

# Students' collaborative inquiry – relation to approaches to studying and instructional intervention

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## Abstract

In order to develop suitable pedagogical methods for inquiry based learning we need an increased understanding of factors that influence students' work in inquiry assignments. The aim of this study was to investigate how high school students' ways to work in a collaborative source-based writing assignment was influenced by their individual approach to studying and the teacher's instructions and guidance in the class. The respondents were 53 high school students who filled out a questionnaire regarding their work on the source based assignment and the OPPI test of their approaches to studying. A factor analysis revealed three work patterns: a collaborative, a labor intense and a subject oriented. The results showed that the collaborative pattern was related to instructional differences, while a subject oriented work pattern was typical for students with a deep approach regardless of instruction. Instructional differences and study approaches also influenced degree of challenges in the project and, to a certain extent, learning experiences. The findings show a complex interplay between personal preferences and instructional interventions in forming students' paths through source based writing assignments.

## Keywords

Inquiry learning; approaches to studying; instruction; high school students; individual differences; collaboration; group work assignment; quantitative analysis

## 1. Introduction

New pedagogical models of inquiry learning are currently being developed in response to a changing information landscape. One such model is Guided Inquiry, based on Kuhlthau's information search process [1], which describes supported inquiry learning where students build their understanding by actively engaging with diverse information sources [2]. Similarly, knowledge-building pedagogy stresses the importance of both declarative and procedural knowledge as students develop their topical understanding through information seeking, evaluation, sharing, and use [3]. Knowledge building pedagogy builds on the premise that students of today, for the first time in history, have an opportunity to actively take part in global knowledge building processes on the Internet. A core argument in knowledge-building pedagogy is the role of discussion and interaction in building a nuanced understanding of a topic [3].

One important step in developing inquiry pedagogics is to increase our understanding of students' responses to inquiry. Source-based writing assignments are inquiry tasks that aim to develop procedural knowledge in finding, evaluating and using information sources alongside topical knowledge construction. Despite a plethora of work on students' information behaviour we still lack a detailed understanding of how students proceed through source-based assignments, the challenges they encounter along the way and how these processes influence their learning experience. Of particular importance for the development of inquiry based pedagogics is to understand mechanisms behind students' work patterns and experiences. This paper will address this research gap by describing findings from a study of high school students' work in a collaborative source-based writing assignment. The emphasis will particularly be on how students' approaches to studying and instructional interventions played out in students' work patterns and experiences.

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## 2. Literature review

Source based writing assignments, such as the ones reported here, are often undertaken as group-work. Independent inquiry into conflicting viewpoints and alternative information sources is often in contrast with traditional schooling which centers around “right answers”. It is therefore common that students proceed in this familiar mindset of searching right answers or facts also in inquiry tasks [4]. Group discussions, which broaden awareness of different perspectives, is one way to counteract this, as they often result in deeper information processing and knowledge construction [5]. Another benefit with group work concerns the challenge of focus formulation. Kuhlthau’s [1] information search process (ISP) describes students’ behavioral, affective and cognitive iterative processes as they proceed through inquiry projects. Students’ initial optimism and enthusiasm often turns into confusion and anxiety as they run into a multitude of information and alternative angles to the topic. An essential step is therefore formulation of a specific focus, which tends to clarify thoughts and renew enthusiasm. This step does not, however, always take place. At times students rush through the explorative stage and formulate a false focus, which in turn obstruct their learning process [1]. Discussions with team members [6] or others ([7, 8, 9]), can substantially facilitate focus formulation in inquiry projects. Various groups, nevertheless, vary in the depth of their information processing and use. Kiili and her colleagues [5] distinguish between *collaborators* who mainly work on acquiring information and *co-constructors* who construct meaning from texts. Strong involvement by the teacher in facilitating collaborative processes is often a crucial element for students’ degree of collaboration, motivation and consequent learning [10].

Enough time for thorough involvement with information sources is an important factor for successful inquiry [11]. Too open assignments and time pressure often persuade students to resort to a false focus in order to cope with formal requirements [12]. Similarly students typically orient towards the final product instead of the ongoing learning process [4, 13]. They commonly simplify search tasks and use minimal effort [14, 15]. It is therefore important that the teacher clarifies the goal of inquiry tasks and carefully guides the students through the process. Important elements include finding manageable research questions for the projects and critical evaluation of sources [16].

Despite general trends in students’ information behavior in source-based assignments, individual differences and preferences can also substantially influence motivation and work paths. Approaches to studying [17] has long been recognized as important in students’ information behavior [18]. It has, among other, been found to influence middle and high school students’ challenges and learning experiences in inquiry projects [19]. An approach to studying is a mindset about what it means to learn, motivation behind learning processes and ways to study [17]. These preconceptions of learning and studying often carry over from project to project and influences what the student pays attention to. Students with a deep approach have an intrinsic motivation to learn and relate new information to their previous understanding of a topic. Students with a surface approach to studying often find learning challenging and fragmented. They have an extrinsic study motivation, and often study by rote learning. Strategic students are organized and efficient, and above all strive for achievement in their educational pursuits [20].

In inquiry projects high school students with a surface study approach have been found to quickly proceed through the task, completing only the necessary requirements. Deep high school students often try to find a personal angle to their topics by relating it to previous knowledge or interest. They are also more concerned about information quality than others as they strive to gain a personal understanding through the project, not merely compiling facts. Students with a strategic approach to studying, in turn, pay particular attention to organizational aspects [19]. Similar connections to motivation have been found among university students, where extrinsically motivated *minimalists* regard writing as a routine task based on quickly available material, while *performing* university students are goal-oriented, hardworking, systematic and abide by task requirements [21]. McDowell [21] found that intrinsically motivated *gathering* university students enjoy exploring. She, however, observed that they struggle with focus formulation and writing. Intrinsically motivated *connecting* students had a more clear sense of direction. They linked what they learnt to their previous understanding, wrote alongside searching, and enjoyed discussing about their topics. Connecting students particularly focused on developing their own interpretations and ideas. They regarded assignments as personal learning opportunities, rather than as contexts to which they needed to adapt [21]. Deep and strategic university students usually enjoy problem-based learning and are also efficient in managing their time, workload and self-directed learning [22]. A study among university

students showed that those with a deep orientation were less fact driven than others. Instead deep students enjoyed exploration and took a holistic approach to their studies [23].

The interplay between instructional design and personal preferences in inquiry learning has been addressed in a few prior studies. Balasooriya, Hughes & Toohey [24] found that an attempt to design the curriculum as to encourage a deep approach polarized students, so that although many did adopt the encouraged deep approach, some became even more surface-oriented than before. The authors concluded that previous learning experiences, learning preferences and cognitive development may override the impact of curriculum design in the learning process. It should, however, be noted that opposite trends have also been found. An example is Hyldegård's study [25], where she found that group work overrides individual tendencies in the information search process.

Stahl [26] has emphasized that the personal and the social interact in collaborative knowledge building. In this study we follow the same line of thought and analyze students' ways of working in a collaborative assignment from the individual learner's viewpoint. We try to reveal if students have different ways to combine individual effort and social interaction in conducting a group assignment. If patterns are found, we attempt to understand mechanisms that may influence these patterns, in terms of possible contextual influences (in this case the course context where the students worked with a specific emphasis on teacher instruction) and individual differences (general approaches to studying). We are also interested in whether contextual and personal factors influence students' experiences of challenges and learning in the process.

### 3. Research questions

- (1) Are high school students' ways of working on the source-based writing assignment related to a) instructional interventions and/or b) approaches to studying? If so, how?
- (2) Are challenges in the project related to a) instructional interventions and/or b) approaches to studying? If so, how?
- (3) Are students' learning experiences related to a) instructional interventions and/or b) approaches to studying? If so, how?

### 4. Method and material

#### 4.1. Data

Data was collected from two eight-week courses in an upper secondary school in Tampere, Finland, during spring term 2011. 30 students organized into ten groups (three members in each) completed a course in Finnish literature. 28 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.

#### 4.2. Course context

The students were asked to collaboratively write an article to be published on Wikipedia (Finnish literature) or the school's local wiki (History). In both courses, the assignment was designed to follow Wikipedia's conventions and requirements for authors. In both courses, student groups selected a topic for their article from a list prepared by the teacher. A group leader was chosen for each group. In instructing the group leader the History teacher mentioned that his/her responsibility was to delegate tasks within the group. The history teacher's general instruction to the class focused on information use, such as citing sources. In the Finnish Literature class the teacher instructed the students more specifically to write the text together.

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

In the history course, the teacher had prepared topics that dealt 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

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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 and had collected materials from the library collection for the students' use. The teacher in Finnish Literature provided her students with additional information sources.

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 online information sources and to write text for the articles under the teacher's supervision. In the history course the regular teacher was replaced by a substitute teacher during two lessons. The teachers designed, introduced, and implemented the assignment by applying their personal professional preferences and practices. Our earlier findings [27, 28] indicated that the History teacher's design could be interpreted as rather traditional. The History teacher did not pay attention to guiding the students through the first stages of their assignment, something which has been pointed out as important in, for instance, the Guided Inquiry framework (see [29]). The Literature teacher, on the other hand, designed special activities and guided students intensively during these stages. We thereby selected instructional design (traditional vs. guided inquiry) as an independent variable in our study.

### 4.3. Instruments

We collected data from the students by individual questionnaires and interviews undertaken in groups. This paper will focus on survey questions regarding the students' approach to studying, ways to work, challenges and learning experiences. 53 students answered these questions. Approaches to studying were explored by the OPPI test [30], a version of the ASSIST test [31] in Finnish. OPPI measures a deep, surface and strategic approach to studying by four items each. Reliability of the scales was explored by Cronbach alpha, giving the following results: deep approach (.66), surface approach (.73) and strategic approach (.75). As approaches to studying have been found to be related to context the students' approaches to studying was compared to a possible influence of the course context through an independent sample t-test. No significant relation was found and it was therefore concluded that students' approaches to studying were independent of the course context in this study.

Ways to work was measured by 18 statements (*see appendix 1*) on a Likert scale from 1 (I did this) to 3 (I did not do this). Challenges (*see appendix 2*) were measured by 13 statements on a Likert-scale from 1 (very easy) to 5 (very difficult). Learning experiences (*see appendix 3*) were measured by 11 statements on a Likert-scale from 1 (I did not learn anything (about this)) to 5 (I learnt very much (about this)).

The research questions were explored through statistical analyses (factor-analysis, correlation and categorical regression analyses) using the SPSS software.

### 4.4. Students' work patterns

Research question 1 dealt with the students' way of working on the project and the possible influence of approach to studying or instructional interventions. Ways of working on the collaborative source-based project was measured by 18 individual items. We therefore begun our investigation by an explorative factor analysis to test whether patterns could be found among aspects of working on the task. The results of a principal component analysis with a varimax rotation resulted in three factors that together explained 47 % of the variance (Table 1). The three factor solution was chosen based on a screen plot of eigenvalues. Additional factors would not have added explanatory value to the analysis. We decided to allow for cross-loadings to show the partial overlap among the factors.

Three factors emerged from the analysis: a collaborative, a labor intense and a subject oriented pattern. Regression factor scores were created for each factor to be used in the consequent analyses:

- (1) In the collaborative pattern students discussed sources with the teacher and team-members, wrote their text collaboratively, asked for comments on their writings and reworked their text accordingly.
- (2) The labor intense factor brought together statements that described an organized and source intense way to work on the project. This factor loaded negatively on group-work in school, but positively on discussing at home and asking parents for comments.
- (3) The subject oriented factor particularly emphasized discovery of new content and learning the subject matter. These students leaned closely on sources and checked their notes while writing. They worked individually and did not interact with their team, teacher or parents in their learning process.

**Table 1.** Factor-analysis of ways to work in the source-based writing assignment, 3-factor solution.

Statements	Collaborative	Labor intense	Subject oriented
I asked the members of my group to comment on my text.	<b>0.84</b>	-0.05	-0.03
I asked the teacher to comment on my text.	<b>0.80</b>	0.07	0.02
I wrote the text together with my team.	<b>0.78</b>	-0.17	0.22
I read the information sources and discussed about them in the group.	<b>0.76</b>	-0.23	0.14
I corrected my text based on comments.	<b>0.69</b>	0.19	0.09
I read the material and discussed about it with the teacher.	<b>0.69</b>	0.02	-0.20
I read my text many times and added to it.	<b>0.43</b>	<b>0.40</b>	0.18
I read the information sources and underlined/marked interesting parts.	<b>0.22</b>	<b>0.12</b>	-0.16
I continued to look for information while I was writing.	-0.09	<b>0.71</b>	0.07
I read the information sources and discussed about them at home.	-0.05	<b>0.63</b>	-0.04
I asked others (e.g. parents) for comments.	-0.23	<b>0.61</b>	-0.04
I adjusted my text to the texts of the group members.	<b>0.50</b>	<b>0.58</b>	-0.23
I tried to get an overview of the assignment before beginning to write.	0.18	<b>0.52</b>	0.15
I took notes while I read the texts.	0.09	<b>0.50</b>	0.23
I checked my notes while I wrote.	0.10	0.19	<b>0.80</b>
I wrote based on reading the material, but from memory.	0.07	0.08	<b>-0.54</b>
I read the information sources and tried to understand their content.	0.05	0.35	<b>0.52</b>
I know the topic from before and wrote based on that prior knowledge.	-0.04	-0.04	<b>-0.50</b>
Variance explained	23 %	14 %	10 %

## 5. Results

### 5.1. The relation between the work patterns and independent variables

In order to answer research question 1, the influence of approaches to studying and instructional interventions on work patterns was explored through a linear regression analysis. We chose a categorical analysis as the dichotomous variable “course” (History or Finnish Literature) was included in the analysis. As our interest lied in the instructional differences between the two courses (as reported elsewhere [27, 28]), we named the variable “instruction”.

The regression analysis showed that the instructional interventions significantly predicted a collaborative work pattern (table 2). Students in Finnish Literature received higher scores than those in the History course on the collaborative work pattern. A deep study approach significantly predicted a subject oriented work pattern, while there was a negative link between a subject oriented work pattern and a strategic approach to studying. There was no significant relation between the labor intense pattern and the background variables.

**Table 2.** Regression analysis of work patterns with instructional interventions and study approaches as independent variables. Only significant results are shown in the table

Work patterns	$\beta$	History M (SD)	Literature M (SD)	Adj. R2	F
Collaborative				0.52	8.23**
Instruction	0.68	-0.74 (0.54)	0.64 (0.85)		
Subject oriented				0.27	4.2**
Deep approach	0.44				
Strategic approach	-0.38				

\* $<.05$ , \*\* $<.01$

## 5.2. The relation between challenges in the project and independent variables

Research question 2 investigated whether challenges in the project could be related to students' approach to studying and/or instructional interventions. This connection was explored through linear regression analyses (table 3).

**Table 3.** Regression analysis of challenges in the project with instructional interventions and study approaches as independent variables. Only significant results are shown in the table.

Challenges	$\beta$	History M (SD)	Literature M (SD)	Adj. R2	F
Understanding the goal of the project				0.30	4.7*
Instruction	0.43	2.92 (0.97)	2.29 (0.90)		
Surface approach	0.32				
Planning the content of the article				0.50	9.6**
Instruction	0.71	3.25 (0.94)	2.1 (0.66)		
Finding relevant material in the school library				0.23	3.7*
Strategic approach	-0.43				
Instruction	0.43	3.67 (0.96)	3.14 (0.76)		
Forming an overview of the topic based on the information sources				0.23	3.6*
Instruction	0.45	2.92 (1.14)	2.43 (0.79)		
Deep approach	-0.37				
Planning my own share of the text				0.16	2.69*
Instruction	0.43	3.08 (1.1)	2.39 (0.79)		
Referring to sources and noting references				0.17	2.73*
Instruction	0.34	2.5 (1.1)	3.14 (0.89)		
Publishing the text on Wikipedia/wiki				0.31	4.91*
Instruction	0.53	2.33 (1.2)	3.07 (1.1)		
Strategic	0.34				

\* $<.05$ , \*\* $<.01$

Students in the History class found information seeking in the school library significantly more challenging than students in the Finnish Literature class. Students in the History class also struggled more than those in Finnish Literature with analytical aspects of the assignment, such as understanding the goal of the project, planning the content of the article, forming an overview of the topic and planning their own share of the text. Students in Finnish Literature, on the other hand, found mechanical aspects, such as publishing their text on Wikipedia and referring to sources, difficult.

Students with a deep approach to studying did not find forming an overview of the topic difficult. Surface students found it difficult to understand the goal of the project. Students with a strategic

approach found publishing the text on Wikipedia/wiki difficult, while finding relevant material in the school library was easy for them.

### 5.3. The relation between learning experiences and independent variables

Research question 3 investigated whether learning experiences could be related to students' approach to studying and/or instructional interventions. The results showed that few of the learning experiences were related to the independent variables (table 4).

The results show that students in the History class and those with a strategic approach had experienced that they had learnt more about information seeking in the public library and/or the public library catalogue. Students with a strategic approach are achievement oriented and may pay attention to information seeking in the library for its utilitarian value in the future. Students with a deep study approach, in turn, felt that they had learnt more about information seeking online.

## 6. Discussion

The findings showed that both approaches to studying and instructional interventions influenced students' work patterns and challenges in the project but to a lesser degree their learning experiences.

**Table 4.** Regression analysis of learning experiences with instructional interventions and study approaches as independent variables. Only significant results are shown in the table.

Learning experiences	$\beta$	History M (SD)	Literature M (SD)	Adj. R <sup>2</sup>	F
Information seeking in the public library/public library catalogue				0.21	3.3*
Strategic approach	0.30	2.92 (0.97)	2.29 (0.90)		
Instruction	0.33				
Information seeking on the Internet				0.22	3.5*
Deep approach	0.44				

\* $<.05$ , \*\* $<.01$

In the Finnish literature course, where the teacher specifically had instructed students to work closely together, the most common work pattern was a collaborative one. Students characterized by the collaborative pattern worked in close cooperation on the assignment discussing sources, commenting each other's texts and writing together. They also asked the teacher to comment on sources and texts. These students only reported challenges related to mechanical work tasks such as publishing the articles on Wikipedia and referring to sources. This suggests that the project advanced smoothly. In results reported elsewhere we found that the teacher in the Finnish Literature course was significantly more involved in the students' work throughout the process [28]. In the History class the students were much left to work on their own, and struggled with analytical difficulties, such as understanding the goal of the course and finding a personal angle to the topic. These challenges suggest difficulties with focus formulation [1] and indicates the need to guide students, especially at the early stages of the assignment [29]. The topics were, moreover, quite extensive and the time frame for the project short. The detrimental influence of time pressure on inquiry learning, and the consequent importance of course design and realistic assignments have been emphasized elsewhere [12].

In the History class, the teacher did not design special activities for the early stages of the assignment [28], guided students less [27], and was replaced by a substitute teacher during two lessons. The lack of proper instruction and a too loose course design seems to explain why History students struggled to grasp the goal of the project and found it difficult to find a personal angle of the topic with a manageable scope. Despite closer instruction and the collaborative context, however, students in Finnish Literature did not report strong learning experiences. Instructional differences in the courses only influenced the learning experience of information seeking in the library. Despite that there was a substantial difference between the courses in the degree of

collaboration, and how challenging the students found analytical aspects, this did not seem to play out in learning experiences.

The subject oriented work pattern where students particularly focused on learning more about the subject area, as opposed to other aspects of source-based writing, was positively linked to a deep study approach but negatively linked to a strategic one. Previous research has found that intrinsically motivated students enjoy exploring topics and focus on developing their own thinking around the subject area [21]. As they develop a personal ownership of the topic this interest may at times make them overlook context specific demands. Typical for deep students is to strive for a personal understanding of a topic by linking learning experiences to previous topical understanding and combining subject areas to wholes. This analytical way to approach learning may result in a meta-cognitive awareness of how topics link together. These students consequently found it easy to write an overview of the topic based on their readings. Strategic students, on the other hand, approach their learning process more through achievement-orientation than intrinsic motivation. They may therefore focus less on learning about the subject area in source-based assignments and pay particular attention to project specific elements in their ambition to gain a good grade. Strategic students had no problems finding information in the school library, but found Wikipedia/wiki publishing difficult. Although Wikipedia/wiki publishing was likely to be a new project element for most students, and thus challenging, it may be that strategic students are particularly alert to this challenge, as it is more important for them to overcome challenges and succeed in their assignment. Students with a surface approach to studying found it difficult to understand the goal of the project. Surface students often have a fragmented and disconnected view of the topics they study. They tend to struggle in their learning process and mainly study by rote learning. They often view source-based assignments as a quick compilation of material [21] and may therefore find it difficult to understand the purpose of the task.

The findings are based on two learning assignments on Wikipedia authoring. The design and implementation of assignments vary from class to class and from school to school and have an effect on students' working paths through the assignment. One should be careful not to generalize the findings beyond these two cases. It should also be noted that the descriptions of work patterns were limited to the items in the questionnaire. Another limitation is that the work patterns were based on a factor analysis that explained less than 50 % of variance.

We chose a quantitative approach in our study to meet our aim of finding general trends in the students' work on the assignment, and particularly to link these trends to background factors. By applying a quantitative approach, however, we could only get an overview of the students' work patterns. In future research a qualitative approach would be beneficial to enlighten, for instance, the motivations behind the students' choices. We can, moreover, not be sure that the students in actuality did as they reported on the questionnaire. During data collection we underlined that the students were anonymous and that data was collected solely for research purposes. Despite this, there is a risk that the students responded as they thought was expected from them. This risk is pertinent as the questionnaires were filled out in a school setting where students are used to respond to tests with correct answers. As our results, however, suggests trends that are feasible, we would like to believe that this add validity to the study.

## 7. Conclusions

We can conclude that instructional interventions and personal preferences in terms of study approaches influenced different aspects of the students' project experience. The teachers had paid particular attention to instructing students in the project specific elements while students' own study approaches influenced their way of learning about the subject area. Instructional differences particularly played out in elements specific for the collaborative source-based assignment such as degree of collaboration, working with information sources and developing a focus. A too loose course design with extensive projects to be undertaken within a short time frame and lack of instructional guidance resulted in the students feeling lost and struggling with focus formulation. There were, however, also individual differences that could increase the risk of analytical difficulties regardless of course design, such as those of surface students who struggled with creating a holistic picture of the studied areas.

Extrinsically motivated students found it difficult to understand the purpose of this non-conventional study format, while intrinsically motivated deep students focused particularly on building a personal understanding of the topic by linking together content. Achievement-oriented

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strategic students were particularly focused on practical elements of the project as opposed to e.g. learning more about the subject area. The approaches to studying framework was developed in a more traditional learning environment where the student had a limited access to information sources and the goal of learning was more specifically focused on learning more about the subject area. McCune & Entwistle [32] have argued that our new complex information landscape calls for an extension of the study approach framework towards the importance for students to cultivate a disposition to understand for oneself, which includes and goes beyond the traditional deep and strategic approach. Our results support this notion as students with a combination of a deep and a strategic approach seem best equipped for inquiry based learning. This in turn supports their development into information literate citizens.

To conclude, the findings show a complex interplay between personal preferences and instructional interventions in forming students' paths through source based writing assignments. Both individual differences and instructions had their own impact on the ways students navigated through the assignment. For students' learning experience the involvement of the teacher is essential both in closely guiding the students through the assignment and in acknowledging students' individuality in preferences and challenges.

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## Appendix 1. Survey questions on ways to work on the assignment

Question: How did you work on the assignment? Scale: 1) I did this; 2) I partly did this; 3) I did not do this

- (1) I read the information sources and tried to understand their content.
- (2) I read the information sources and underlined/marked interesting parts.
- (3) I took notes while I read the texts.
- (4) I read the information sources and discussed about them in the group.
- (5) I read the material and discussed about it with the teacher.
- (6) I read the information sources and discussed about them at home.
- (7) I tried to get an overview of the assignment before beginning to write.
- (8) I know the topic from before and wrote based on that prior knowledge.
- (9) I wrote based on reading the material, but from memory.
- (10) I checked my notes while I wrote.
- (11) I wrote the text together with my team.
- (12) I continued to look for information while I was writing.
- (13) I read my text many times and added to it.
- (14) I asked the members of my group to comment on my text.
- (15) I asked the teacher to comment on my text.
- (16) I asked others (e.g. parents) for comments.
- (17) I corrected my text based on comments.
- (18) I adjusted my text to the texts of the group members.

## Appendix 2. Survey questions on challenges

Question: How difficult or easy did you experience this phase or task? Scale: 1) Very easy; 2) Fairly easy; 3) Neutral; 4) Quite difficult; 5) Very difficult

- (1) Understanding the goal of the project
  - (2) Planning the content of the article
-

- (3) Finding relevant material in the school library
- (4) Finding relevant material in the online catalogue of the public library
- (5) Finding relevant material online
- (6) Deciding whether the information sources were relevant for my topic
- (7) Forming an overview of the topic based on the information sources
- (8) Planning my own share of the text
- (9) Writing my own text based on the information sources
- (10) Referring to sources and noting references
- (11) Adjusting my own text to the text of others
- (12) Writing for Wikipedia/wiki
- (13) Publishing the text on Wikipedia/wiki
- (14) Something else? \_\_\_\_\_

### **Appendix 3. Survey questions on learning experiences**

Question: How much did you learn about the following? Scale: 1) Nothing; 2) A little; 3) Neutral; 4) A lot; 5) Very much

- (1) Subject area
- (2) Information seeking in the school library
- (3) Information seeking in the public library/public library catalogue
- (4) Information seeking on the Internet
- (5) Using new types of information sources
- (6) Comparing and evaluating information sources
- (7) Noticing different perspectives from sources
- (8) Differences between Wikipedia-articles and other information sources
- (9) Source-based writing
- (10) Referring to sources
- (11) Wikipedia/wiki
- (12) Other, what? \_\_\_\_\_