown in mutual intelligibility, but not in collaboration. In this study, it was often presumed that, in reformulating sentences, different viewpoints and ideas from individual summaries would be taken into account. When incongruous ideas encounter each other, conflicts may arise. Second, by writing individual summaries, students were able to conceptualize the issue in question and produce their own interpretation; thus, they had enough knowledge to voice disagreement with other students' interpretations or defend their own contribution. They also had enough knowledge to recognize the discrepancy between their own and other students' understanding of the concepts or theoretical principles under discussion. Third, expressing disagreement or conflict may also be a sign of mistrust of other students' thoughts or interpretations. Students sometimes rejected other students' thoughts, whereas they accepted information from the course book without question. The reason for this may be that the course book was seen as an authority which cannot be challenged, although it is possible that the book was theoretically interpreted differently by different students.

Utterances indicating content processing were usually somewhat longer than utterances indicating collaborative interaction. Some ideas were complicated or difficult for the students, and consequently long explanations were needed in order to clarify them. The students seldom created totally new text for their essay. Where students clarified their ideas by an example, they took it from the book rather than created one of their own. They clung to their individual summaries or to ideas taken directly from the course book, but they did not further evolve their thinking together. This might be due to the task assignment, which guided them to write a joint essay as a summary of a theory presented in the course book. Other reasons for the small amount of students' new text might the limited time they were given to perform the task, and that the book was written in a foreign language. English was quite difficult for some of the students to understand, and thus they might have needed more time to understand the content of the book. Therefore, they probably merely adhered to the text of the book instead of re-creating the idea in their own words.

The small proportion of monitoring and regulating can be explained by the task. The students were not asked to evaluate either their own comprehension or performance or others' contributions during the writing process. However, the students monitored their comprehension spontaneously during their collaborative work. Monitoring may stimulate knowledge construction, because it reveals misunderstandings and requires that misconceptions should be rectified by clarification. The small amount of off-task discussion suggests that in general the students concentrated very well on the writing task. It is worth noticing that off-task discussion occurred mostly when students wrote ideas on the basis of the course book, which may indicate that they experienced difficulties in reading and translating as well as understanding the book, which they then tried to diminish by engaging in off-task discussion. Another reason for the occurrence of off-task discussion when writing book-based ideas may be that reading the course book during the collaborative writing phase may have overloaded the students' working memory and disturbed their ability to concentrate on writing.

In order to assess how a collaborative writing task, such as the one used in this study, can benefit knowledge construction, the task assignment as a whole has to be borne in mind. Although single actions, such as utilizing a course book, might introduce features that may adversely affect the knowledge acquisition process, in total the use of individually written summaries, the opportunity to use the course book during the writing process, and the composition of a joint essay through group discussion, can be argued to

constitute an entity which can promote knowledge construction in multiple ways. A collaborative writing task that combines reading, summary writing and group discussion may produce more beneficial learning outcomes than when they are used separately (see Tynjälä, 2001). Thus, it can be said that reading theories presented in course books, writing summaries on them, and then working on the theories further in seminar situations can produce rich discussions which seem to assist students in their construction of knowledge.

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