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## Students' group work strategies in source-based writing assignments

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## Abstract

Source-based writing assignments conducted by groups of students are a common learning task used in information literacy instruction. The fundamental assumption in group assignments is that students' collaboration substantially enhances their learning. The present study focused on the group work strategies adopted by upper secondary school students in source-based writing assignments. Seventeen groups authored Wikipedia or Wikipedia-style articles and were interviewed during and after the assignment. The interviews were analyzed to identify the key activities in which the students were involved, the ways the group work was conducted in these activities and how the students justified their choice of group work strategies.

These group work strategies were analyzed in six activities: planning, searching, assessing sources, reading, writing and editing. The students used two cooperative strategies, and two collaborative strategies. Cooperation by dividing the work into independently conducted personal projects was the most popular and group collaboration, where students worked together to complete the activity, was also commonly applied. Cooperation was justified by efficiency in completing the project and by ease of control in the fair division of contributions. The reasons for collaboration were related to quality issues and shared responsibility. The authors suggest that the present designs of learning tasks guide students in avoiding collaboration and in increasing the risk of low learning outcomes in information literacy instruction.

## Introduction

Our views on learning are informed by competing knowledge-acquisition and participation metaphors based on theories emphasizing either the individual or the social aspects of learning. Present pedagogies of schooling build on the knowledge-acquisition metaphor where motivation, cognition, rational thinking and knowledge of an *individual* are in the focus of teaching. (Hakkarainen, 2009; Sfard, 1998.) In practice the division between camps is not clear cut. Schools have gradually adopted some aspects of collaborative learning into their work methods; for instance, various types of group work projects have become popular.

Collaboration brings many benefits to the knowledge building process: for example, joint efforts to complete a learning assignment encourages students to discuss the problem in hand from various viewpoints, to activate and share relevant knowledge about the problem, to generate ideas on how to solve the problem, and to search for and

negotiate the use of information sources. Through constant discussion and interaction, students gain insights that would be difficult for them to achieve on their own (Stahl, 2006). New knowledge can be built from the pooling of ideas and information, and be actively tested against the ideas of others (Haythornthwaite, 2006).

Group work has also become common in the school's information literacy education (see e.g. van Aalst, Fung, Li & Wong, 2007; Chu, Chow, Tse, & Kuhlthau, 2008; Chu, Tse & Chow, 2011; Kuiper, Volman & Terwel, 2005; Lehtiö & Sormunen, 2011; Limberg, 1999). Kuhlthau, Maniotes and Caspari (2007, 35-45) have introduced a model called *inquiry circles* for integrating group work into information literacy instruction. An inquiry circle may take different forms but the process is based on a sequence of personal and group activities. Team members, for example, may be organized to study individually the same set or different sets of documents about a topic and to discuss their findings in a group meeting. However, we are lacking research on how students actually collaborate in performing group work in information literacy classes.

This paper reports an empirical study on how student groups at an upper secondary school collaborated in a source-based writing assignment intended to develop their information literacy practices. Our goal was to learn how deeply students engage into collaboration in different activities of the assignment such as information seeking and evaluation, reading of sources, planning the content and writing the required text. We also wished to reveal whether we can categorize groups on the basis of their overall collaboration patterns. Further, we wanted to find out how students justify their group work strategies in different activities.

The paper is organized as follows: we begin by introducing our theoretical framework, which is followed by a review of related research. Then we present our research questions, and report our methods for data collection and analysis. We continue by presenting the findings and close by discussing them and presenting conclusions.

## **Theoretical framework**

The overall framework of our research is bound to knowledge building pedagogy (Scardamalia & Bereiter, 2006) and to the task-based approach of information retrieval and seeking (Ingwersen & Järvelin, 2005; Vakkari, 2003). The knowledge building pedagogy is an alluring perspective to learning because it aims to create a balance between individual and social aspects of learning. We argue that it is fruitful to conceptualize learning assignments as tasks since the design of learning tasks is the teacher's primary instrument in directing students to practice appropriate forms of information seeking and use (cf. Limberg, 2007).

## Knowledge-building pedagogy

Knowledge- building pedagogy was developed by scholars in computer supported collaborative learning (CSCL) (see Bereiter, 2003; Scardamalia & Bereiter, 2006; Hakkarainen, 2009 and Stahl, 2004). Knowledge building pedagogy advocates a “shift from treating students as learners and inquirers to treating them as members of a knowledge building community”. Interestingly, the authors associate this principle with the Internet age and state that the Internet “... becomes the first realistic means for students to connect with civilization-wide knowledge building and to make their classroom work part of it”. The very basic premise is that the focus is moved from the individual student to advancing the state of the classroom community. (Scardamalia & Bereiter, 2006.)

Scardamalia and Bereiter (2006) list several aspects of the knowledge building pedagogy where it differs from the present school pedagogy:

- Students are engaged in the collaborative creation of “epistemic artifacts” which may be purely conceptual, such as theories and abstract models, or “epistemic things” such as concrete models or experimental set-ups.
- The goal of knowledge building is more about the improvement of ideas than adopting “pre-existing truths”. The improvement of ideas in the classroom community is, however, intended to lead towards justified views of the world.
- Similar to inquiry learning (e.g. inquiry-, project-, or problem-based learning) knowledge is seen as a broad notion called *knowledge of* [something] which roughly covers both declarative and procedural knowledge. Knowledge [of] is structured around problems rather than topics. Driving questions are a typical trigger in improving ideas.
- Knowledge building discourse is a key tool in enhancing the state of knowledge of the community. Students have to engage in three commitments in discourse: 1) to progress, 2) to seek common understanding, and 3) to expand the base of accepted facts.
- Constructive use of first-hand experience, secondary sources and authoritative information, and judging their quality are an essential part of knowledge building discourse.

Stahl’s (2000) model characterizes how the personal and the social interact in the process of knowledge building (Fig. 1). The elements on the left illustrate the cycle of personal understanding. The cycle starts from the tacit pre-

understanding on which our beliefs of the world are based. In some activities we become aware of a mismatch between our beliefs and something else in the world. The network of meanings by which we make sense of our world must be mended. We may “repair” our understanding by reinterpreting our meaning structures, for example, by using a cultural artifact such as a document.

[Fig. 1 about here]

The theory of knowledge building pedagogy (Scardamalia & Bereiter, 2006) and the model of individual and social knowledge building (Stahl, 2000; 2004) inform us of some important characteristics of collaborative learning tasks. Traditional group work was based on *cooperation*. Cooperation as a pedagogy emphasizes the effect of group work on the individual’s motivation and learning outcomes (Lehtinen, 2003). On the other hand, cooperation does not necessarily lead to collaborative learning in terms of knowledge building.

Dillenbourg (1999) makes an important distinction between collaborative and cooperative learning. In collaboration, partners work together from start to finish. In cooperation, the task is split into subtasks which are completed individually so that at the end, the partial results are assembled into the final output. Both Roschelle and Teasley (1995) and Stahl, Koschmann and Suther (2006) point out that cooperation and collaboration lead to different learning processes: in the former, learning is accomplished solely by individuals in separated processes while, in the latter, learning occurs socially as a shared building of knowledge.

### **Task-based approach to information seeking and use**

A task can be defined as an activity to be performed to accomplish a goal. The performance of a task includes physical and cognitive actions. The process consists of a series of subtasks and results in a meaningful (end-)product. The study of tasks is motivated by the view that our understanding of information searching is only partial if we neglect the task as the trigger of searching. (Vakkari, 2003.) The goal of research has typically been to reveal how variation in task variables (e.g. task complexity – Byström & Järvelin, 1995; Vakkari, 1999) explains variation in information seeking and retrieval variables.

Limberg (2007) argues that although tasks are commonly interpreted as work-related learning, assignments can be regarded as a sub-category of tasks. She suggests there are particular conditions that shape learning-related information seeking. Assignments are imposed to students by the teacher and the goals of the assignment are related to learning outcomes of topical contents and abilities.

Learning tasks have been explored as a context of information seeking and use since the 1980s. In particular the work by Carol Kuhlthau on the information searching process (ISP) model has been fundamental in the field (see e.g. Kuhlthau, 1991; 2004). The ISP model was developed from the individual constructivist perspective where information searching is seen as a sub-process of the construction process of learning. Later the model was tested in collaborative learning contexts: for example, Hyldegård (2006; 2009) studied the applicability of the ISP model to the analysis of information behavior of student teams. The ISP model did not ideally serve the study of teams. The problem solving process shifted between the group and the individual perspectives. Hyldegård concluded that the task becomes a complex framework to study when teams of individuals are involved.

The process model of information behavior in assigned learning assignments proposed by Tanni and Sormunen (2008) makes an interesting differentiation between the cognitive process of learning and the physical process of composing an epistemic artifact, such as an essay. The work on the epistemic artifact links the task-based model of information behavior in learning (see Tanni & Sormunen, 2008) to the knowledge-building process model by Stahl (2000; see Fig. 1). The focus on the epistemic artifact encourages analysis, for example, how source information is used in writing texts (Sormunen & Lehtiö, 2011; Sormunen, Heinström, Romu & Turunen, 2012) and how the depth of collaborative information processing is associated with the quality of the text written (Kiili, 2012; Kiili, Laurinen, Marttunen & Leu, 2012).

The task-based and the sociocultural approaches are at times seen as mutually exclusive research paradigms. We believe that a deep understanding of information seeking and use in collaborative learning processes requires that neither individual nor social aspects are neglected. The framework for cognitive, task-based information seeking and retrieval proposed by Ingwersen and Järvelin (2005, 313-357) includes social, organizational and cultural dimensions of the (work) task context as a bridge to sociocultural research themes. The framework does not emphasize collaboration of the actors but on the other hand neither does it exclude it.

## Related research

Kuiper, Volman and Terwel (2009) made an extensive study on four teachers working with 94 5th grade students on a brochure about healthy food. The collaborative inquiry activities aimed at both the development of web literacies and content knowledge building. The groups of one school were substantially more active in collaboration, had a higher motivation to complete the project, shared more actively information within and beyond the group, and knew what

everyone else was doing. In addition, learning results were assessed high in this class. The authors argue that the teacher of this class was the only one who “focused explicitly on collaborative group work and introduced herself as part of that group. She talked with the students about the ways of working together at the computer and took time to solve problems. She created extra conditions to affect this collaboration, for example by physical rearrangements in the classroom...”.

In a case study by van Aalst, Fung, Li & Wong (2007) six groups of 2-3 secondary school students completed a five-week inquiry project. They found that meetings, instant messages and telephone calls were the most popular communication methods within team members. The teacher did not allocate specified roles for group members. However, it turned out that in the actively collaborating groups one of the members had taken on leadership status. In a similar study also from Hong Kong, Jun and Pow (2011) found that all groups showing active collaboration had a recognized leader. The reverse did not hold: some recognized leaders failed to activate other members to collaborate and had to make most of the work alone. In both case studies, actively collaborating groups were more likely to create high-quality inquiry reports. It was also the case that Pauli, Mohiyeddini, Bray, Michie, and Street (2008) found that inability to work on the actual task was a problem in groups lacking leadership.

Meyers (2010; 2011) studied the effect of group work on middle school students’ information seeking, learning outcomes, and problem solving. In the field experiment, half of the 120 students (ages 13-14 years) performed two complex health-related information seeking (and problem solving) tasks in groups of threes and the other half as individuals. The groups were using a single computer accessing the web in searching information resources, while data were collected by observation, screen capture, pre- and post-tests, and questionnaires (Meyer, 2011, 88-96).

The analysis revealed that, on average, individuals achieved better search results than groups. There was no difference in learning outcomes between groups and individuals. However, some students were high performers in one condition (e.g. individual task) but failed in the other (e.g. group task) (Meyer, 2011, 109-148). Groups seemed to favor relying on their background knowledge rather than using information sources already found, and moved quickly onto the next step of the task rather than staying to examine the issue at hand more carefully. Students perceived the need to get “everyone to agree” on a problem in group work and they tried to avoid situations where “group thinking” might lead to cognitive conflicts (Meyer, 2011, 234-240). On the other hand, students agreed in questionnaire responses that group process was “fun” and provided a great deal of affective motivation (Meyer, 2011, 241-242).

Hancock (2004) also found that students who desire to work together do not necessarily learn more in a setting that fosters student interaction and collaboration.

Saleh & Large (2011) conducted a survey study on collaborative activities of 42 undergraduate students in a design engineering project course where the students worked for eight months on a professionally realistic design task in small multidisciplinary groups. On average, the groups were meeting 2-3 times per week. The main findings were that students engaged most in collaboration at the early stages of the project (e.g. generation of ideas, formulation of the task, identification of information needs) and at the end when the final report was written. Division of labor, i.e. allocating different subtasks to individual group members, was common, so that for example, information seeking could be divided by topic or by channel. Some groups applied quite sophisticated strategies in balancing between individual and collaborative efforts. When complex tasks or information needs were encountered, other group members were used as information channels or information was searched as a group. It was also common to assess the quality of information together.

Hyldegård (2009) explored Kuhlthau's information search process (ISP) model in a study of three groups of 3-4 voluntary graduate students working on a 3.5 month project producing a report of 30-40 pages. Data were collected by surveys, diaries and interviews. The in-depth study the three groups contributed by several findings related to collaboration:

- If the members knew each other, it turned out to be an important criterion in joining a group even beyond the topic of the assignment. Roles in the group were found easily and the members shared the same ambitions and working styles.
- Physical presence in group meetings was preferred in communications, information sharing and maintaining the 'group spirit'. Group members were regarded as the source of reliable information for problem solving.
- At the beginning, all groups used mind-mapping to obtain the shared understanding of the focus and goal of the assignment. After the midpoint of the project, reading and discussing other members' writing was the primary mode of communication. The author argues that this behavior had many common elements with the collaborative information behavior in professional teams solving complex problems.

Kiili, Marttunen, Laurinen and Leu (2012) studied information acquisition and meaning making processes in a pseudo-controlled setting, where student pairs of an upper secondary school conducted essay projects on a controversial topic (censorship in the internet). The subjects started by a 15 minutes' discussion about the topic, continued by searching for information for 30 minutes on the Web and ended by writing an essay during the last 45 minutes of the assignment. The authors analyzed students' behavior in two dimensions: as to whether the pairs were oriented 1) to deep or shallow processing of information contents, and 2) to work in collaboration or individually. In the cluster analysis five student pair groups were identified:

- Co-constructors (n=2) were engaged in collaboration and used considerable time (83%) for deep processing of information (constructing meaning from sources and constructing knowledge for their essays).
- Collaborators (n=2) were also engaged in collaboration but they shared time equally (41% vs. 46%) between shallow processing (i.e. knowledge acquisition and clarification) and deep processing of information.
- Blenders (n=6) shared their time equally between collaborative and individual activities. In collaboration they were mainly involved in deep processing of information (37%).
- Individually-oriented readers (n=4) used less time in collaboration (32%) and most of it was related to shallow processing of information (25%).
- Silent readers (n=5) used very little time for collaboration (14%) and it was equally shared between deep and shallow processing of information. (Note that by reading, researchers refer to a broad spectrum of activities: searching, assessing and reading sources, and writing a source-based text.)

A group of teachers made independent assessments of essays with the outcome that the average scores of group essays was higher than the scores of individually composed essays in the control group. Within the experimental group the co-constructors cluster earned the highest scores and the silent readers were given the lowest. In the post-study questionnaire, the majority of students agreed that collaboration was especially useful in exploring different viewpoints on the issue, in evaluating usefulness of information, and in extracting main ideas from the sources.

A considerable amount of research has demonstrated how differently students may perceive group work, such as, lower-performing students tend to appreciate the help from the group, thus achieving higher grades than usual (Su, 2007; Almond, 2009), whereas high achievers have consequently been found to prefer working on their own (Bahar,

2003). The reason possibly is that they might feel contributions are unequal within the team (Pauli et al, 2008), and that individual modes of working are a more effective way of learning (Walker, 2001). Heinström and Sormunen (2012) found that dividing tasks to be undertaken individually by each member tended to be a negative experience, while working collaboratively enhanced learning. Students may also value the exchange of ideas and the opportunity to increase their understanding through collaboration (Hillyard, Gillespie & Littig, 2010).

## Research questions

Our general goal was to reveal how students actually collaborate in group work assignments used commonly in information literacy education. Our point of departure was naturalistic: the findings should illuminate students' collaborative strategies in a typical school context. The idea of the course came from the teachers themselves and they basically had free hands in designing and implementing the assignment as they liked. They were not instructed to apply any of the dedicated pedagogical approaches for IL instruction such as Guided Inquiry: rather they leaned on their professional views on appropriate practice of schooling. The choice of the genre, Wikipedia, as the assignment's framework can be seen as a timely approach in their professional practice.

We formulated three research questions:

1. What group work strategies do students use in different activities of a source-based writing assignment?
2. Do the selections of cooperative and collaborative strategies form systematically varying patterns across activities?
3. How do student groups justify their group work strategies?

RQ1 requires that we identify the characterizing activities used by students in performing a collaborative assignment and the types of group work strategies applied in those activities. RQ2 focuses on the variation between groups in adopting a group work strategy and tries to categorize groups on the basis of their tendency to favor or avoid particular ways of collaboration. RQ3 aims to reveal how students reason the use of a particular group work strategy overall or in a particular activity.

## Data and methods

### Case courses

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Data were collected from two eight-week courses in an upper secondary school in the city of Tampere, Finland, during the spring term of 2011. Thirty students organized into ten groups (three members in each) completed a course in Finnish literature. Twenty-eight students organized into seven groups completed a course in Finnish history: two 3-member, three 4-member and two 5-member groups. The members were allocated into groups randomly by lot.

On the literature course, the task was to write an article for the Finnish edition of Wikipedia and the history course used a dedicated school wiki as the writing forum. On both courses, the assignment was designed to follow Wikipedia's conventions and requirements for authors. The student groups selected a topic for their article from a list prepared by the teacher.

On the literature course each assignment was about a classic Finnish novel. The students were required to read the novel first and then write their own literary essay on before the group work started. The teams were required to write about the novel, about the author, about the reception of the novel in its time, etc.

On the history course, the teacher had prepared topics dealing with Finnish history from the Civil War to the beginning of the Winter War (1918-1939). The topics were quite extensive: The Civil War (1918), a dispute over the Finnish constitution (1918-19), economic development, the role of the left wing, the role of the right wing and foreign policy. The articles on the last four topics were intended to cover the period 1918-39. For each topic, the teacher had listed sub-topics to help students comprehend what the article should contain and how to share the writing task.

The total time reserved for the assignment was 13 days in the history class and 30 days in the literature class (including time for reading the novel and preparing a personal literary essay). On both courses the assignment was introduced, written guidelines were distributed, groups formed, and topics for the articles selected at the first meeting. The second meeting was a visit to the nearby city library. One 30-minute lesson was devoted to the library collections and services and another lesson to searching on the internet. The librarian was informed of the topics selected and had collected materials from the library collection as references for the students.

After the visit to the library, the students worked the next five (in the history course four) lessons in the computer class to search for information, to select and read sources found and to write text for the articles under the teacher's supervision. On the history course a substitute teacher was supervising the class for two lessons instead of the regular teacher.

## Data collection

The student groups were interviewed during classroom sessions and at the end of the course. The aim of classroom interviews was to collect authentic data on what the students had achieved so far in their projects, what they were currently working on, how they had organized their work in different activities and why they had decided to work as they did. The interview at the end of the course aimed to give the student groups a chance to reflect on the whole assignment process. We asked them to describe the phases of the assignment process, how they had performed different activities, how they had collaborated or divided their work, and on what grounds they decided to do so.

Our goal was to interview student groups in the classroom at least once during each 75 minute lesson while students were working on their assignment. Four groups were interviewed three times, eleven groups four times, and two groups five times during the lessons. The average length of a classroom interview was about five minutes. In ten out of seventeen groups, all members of the group participated in the final interview; in six groups, at least one member was present; and one group did not attend the last one at all. The length of the final interviews ranged from 25 to 65 minutes, with the average about 40 minutes.

The recorded interviews were transcribed and as the interviews were undertaken in groups, the transcript described each respondent as “girl 1 group x”, “boy 2 group y” and so on. As the interviewer was familiar with the students, having worked in the class and interviewed them several times, she was able to identify the students by their voices. She added the fictitious names of the respondents to the interview transcripts which made it possible to identify the answers of individual students.

## Data coding

The transcripts were analyzed thematically. Boyatzis (1998: 4, 11, 16–17; 31–32) describes thematic analysis as a process of encoding qualitative information explicitly by using (a set of) codes. A theme is a pattern identified in data that, at a minimum, describes and organizes an aspect of the data and, at a maximum, interprets or explains aspects of the phenomenon under study. A theme can be manifest (i.e. directly observable in data) or latent (i.e. underlying the phenomenon). A code captures the essence of thematic findings, providing a link between data and the researcher’s ideas about the data. (Boyatzis, 1998: 4, 11, 16–17, 31–32.)

The qualitative data analysis method was facilitated by Atlas.ti software package. As the first step of the analysis, a subsample of four student groups was selected out of the total of seventeen, with efficient code development in

mind. Two criteria were used in selecting the subsample: the subject (independent variable) and the groups' general facility for collaboration (dependent variable). Of both subjects, the most and the least collaborative groups were selected, based on the impressions of the first reading of all interviews. The maximum differentiation between groups was sought to ensure that the codes developed on the basis that the subsample captured the whole variation in the groups' means of collaboration. The groups constituting the subsample are highlighted in the findings section.

The unit of analysis was a group of students, represented by the corresponding transcripts of the classroom interviews and the end interview. In thematic analysis, codes are assigned to units, which should capture "the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon" (see *ibid.*: 63–65). The unit of coding comprised a student group's response to each interview question or multiple responses, where a series of questions and responses elaborated a single theme.

The point of departure of the method was the theoretical construct of activities, which was devised from research on information seeking and retrieval and collaborative writing. An activity was considered as an aspect of students' (information) behavior in the context of the collaborative writing task, focusing directly on the performance of the task proper, or, as an auxiliary process, on planning the activities proper. An initial set of codes for the activities was produced a priori and revised in the context of the raw data to ensure each code was valid and applicable. The information activities were, therefore, instrumental to the analysis of strategies of collaboration in context. A total of 11 activities and 2 meta-activities used in coding were merged to five core activities (Searching, Assessing sources, Reading, Writing, Editing) and one meta-activity (Planning) used in data analysis. Only activities that were ongoing at the time the interviews or activities that preceded the interviews were considered. Data about prospective activities being planned, the assessment of concluded activities or reflections on what had been learned about the activities were not coded as activities.

Coding of all interviews was conducted by the second author (primary coder). To test that subjective biases or errors of a single coder do not cause a reliability problem, the third author (test coder) coded independently the interviews of three groups after training with two groups. In these three test groups the primary coder had assigned 298 codes and the test coder assigned 267 codes. The overall consistency was 64 percent in activity codes and 51 percent in group work strategy codes. Because of the low consistency in group work strategy codes the instances of inconsistent selections ( $n=38$ ; 27 by the primary and 11 by the test coder) were rated independently by the first and fourth author

(evaluators) using three categories “agree”, “on the borderline” and “do not agree”. With the primary coder, the evaluators agreed in 20 cases, regarded five as borderline cases, and disagreed in two cases. With the test coder, they agreed in three cases, considered three as borderline cases and disagreed in five cases. Removing two codes regarded as questionable and adding three new codes assigned ‘correctly’ by the test coder had only a minor effect on empirical results. The value of one cell in a table 3 x 6 data cells changed. We concluded that we can trust the codes assigned by the primary coder.

## Data analysis

The analytic method of constant comparisons was applied in the analysis of the student groups’ strategies of collaboration and the ways in which they justified them. The subsample was read through and an initial set of themes was produced based on (dis)similarities in the activities. This subsample was reread through several times group-by-group and then systematically coded for the emerging themes. The thematic data were retrieved code-by-code and each theme checked internally for consistency and externally for differences across the themes. Reading within a theme emphasized the differences in the theme; reading across the themes emphasized the similarities in each theme. The codes were split or new ones added if necessary. The codes, thus, gradually developed in contact with the data, to become more discriminating and consistent. The process was concluded when the revised codes were crystallized and stabilized. As the final step of the analysis, the codes were applied to the whole set of data. The anomalies are discussed in the findings section of this paper.

Hierarchical cluster analysis (HCA) was used to identify groups which behave similarly in group work. HCA is a useful method in finding clusters of cases which have similar measured characteristics. Hierarchical clustering algorithms start from a situation where each case (here a student group) forms a cluster and combines clusters until only one is left. Distance measures such as the Euclidean distance are used in calculating similarity of clusters and adding them into the hierarchical tree structure one-by-one. The result of the analysis is typically presented as a dendrogram. (Aldenderfer & Blashfield, 1984; Kaufman & Rousseeuw, 1990.)

To apply hierarchical cluster analysis, we interpreted each activity as a dimension (variable) in which we measured the value of group work strategy. Thus the data was presented as a table of m columns and n rows (m = number of activity categories; n = number of student groups). Our data on group work strategies in different activities are in a strict sense ordinal but can be interpreted as interval. The categories of group work strategy were presented as integers

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0/1/2 in ascending order of collaboration intensity. We argue that this quantification is appropriate for exploring differences in overall behavioral patterns to support our qualitative analysis. Statistical software IBM SPSS was used in the analysis with the following parameters:

- clustering method was between-group linkage
- distance measure was squared Euclidean distance
- the number of clusters was not specified in advance

Our data for 17 groups and six activities contained nine empty cells (9 % of all cells) indicating that the interviews did not give clear evidence of the group work strategy applied. Fortunately, no group suffered from more than one missing datum. We decided to replace the nine empty cells by the most frequently used strategy applied by the group (for empty cells see Table 3 below).

## Findings

### RQ1: Group work strategies in activities

Our analysis revealed four group work strategies, which the students applied in the activities of their article projects. The strategies are described in Table 1 in the order of increasing collaboration from the case where an individual member takes care of an activity alone to the other extreme where the whole group works together to complete an activity. The first two strategies emphasize individual efforts and the two latter collaborative efforts. The analysis of team behaviors captured the way of working as it occurred in each activity throughout the project. Most groups agreed in the beginning of an overall plan to work either cooperatively or collaboratively. However, the overall plan could change during the project due to situational factors such as lack of shared times or a team member's failure to complete agreed tasks. The performance of a single activity could split into several sessions and the group work strategy could change from session to session.

[Table 1 about here]

In **DELEGATION** strategy the responsibility for a selected activity was wholly given to an individual group member. For example, editing of the final article was assigned to one group member. SUSANNA/L8: *"[We worked] pretty much on our own topics, but then I corrected those [texts] which we've been writing, their language ... more formal."*

**DIVISION** was often based on the decision made at the beginning of the project that each member worked solely on a subtopic or a subsection of the article. A respondent elaborates division as an overall plan in the history class.

HANNNELE/H1: *"Everyone searches their own [topic] and then writes about their own ..."* HANNA/H1: *"... own topic."*

In the literature class, members of one group discussed how they divided the tasks. SEPPO/L10: *"We agreed that I take care of the plot, meaning that I did the plot analysis [...]"* SEVERI: *"Then I took care of the characters [...]"* SEPPO: *"Then the milieu and..."* SEVERI: *"And the milieu, time and the story teller."* SEPPO: *"Then SEIJA took care of the definition."*

The strategy was also adopted on the activity level as well. The group members might have a shared responsibility for an activity, but each member worked on it individually. SEPPO/L10: *"SEIJA was away [...], and I had to do without her. And SEIJA [...] later brought a couple more sources [...]"* Some groups shared ideas and information sources between group members, but still kept working on their own subtopics. ISMO/H7: *"[We agreed that one can] share books, if one sees things concerning others' topics or something else, then one can share them. "*

In **PAIR COLLABORATION** two members of the (larger) group worked together in an activity. One collaborating pair described particularly aptly the strategy in action. SOHVI/L6: *"[...] SOFIA sat in front of the computer and I next to it, and SOFIA wrote and both... "* SOFIA: *"[...] spoke".* SOHVI: *"So, both were suggesting all along what we should be writing next."* SOFIA: *"And then we were jumping backwards a little, 'that no, let's say it like that after all and let's change the word order [...]"*.

The strategy was typically a deviation from the general plan of DIVISION or GROUP COLLABORATION. The latter particularly happened in three member groups. Group H2, which had assigned each member a subtopic, turned occasionally to pair collaboration. HILJA/H2: *"We have searched on our topics, and then those two [other members of the group], they too have two topics, and they have been searching (for information) about them together."* Group L5 adopted the overall plan of GROUP COLLABORATION but was forced to provisional PAIR COLLABORATION because the third student was absent. TOINI/L5: *"Well, there were only two of us present, but we worked together."* [P51:8] Some groups adopted even more complex arrangements including both division of work and pair collaboration within an

activity. SIIRI/L3: *“SIPI took care of the scene and time [of the novel], and then I and SIMO worked on the themes and interpretations.”*

**GROUP COLLABORATION** typically took place at least in the initiation of the task. Some groups adopted group collaboration as an overall strategy but some groups worked together only in a few activities. Group H5 explicated the first approach concisely. ILPO/H5: *“In the beginning everyone was present, when we divided the tasks.”* Another group described group collaboration as a combined reading and writing strategy. TEEMU/L9: *“Mostly in the way that one wrote and others looked from the source materials for suitable sections, and then it was revised once we got it into some kind of a shape.”* Sometimes groups gathered together to plan the next steps although their overall plan was to work independently on their personal themes. IIDA/H6: *“In the end, I guess we talked about something.”* IIRIS/H6: *“We discussed, about how we’re going to put these (text pieces) there (in the Wiki), and at which point, we ended up deciding that we’d do that independently as well.”*

Table 2 shows how many of the groups mentioned the use of a particular strategy in performing an activity. For example, in the searching activity we have data on 16 groups. The interviews revealed that 2 out of 16 groups delegated, 15 divided, 4 worked as pairs and 9 worked in larger teams in searching at some points of their projects. The second last row presents dominating strategies for each activity across all groups. The groups could apply various strategies in performing an activity at different stages of the assignment process. The last row gives the average number of strategies a single group used per activity.

[Table 2 about here]

DELEGATION was not a commonly applied strategy. Planning and reading was never delegated and most of the other activities were delegated by one or two groups only. The final editing was an exception since six groups delegated the activity to one group member. The use of DIVISION strategy was particularly common in searching and writing (15 groups), slightly less common in planning and assessing sources (11 groups), and least likely applied in editing (6 groups). In reading it was the most popular strategy but only 11 groups mentioned explicitly if they did or did not collaborate.

PAIR COLLABORATION was used more often than delegation but yet only 2-5 groups per activity reported that pair work was practiced in their group. It was the most typical in planning and the least typical in assessing sources. GROUP COLLABORATION was as popular as the division strategy in planning and assessing sources (11 groups) and even more

popular than any other method in editing (8 vs. 6 groups). However, division was far more common than group collaboration in searching (15 vs. 9), reading (6 vs. 3) and writing (15 vs. 5 groups).

Overall, DIVISION was a dominant strategy in searching, reading and writing. DIVISION and GROUP COLLABORATION were equally popular in planning and in assessing sources. The distribution of strategies used in editing was different from other activities. The use of all group work strategies was nearly as active since 4-8 groups applied delegation, division, and pair collaboration and group collaboration. The average number of strategies applied by a group in a single activity was 1.5. The main deviations from the mean were in searching (1.9) and reading (1.1). The co-occurrences of strategies are discussed in more detail below.

## **RQ2: Patterns of overall group work behavior**

The second research question dealt with the patterns of variation in group work behavior across activities. By comparing the patterns in adopting group work strategies for different activities, we try to assign student groups into clusters within which the variation is minimized and between which the variation is maximized. We start reporting the findings with Table 3 which gives a detailed picture of all group work strategies applied by groups in the different activities.

The results presented for the first research question revealed that the work division strategy (B) and group work strategy (D) were applied more often than delegation (A) and pair work (C). Thus Table 3 contains many cells with B or D or their combination B + D. In searching most groups applied two or three group work strategies (typically B + D included) while in reading, only one group used more than one strategy. In other activities, 8-11 groups have mentioned one strategy only. More details can be inferred from the table by the reader.

[Table 3 about here]

The results of the hierarchical cluster analysis (HCA) help explore systematic patterns in the groups' overall collaborative behavior. Value "0" was assigned to cells containing A (delegation), B (division) or their combination. Plain collaborative behavior - C (pair collaboration), D (group collaboration) or their combination - were given value "2". The cells indicating mixed behavior kept the intervening value "1".

The dendrogram presented in Figure 2 suggests that the groups' behavior set a pattern of two clusters:

1. COLLABORATORS (eighth first groups from L2 to L3)
2. COOPERATORS (nine last groups from L5 to H3)

To make the interpretation of clusters easier, the categories of group work in Table 3 were condensed into three aggregate strategies presented in Table 4 (equals with the scale 0/1/2 used in HCA above). Plain cooperative strategies (delegation and division) were denoted by COOP, plain collaborative strategies (pair or group collaboration) by COLL and their combinations by MIXED. The rows were sorted according to the dendograms generated by the cluster analysis.

In the COLLABORATORS cluster the main trend is that groups work together in four activities: planning, searching (except L6), information assessment (except L4), and editing of the article. In reading and writing the groups apply various strategies. The major trend in the core groups of the COOPERATORS cluster is that the activities of writing (except H7) and editing (except L8), the critical steps in composing the shared intellectual output, were made separately by group members. Also reading was undertaken individually but many groups did not talk about it in the interviews. In planning, searching and information assessment, the strategies diverged.

In Fig. 3 we identified two sub-clusters of COLLABORATORS and two sub-clusters of COOPERATORS (see Table 4). In the COLLABORATORS 1 sub-cluster, groups L2, L9 and L6 worked nearly solely in collaboration especially in planning their work, assessing information and editing the final text. In searching, reading and writing activities there were more indications of individual work as well. The other sub-cluster of COLLABORATORS H2, L10, L4, L1 and L3 showed pure collaboration only in reading and switched between collaboration and individual efforts in planning, searching, assessing and editing activities. In writing, the groups' behavior varied from solely individual to mixed strategies.

[Fig. 2 about here]

In the COOPERATORS 1 sub-cluster, the students read, wrote, and edited (except L8) alone. In planning, searching, and assessing information their behavior varied but most groups collaborated. Groups H7 and H3 formed the sub-cluster COOPERATORS 2 but their behaviors did not create a clear pattern except that neither of them collaborated in searching for and assessing information sources.

[Table 4 about here]

The comparison of clusters reveals that students had an orientation either to collaborate or cooperate in group assignments. COLLABORATORS tend to perform all activities either partly (MIXED) or totally (COLL) together. COOPERATORS tended to avoid collaboration consistently especially in reading sources, writing their basic texts and editing the final article. Some groups reported of collaboration in planning their work, searching and assessing sources. Some COOPERATOR groups (H1, H4, H7) did not even plan their work together beyond the allocation of subtopics to group members as a separate personal project.

### RQ3: Justifications for the group work strategies

The justifications reported below capture conscious choices described by the student groups. The students also mentioned other factors that influenced their group work strategies such as fellow group members' absence because of illness or a class trip. These factors were, however, excluded from the findings as being circumstantial rather than reflecting students' conceptions of group work strategies.

The justifications concern both the student groups' overall plans as well as their strategies for individual activities. SULO/L8 explains how the group's decision to divide each member a section of the article to write led to the division of searching as well: *"[The article] is made in sections anyway, that is, everyone has a section of their own. Why would you need that [extra] information? There's no point in searching for information if you have no use for it yourself."*

**DELEGATION** was mainly used in editing. Three groups delegated also in other activities, group L4 being the most active by delegating in three activities. They found delegation beneficial in three different ways. A group member argued that delegation is a common strategy to ensure FAIR SHARE OF WORK but denied that it was the reason to delegate in their group. TAAVI/L4: *"[In group work] someone gets to cop out. I don't think of TANELI as someone who cops out [...] But had this been typical group work, [...] that someone cops out, does nothing."* Delegation was also justified by the SPECIAL COMPETENCE of a member. TAAVI/L4: *"[...] I would never have been able to upload it into Wikipedia, nor would TAIJA [...]"*. The person mentioned raised the third justification by saying that the activity was in his PERSONAL PREFERENCES. TANELI/L4: *"[Writing to Wikipedia] was very satisfying."*

**DIVISION** was justified with the EFFICIENCY OF THE WORK PROCESS. The theme captures various subthemes about coping with the social costs of group work. The students argued that they were able to concentrate or specialize in their individual activities. IIDA/H6 explains: *"One's maybe better able to focus one's information seeking, so one doesn't have to seek anything so widely."* A member of group H7 also argued for efficient use of time in assessing

information. ILPO/H7 : *"It'll take quite a lot of time, to begin looking at all the group members' texts one by one and the sources ... used in them."* Group H7 pointed out that division of work was easier to schedule than group collaboration. ISABELLA/H7: *"One can do some of it in school, but as there's always some of it left for spare time, then you always have to wangle those times when we could meet."*

Another justification for efficiency was avoiding overlapping work. ILMATAR/H5: *"As it's five persons in the group [...] if all start doing the same thing, maybe a lot of overlap occurs."* Not having to keep an eye on the others' work was also an efficiency issue. HILDING/H2: *"It was in my opinion much more efficient to do it alone, you don't have to constantly check what [...] the other does."* One efficiency related explanation was the perceived lack of time to work together. Group L2 was forced to work at home because they were running out of time at school. TUIJA/L2: *"[...] it was necessary to divide a bit. At first we thought we could make all of this together in the class as a group."*

Some students expressed justifications related to perceived SOCIAL INCONVENIENCE in group work situations. For example, one student mentioned he did not like to negotiate about contrasting viewpoints and arguments with other group members. HILJA/H2: *"It's somehow easier to focus on one's own topic than to try to fiddle around trying to fit it all together as everybody has a different opinion [...]"* and continued: *"[In group work] time is wasted in thinking about how we're going to put it together as everyone wants to write differently."* A member of group H4 argued that by dividing tasks they were getting more done and with less hassle and other distractions. HEINI/H4: *"I personally like it this way, doing it independently, even if it was group work."* HEIDI/H4 adds: *"[Group work] usually becomes quite a hassle."*

The TEACHER'S INSTRUCTIONS in the history class offered a reason for the division strategy. Each group in the history class was given a topic divided into subtopics by the teacher. IRA/H3: *"Because we had been handed out those instructions, where the topics were clearly divided, it was pretty easy to [divide subtopics] as they don't even relate to each other much"*. Group H4 gave the FAIR SHARE OF WORK as a justification for the strategy. They pointed out that when each student was responsible for their own subtopic, free riding was avoided. HEINI/H4: *"[...] then someone [often] comes as a free rider if it is group work so, this was really a good system. Everybody did just about as much."* [P30:19] Another reason for the division was PERSONAL PREFERENCES. TAAVI/L4: *"I thought [...] I could leave [to TAIJA] the source issues because I hate them."* An avid reader in the group adopted writing a section of the article from source-materials; another member wrote on the basis of the novel itself.

**PAIR COLLABORATION** was justified by the **QUALITY OF THE WORK PROCESS**. One pair of girls in particular reflected on how they saw the benefits of collaboration in contrast to division of work. The pair argued that it was a positive aspect that they could hear each other's opinions, discuss the different viewpoints, and correct each other's mistakes. As a result they could motivate and trust each other. SOHVI/L6 explains why they were writing together: *"It just felt natural that when we are both sitting here, we're talking about what would be good, and both suggesting different things. And then we correct each other, and just feel that it is good for us."* SOFIA/L6 adds: *"Motivation was higher as there were two of us, as the other was always supportive."* It is a point of interest, that they were aware that writing together was not the quickest strategy to complete the article but they accepted the extra effort in order to achieve their quality standards. SOHVI/L6 explains: *"It might have been [...] more efficient that we had agreed that you do this thing at home and then you do this, but I know we should have read that through anyway the next day [...] for your section is not good enough."* **SHARED RESPONSIBILITY** was another reason given by the pair. SOFIA/L6 says: *"As we both in principle are responsible for that text, then [we will not] just blame each other for a poor section or so."* The pair explained the use of pair collaboration with **FAIR SHARE OF WORK**. SOFIA/L6 reflects on the group's overall strategy: *"We were both really happy with that and [...] that feeling didn't come when one does something and the other just sits and does nothing."*

**GROUP COLLABORATION** was also justified with the **QUALITY OF THE WORK PROCESS**. The groups argued that they were getting many opinions heard. TUIJA/L2 justifies assessing information together as a group: *"I find it's somehow more reassuring that we tell each other our opinions. And as everybody has their own views on what is important, we thought it would be good to do this as a group."* Justifications concerning the **QUALITY OF THE END-PRODUCT** emphasized achieving a (better) result. SEPPO/L10 explains why the group was collaborating in searching: *"We settled on [group collaboration], as we just want as many sources as possible so we'll get as good and broad idea of our book and writer as is possible."* Another group (L9) justified writing and editing together to achieve a more consistent end-product. Taking **SHARED RESPONSIBILITY** for the article was another reason for group collaboration. TEEMU/L9 justified writing together: *"It's nevertheless a work by us all, so we don't need [...] to get this done quickly."*

## Discussion

The knowledge pedagogy (Scardamalia&Bereiter, 2006) and especially the model for the collaborative knowledge building process (Stahl, 2000) give us an appropriate framework to interpret our empirical findings. The process model presented in Fig. 1 emphasizes both the individual effort to enhance one's personal understanding and the

collaborative effort of knowledge building. In the latter effort, the role of collaboration in constructing the epistemic artifact (here the content of the article) becomes essential.

Our findings show that there is a good deal of variation in the way in which student groups either emphasized the personal or the collaborative work in general or in particular activities. The COLLABORATORS either tended to emphasize working together in all activities (social knowledge building circle in Fig. 1) or both personal and collaborative work (both circles in Fig. 1). These groups had at least in principle the chance to articulate their personal beliefs to others, discuss alternatives, clarify meanings, negotiate perspectives, and formalize and objectify their shared understanding in the written article (cf. Fig. 1). Our data does not allow us to make strong conclusions as to whether collaborative knowledge building really occurred in all these groups. Nevertheless, many interviews indicate that several students strove for collaborative knowledge building in their groups and were able to reflect on that.

The COOPERATORS either started to work collaboratively (planning, searching, assessing) but changed to work individually later (reading, writing, editing) or split the work into personal projects from the beginning. Our conclusion is that in both cases the groups did not collaborate in building the epistemic artifact, which is one of the core objectives in the circle of social knowledge building (cf. Fig. 1). Learning by these groups is limited to enhancing personal knowledge in the topic the student was working on. Further, the process has a concrete outcome in the form of the essay, which hardly matches the characteristics of a unified epistemic artifact, but is in fact more like a compilation of loosely related personal texts.

Students' justifications in preferring either cooperative or collaborative strategies were quite different **or** from opposite ends of a dimension. Students favoring cooperation in forms of work delegation and division emphasized efficiency. By efficiency, students mean, for example, that the texts required are completed in time, or that one can personally focus on a limited task and need not care what others are doing in their tasks. Efficiency was also involved when delegation was justified by special competences of one particular person: the activity is completed faster by an expert than a novice. Avoiding collaboration was justified also on the basis of extra effort and time required in achieving a shared understanding or opinion in a group. This seemed to be not just an efficiency issue but also a question of perceived social inconvenience in meeting contradiction in a group. The finding is in line with Meyer's (2011, 234-240) observation that some students try to avoid possible cognitive conflicts in intensive collaboration.

It was interesting to observe that the fair share of work was presented as a justification both in the clusters of cooperators and collaborators. In the groups of collaborators, fairness were measured by equal contribution to the collaborative activity (knowledge building) in terms of discussion and participation in group activities, while the groups of individualists saw that the physical text written separately by each member was the best guarantee in manifesting the fair share of work. The two lines of thinking seem to rest on either trust or mistrust. One student favoring division even explained that in the event of someone failing to write his or her part of the text, the teacher would acknowledge the contributions of others. This finding may be related to those by Bahar (2003) that high achievers prefer working on their own and that they might feel contributions unequal within the group (Pauli et al, 2008). In the groups favoring collaboration, we did not identify any indications of mistrust of others.

The groups favoring collaboration were aware of the extra effort of working together but could accept the risk of lower (technical) efficiency. They emphasized shared responsibility in completing the task and the quality of the process and its outcome. Their comments indicate that individual members perceived that other group members helped them, for example, in searching or in assessing sources and improving their own texts. These groups did not see the interaction with other members socially stressful, but instead emphasized that different viewpoints help to extend and improve the contents of the article. It seems obvious, therefore, that the groups favoring collaboration had a potential to use more time for joint knowledge acquisition and clarification as well as for constructing meaning and knowledge. In the experiment by Kiili et al (2012) this happened in the actively collaborating student pairs who achieved better learning outcomes in terms of higher group essay scores.

The clusters in Table 4 indicate a dramatic difference between the classes of history and literature: seven out of eight groups in the collaborators' clusters came from the literature class. This calls for paying more attention to the design and implementation of learning tasks. What task-related characteristics might explain this difference? Both assignments were part of a mandatory course of the same upper secondary school and participants were at about the same stage in their studies. Thus the context (the school) or the sample of students are unlikely explanations for the difference. Both groups wrote an article in the Wikipedia genre but in practice the tasks were different in various aspects. Some of them have been listed in Sormunen, Eriksson and Kurkipää (2012): subject of the class, broadness of topics, guidelines given, preparing students for information acquisition, interventions by the teacher, etc. However, a more detailed analysis is needed to reveal the connections between learning task characteristics and adopted group

work strategies. Earlier studies also suggest that various practical choices made by the teacher affect the student's collaboration activity (cf. Kuiper et al, 2009).

The problems related to the lack of leadership in the group (van Aalst et al, 2007; Jun & Pow, 2011; Pauli et al, 2008) did not arise as a real issue in our data. Each group had a leader who was responsible for reporting work done at some points in the project. Several group members gave credit to the leader student for his or her role. In one group we could see that one member was taking on the roles of both a leader and an active worker, resulting in an unequal division of workloads.

Saleh & Large (2011) and Hyldegård (2009) have reported findings on group work strategies adopted by the teams of undergraduate and graduate students. Both studies suggest that some academic student teams are capable of combining elaborate cooperative and collaborative strategies typical of professional teams. Teams allocate subtasks to individuals but the outcomes of individual efforts are brought into the collaborative treatment of the team. Complex problems were discussed in the team and often solved as a team, but we could not see this happening in our groups of cooperators. One explanation may be the relatively short duration of the courses where the students worked under time pressures. The primary idea of cooperation was to replace the perceived time consuming collaboration with separate personal efforts and by merging straightforwardly the personal pieces of texts into the submitted article (the principle of least effort).

## Conclusions

The findings of this study demonstrate that schools face severe problems in group assignments on source-based writing. In most groups we studied, the school's practice in designing and conducting collaborative learning tasks did not lead to the desired collaboration in learning. Many student groups replaced collaboration by loose cooperation and missed the possibility of discussing the alternative viewpoints on the topic, and different ways of constructing meaning and knowledge. From the perspective of knowledge-building pedagogy (Scardamalia & Bereiter, 2006), a great deal of the social potential of learning was wasted.

Information literacy can be credibly defined as a set of personal abilities (Iannuzzi, 2000) or as a sociotechnical practice (Tuominen, Savolainen & Talja, 2005). However, information literacy as a learning object can hardly be achieved effectively if the social context of learning is neglected. This can be seen where Limberg (1999) and Limberg, Alexandersson, Lantz-Andersson and Folkesson (2008) have emphasized how the context ('school culture') shapes

students' information practices in learning assignments. These views are in harmony with the goal of the knowledge-building pedagogy enhancing the state of knowledge (in a broad sense) of the community (Scardamalia & Bereiter, 2006).

The teacher is the core player in the development of information literacy instruction in schools (this is a justified statement and acknowledges the essential roles of school librarians, principals and other actors in school). In the classroom, the learning assignment is the main instrument the teacher can use to create a favorable learning environment for students to work in. Our findings call for research on different designs of learning assignments in collaborative information literacy instruction.

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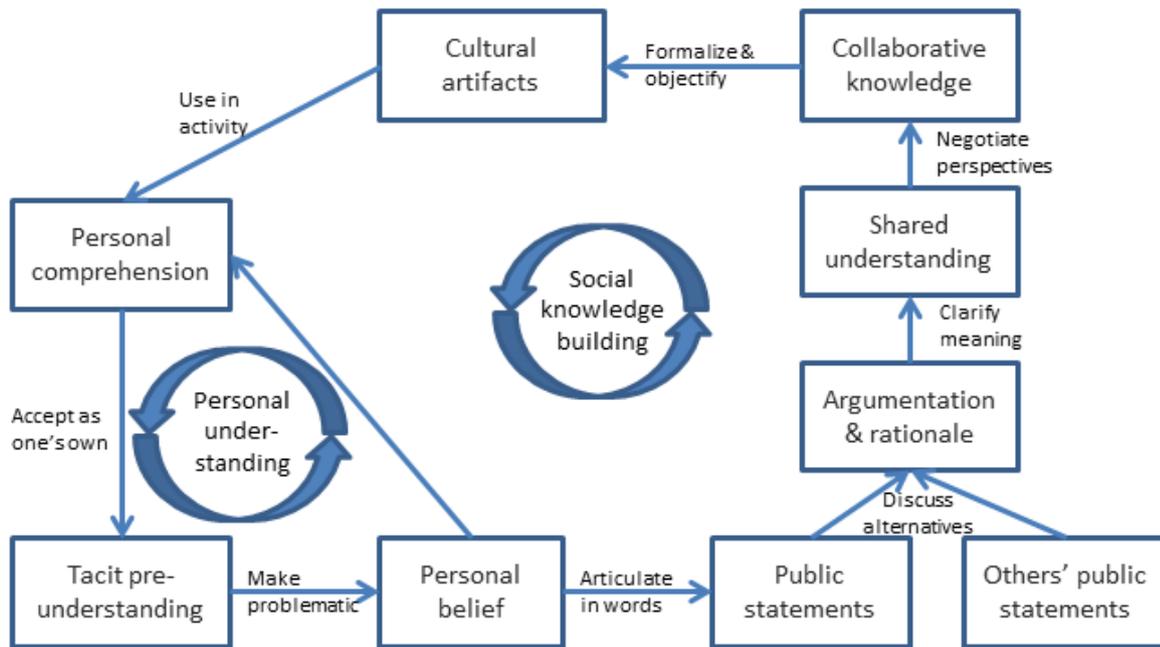


Figure 1. A diagram of knowledge-building processes (redrawn from Stahl 2000).

TABLE 1. The group work strategies

Aggregate strategies	Strategy	Description
Cooperative	Delegation	One group member was responsible for the whole activity.
	Division	The performance of the activity was divided between group members into individually completed subtask.
Collaborative	Pair collaboration	Two group members worked as a pair on the same activity.
	Group collaboration	At least three team members worked together on the same activity.

TABLE 2. The popularity of group work strategies

Group work strategy	Planning (n=17)	Searching (n=16)	Assessing sources (n=17)	Reading (n=11)	Writing (n=17)	Editing (n=15)	Average
A. Delegation	0	2	2	0	1	6	1.8
B. Division	11	<b>15</b>	11	6	<b>15</b>	6	10.7
C. Pair collaboration	5	4	2	3	4	4	3.7
D. Group collaboration	11	9	11	3	5	8	7.7
Dominating strategy	B,D	B	B, D	B	B	A, B,D	B
# of str per group	1.5	1.9	1.5	1.1	1.5	1.5	1.5

TABLE 3. All strategies applied by student groups in different activities (A = delegation; B = division; C = pair collaboration; D = group collaboration).

Group	Planning	Searching	Assessing information	Reading	Writing	Editing	Dominant strategy ( $\geq 3$ )
H1	B	B + D	B + D		B	B	B
H2	B + C	B + C	B + C	C	B + C + D	A + D	C
H3	B + D	B	B		B	E	B
H4	B	B + D	B + D		A + B	B	B
H5	B + D	B	B + D		B	B	B
H6	B + D	B + C	B	B	B	B	B
H7	B	B	B	B	B + D		B
L1	D	B + D	A + D		B	A + B + D	D
L2	D	B + D	D	D	D		D
L3	C + D		B + D	C	B + C + D	C + D	C/D
L4	B + C	A + B + D	A		B + C	A + D	A/B
L5	D	B + C + D	B + D	B	B	A	B/D
L6	C + D	B	C	B + C	B + C	C	C
L7	B + D	B	D	B	B	A	B
L8	B + D	B + D	B + D	B	B	A + C + D	B
L9	D	A + D	D	D	D	D	D
L10	B + C	B + C + D	B + D	D	B	B + C + D	B
Dominant strategy	D	B	B/D	B	B	B/D	B/D

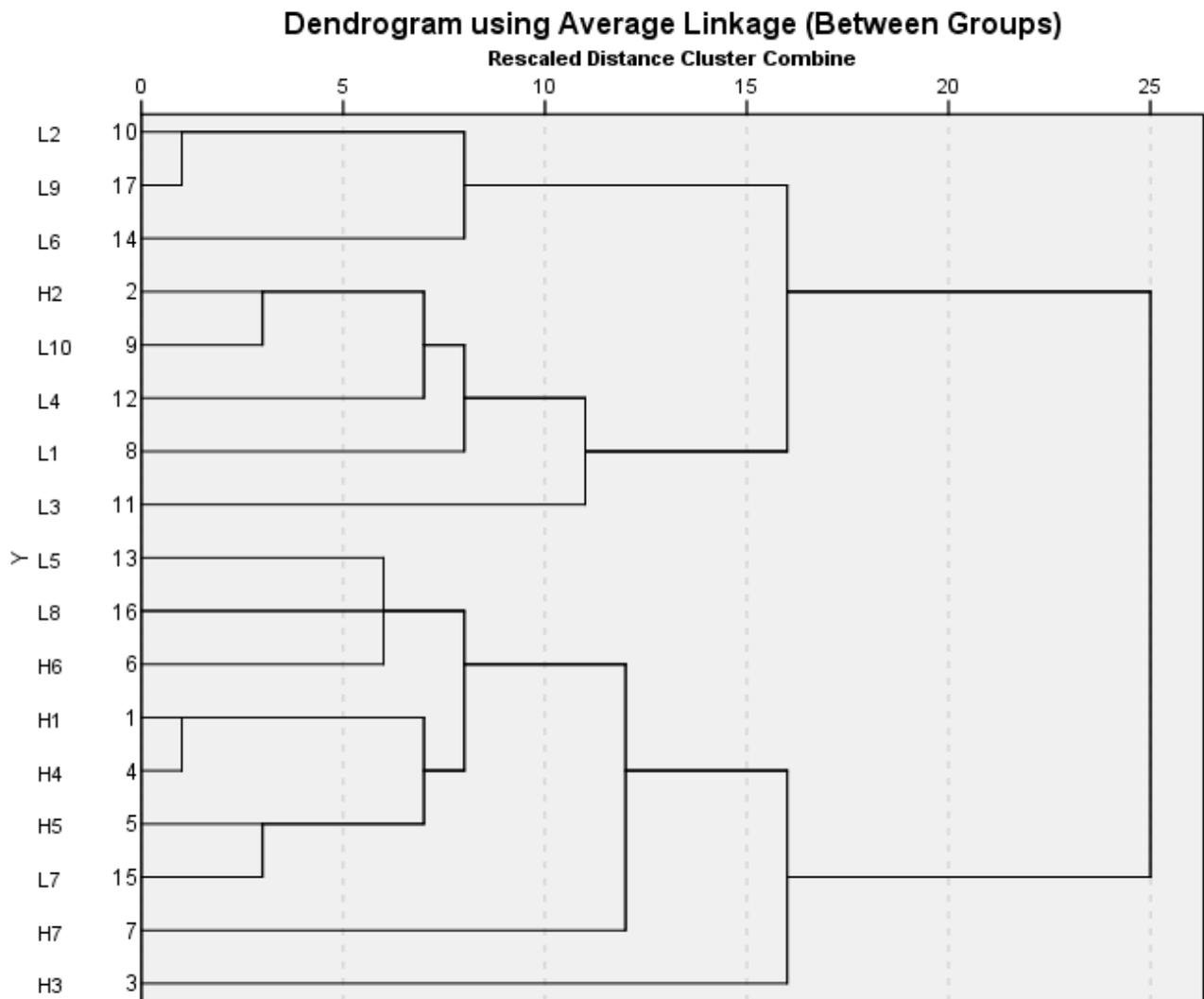


FIG 2. Dendrogram of patterns in group work strategies.

TABLE 4. Summary of group work strategies (COOP = delegation or division or work only; COLL = pair or group collaboration only; MIXED = a combination of COOP and COLL strategies).

Group	Planning	Searching	Assessing	Reading	Writing	Editing	Clusters
L2	COLL	MIXED	COLL	COLL	COLL		COLLABORATORS 1
L9	COLL	MIXED	COLL	COLL	COLL	COLL	
L6	COLL	COOP	COLL	MIXED	MIXED	COLL	
H2	MIXED	MIXED	MIXED	COLL	MIXED	MIXED	COLLABORATORS 2
L10	MIXED	MIXED	MIXED	COLL	COOP	MIXED	
L4	MIXED	MIXED	COOP		MIXED	MIXED	
L1	COLL	MIXED	MIXED		COOP	MIXED	
L3	COLL		MIXED	COLL	MIXED	COLL	COOPERATORS 1
L5	COLL	MIXED	MIXED	COOP	COOP	COOP	
L8	MIXED	MIXED	MIXED	COOP	COOP	MIXED	
H6	MIXED	MIXED	COOP	COOP	COOP	COOP	
H1	COOP	MIXED	MIXED		COOP	COOP	
H4	COOP	MIXED	MIXED		COOP	COOP	
H5	MIXED	COOP	MIXED		COOP	COOP	
L7	MIXED	COOP	COLL	COOP	COOP	COOP	COOPERATORS 2
H7	COOP	COOP	COOP	COOP	MIXED		
H3	MIXED	COOP	COOP		COOP	COLL	