

Supporting University Students' Argumentative Source-based Writing

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Abstract

Argumentative writing from sources is a literacy practice that students commonly find challenging. The present article reports a descriptive study where students' source-based writing in small groups was supported with either print-based or digital scaffolding. Students analyzed source texts given to them and used their analysis to compose a position paper on a controversial educational topic. Position papers were analyzed for depth and breadth of argumentation, stand and justifications, degree of transformation of source texts' argumentation, and structure. The study suggests that students in both scaffolding groups were fairly capable of identifying relevant reasons representing various perspectives on the topic in source texts and using them to build an argument in their position papers. However, students seldom transformed the arguments by adding their own thoughts or connecting arguments across the texts. Further, quite a few students seem to struggle in structuring their essays: 41% of essays in the print-based scaffolding group and 24% of essays in the digital scaffolding group were unstructured. Instructional implications are discussed.

Keywords

argumentation, multiple document literacy, representational tools, writing from sources, higher education, scaffolding

1. Introduction

Writing from sources is a common practice in higher education and a central means for learning in many disciplines (Ellis, Taylor, & Drury 2005). Source-based essays are also important indicators of students' understanding of source texts (Weston-Sementelli, Allen, & McNamara 2018) and their ability to integrate and communicate multiple perspectives represented in source materials (Anmarkrud, Bråten, & Strømsø 2014; Mateos et al. 2018).

Unfortunately, many students entering higher education are not well prepared for the demands of academic, source-based writing (Wingate 2015), nor the argumentative culture of universities (Graff 2003). As tasks that combine reading and writing require a lot of practice (Grabe & Zhang 2013), there is a clear need to provide opportunities and support for practicing source-based writing as an integral part of learning in various academic disciplines (Wingate 2006, 2015). In the social sciences, argumentative source-based writing that explores different viewpoints on controversial issues is one important area where students need support (Granado-Peinado, Mateos, Martin & Cuevas 2019; Wingate 2012).

To answer this need the present article reports a study where students' source-based writing in small groups was supported with either print-based or digital scaffolding. The study was embedded in an educational science course during which students analyzed source texts given to them and used their analysis to compose a position paper on a controversial educational topic. The study sought to explore how students build an argument in their joint source-based position papers and how they structure their papers when using either digital or print scaffolding.

2. Argumentative writing from sources

Academic source-based writing is an activity in which reading and writing practices are intertwined (c.f. Mateos & Solé 2009). Spivey and King (1989) term tasks that require moving back and forth between reading and writing *hybrid tasks* (Spivey & King 1989). When writing from sources, learners engage in a complex process during which they select, organize, and connect content from source texts (Martinez, Mateos, Martín, & Rijlaarsdam 2015; Spivey & King 1989). In the selection process, learners determine the degree of importance of the information in the sources. During the organizing process, learners look for keys in the sources that would enable them to group ideas. Finally, learners connect various pieces of information from the source texts with each other and with their prior knowledge (Perfetti, Rouet, & Britt 1999).

These processes of linking up various pieces of information from source texts are of especial importance in argumentative writing. The writer is required, first, to select and analyze arguments from the source texts, second, to construct a position by comparing and contrasting these arguments, and finally to present that position in a coherent manner (Wingate 2012). These skills are highlighted when students engage in collaborative source-based writing where they are expected to synthesize various competing arguments (c.f. Cuevas et al. 2016) by negotiating the meanings presented in the source texts, discussing different viewpoints, and weighing alternative solutions (Kiili, Laurinen, Marttunen, & Leu 2012; Newell, Beach, Smith, & VanDerHeide 2011; Salminen, Marttunen, & Laurinen 2010). According to Mateos et al. (2014), hybrid tasks are demanding for students: in source-based writing, the writer has to consider how to express the source content in his/her own words without ignoring the author's voice. During

source-based writing, writers must also make decisions about which organizational structure to adopt to best integrate information from different sources, a process that may lead to the transformation of knowledge (Mateos et al. 2014; see also Bereiter & Scardamalia 1987).

3. Purpose and quality of written argumentation

The purposes of written argumentation vary (see Nussbaum 2008; Mateos et al. 2018). For example, through reasoning that relies on one-sided argumentation and the refutation of counterarguments, the objective may be to persuade or convince the reader to adopt a specific position. Alternatively, the purpose may be to encourage reflection i.e., explore and integrate various sides and perspectives of an issue to reach a reasoned conclusion (see also Coiro, Sparks, & Kulikowich 2018). The latter purpose can also be understood as argumentation for learning where, after weighing different views, a person may be willing to change his or her original opinion on an issue (Schwarz 2009). The ability to reflect on the views of different parties in decision-making or taking a position is important, particularly, for students in the social sciences where issues are often complex and do not have one right answer.

The purpose of argumentative writing affects how the quality of argumentation is perceived. If, as in this study, the purpose of argumentation is to arrive at an informed position after exploring multiple sources representing different views and objectives, then quality can be evaluated through the breadth and depth of the argumentation used, the argumentative structure of the text, and the justification for the final position. Breadth of

argumentation, or as van Amelsvoort, Andriessen, and Kanselaar (2007) put it, the breadth of the space of debate, is defined as the number of standpoints (e.g. finance, ethics, health) relating to the issue mentioned or discussed in the text. In this study, these different standpoints have been termed argumentation perspectives (see Xu & Yao 2015). Depth of argumentation, or the depth of the space of debate (van Amelsvoort et al. 2007), in turn, refers to the extent to which the standpoints are explored, e.g. elaborated with rebuttals or explanations. In the present study, the term “depth of argumentation” is used to refer to the number of evidence (Forzani 2016) and reasons (e.g. Means & Voss 1996) that support a claim or a conclusion.

Further, a high-quality argumentative text proceeds through an argumentation perspective-based structure that supports intertextual integration, i.e., integration of ideas across various texts (List, 2020) and argument-counterargument integration (Nussbaum & Schraw, 2007) within the same argumentation perspective. In contrast, a lower quality argumentative text often proceeds through a structure based on the writer's argumentative orientation (for or against) for the issue when, instead of argument-counterargument integration, the for and against reasons/evidence are listed one after the other within the particular argumentative orientation. Argument-counterargument integration is important as it facilitates students' learning by requiring students to elaborate and organize their thinking, makes written arguments logically stronger, and is also a central aspect of critical thinking (Nussbaum & Schraw 2007).

4. Struggles with source-based writing

Previous research suggests that students struggle in multiple areas of source-based writing (Li & Casanave 2012; Wingate 2012). First, many students face difficulties in developing convincing arguments in their essays (Hyytinen, Löfström, & Lindblom-Ylänne 2017; Wingate 2012). For example, reflective argumentative writing (see Nussbaum 2008) has been shown to be particularly challenging for many students (Mateos et al. 2018) and even good students have difficulty incorporating other side information into their arguments, regardless of their personal opinions (see Wolfe & Britt 2008).

Second, students often seem to rely on superficial strategies in their use of sources. University students have been shown to struggle in expressing ideas found in sources in their own words (Hyytinen, Löfström, & Lindblom-Ylänne 2017). For example, Hirvela and Du (2013) found that, instead of paraphrasing source texts, undergraduate students quoted sources directly to stay true to their original meaning. In addition, Howard, Serviss, and Rodrigue (2010) also found that college students' research papers contained a high incidence of copying, patchwriting, and paraphrasing from sources, but no summarizing ideas. These studies suggest that students tend to use a knowledge-telling strategy, meaning that they mainly reproduce ideas retrieved from various sources, whereas the focus should be on a knowledge-transforming strategy where thoughts are developed during the process of composition itself (Bereiter & Scardamalia 1987).

Finally, students have been shown to use simple structures in their essays, e.g. serial listing of successive points extracted from source materials instead of more sophisticated structures that integrate different aspects of the essay into a coherent whole (Campbell, Smith, & Brooker 1998).

5. Representational tools to support students' argumentation

Various knowledge representation tools have been used to support student engagement in argumentative literacy tasks in both individual and collaborative settings (see Noroozi, Weinberger, Biemans, Mulder, & Chizari 2012). Representational tools have been used to foster the expression of balanced argumentation (van Boxtel & Veerman 2001), knowledge construction (Marttunen & Laurinen 2007; Salminen, Marttunen, & Laurinen 2010), counter-argumentation (Wolfe, Britt, Petrovic, Albrecht & Kopp 2009), argumentative writing processes (Benetos & Bétrancourt 2020), and argumentative synthesis writing (Luna et al. 2020). For example, Cho and Jonassen (2002) found that the use of online argumentation supported the collaborative construction of arguments among students enrolled in an undergraduate introductory economics course. Similarly, Wolfe et al. (2009) studied the use of a Web-based counterargument tutor to help university students identify counterarguments and responses to counterarguments and found that the positive effects were often limited to high-ability participants. Luna et al. (2020) aimed to improve undergraduate students' synthesis writing through online training and found that, compared to controls, students in the training group wrote better-structured texts including a higher proportion of arguments for the against position and a higher degree of integration of various perspectives.

To our knowledge, although technology-based tools have been used to support different aspects of argumentation, and writing performance also more generally (Limpo et al. 2020), studies on representation tools designed to support students' argumentative analysis of multiple argumentative source texts and structured writing based on them in higher education are scarce. Particularly, tools to scaffold students organize arguments

for and against found in the source texts according to certain argumentation perspectives are not previously available. To meet these needs, we examined the potential benefits of a novel online tool (see Figure 1: 10) to support source-based writing in a higher education context. The tool (Kiili, Coiro, & Hämäläinen 2016) was originally designed to support adolescents' writing from multiple online sources, and later slightly modified to be better fitted to higher education.

The tool was designed to help students select and organize reasons both for and against a given claim (depth of argumentation) and to organize these reasons according to different argumentation perspectives on the issue (breadth of argumentation). The students were also clearly prompted to name the argumentation perspectives by themselves. The students could also easily modify the content of the argument graph made by the online tool as the titles of the argumentation perspectives were easily refined or renamed and the texts inside the reason boxes were easily editable, as in a word processor. Further, the graph was easily restructured by dragging different reason boxes across different argumentation perspectives to achieve a deeper understanding of the relations between argumentation perspectives and related supporting and refuting reasons. This was supposed to help students to focus their thinking on larger argumentative wholenesses, i.e., argumentation perspectives, rather than on individual reasons when planning how to structure their argumentative writing. The tool was also intended to help students monitor the balance of argumentation, i.e., whether both sides are considered in each perspective. This, in turn, would help them weigh different perspectives and reasons in making their decisions (Mateos et al. 2018). In addition to boxes for reasons and perspectives, the tool included so-called "synthesis boxes" in which students could summarize the main findings of each perspective. This was supposed to

support the transformation of original ideas and argument-counterargument integration (Nussbaum & Schraw 2007).

6. Aim and research questions

In this study, students were tasked to compose a joint position paper on a current educational topic concerning the reduction of class sizes by analyzing three source texts representing different views. The study aimed to explore how students performed this argumentative source-based writing task in small groups when they were scaffolded in their text analyses and joint writing with either digital or print scaffolding. The research questions were:

- 1) What were the depth and breadth of argumentation in the students' position papers in the digital and print scaffolding groups?
- 2) What stand did students in the digital and print scaffolding groups take in their position papers and how did they justify it?
- 3) How did students in the digital and print scaffolding groups transform the reasons and evidence collected from the source texts in their position papers?
- 4) How did students in the digital and print scaffolding groups structure their position papers?

7. Method

7.1 Subjects

Participants were 346 university students (males 17%, females 83%; mean age 21.7 years) in the first two years of various degree programs enrolled in a university in Finland. This study was integrated as part of the course titled “Scientific Thinking and Knowledge”. Students were asked for informed consent to use the collected data for research purposes. Students participated in the course on a voluntary basis and they had the possibility to leave off the course whenever they wanted.

7.2 Task and source texts

Students worked in small groups (2–3 students per group) with the aim of writing a position paper on the controversial issue of whether school class sizes should be reduced. This issue was selected as it is a topical educational issue in Finland and a debatable (Golder & Pouit 1999) and many-sided issue that can be argued for or against from several standpoints.

To complete the task, the students read three source texts representing various views on the selected issue. The characteristics of the source texts are summarized in Table 1.

Table 1. Summary of the source texts

<i>Text title</i>	<i>Venue of publication</i>	<i>Length in pages</i>	<i>Position towards reduction of class sizes</i>
1. Large class tires out. Class teacher sees work as taxing.	Teacher trade journal	4	Mainly for reduction
2. Class sizes in Finland are already small	A leading newspaper (opinion piece by a professor)	1	Mainly against reduction
3. Associations of class and school sizes with school achievement: are there differences between boys and girls?	Finnish Journal of Education	12	Neutral (research-based arguments both for and against)

To establish how the question of school class size was discussed in the three different source texts, the researchers analyzed the nature of the argumentation in each. First, all the extracts in the texts used as reasons/evidence for ($n = 55$) and against ($n = 26$) the claim “School class sizes should be reduced” were identified. Second, these 81 reasons/evidence were condensed, leaving the essence of the reason/evidence intact. This process yielded 43 condensed reasons/evidence (25 for and 18 against) which were then grouped into 11 argumentation perspectives representing more general viewpoints on the issue of class sizes such as “School achievement” (14 condensed reasons/evidence), “Teacher actions: use of time, teaching practices” (5), and “Learning” (5).

7.3 Digital and print scaffolds

To examine the kinds of argumentation presented in the source texts and compose their position papers, the students were assigned to small groups that used either digital or print

scaffolding. The digital scaffold groups analyzed the source texts' argumentation by using an online inquiry tool (Figure 1) and the print scaffold groups by using a pen-and-paper analysis matrix. The print analysis matrix comprised two columns, one for reasons supporting and the other for those opposing a reduction in class sizes. The Online Inquiry Tool is described at the end of section 5 "Representational tools to support students' argumentation".

Figure 1 here

7.4 Phases of work

Students worked in four phases. They 1) received two hours of instruction in argumentation, 2) analyzed source texts individually, 3) worked in small groups to jointly examine the source texts, and 4) wrote their joint position paper.

In phase 1, students were taught the basics of argumentation including central definitions, argument elements, criteria for quality of argumentation, and common fallacies. Students were also introduced to digital scaffolding with the help of a video that they watched at home.

In phase 2, students individually analyzed, as homework, the three argumentative texts on whether class sizes should be reduced in schools. The students' task was to locate and mark on each text all the reasons given for and against a reduction in class sizes.

In phase 3, the students attended a class (approximately 20 students in each) to discuss their previous individual analyses and jointly finalize their analyses of the source texts' argumentation. In the class (90 minutes), students worked in non-randomized small groups of from two to four students formed jointly at the beginning of the class by the teacher and researcher. The small groups were assigned to one of the two types of scaffolding for the analyses so that the digital and print scaffolding groups attended different classes.

In both scaffolding conditions, students were set the same task: Discuss the reasons, both for and against the issue, you have marked in the source texts, think about alternative argumentation perspectives on the issue, and think about how to synthesize the reasons relating to each perspective. After discussing their individual analyses, the students completed their analyses by using either the Online Inquiry tool or the printed analysis matrix. The working of the small groups was tutored by the teachers of the course who advised the students if they needed help when analyzing the source texts.

Lastly, in phase 4, the students in each small group met in their own time and collaboratively composed their groups' position paper and returned the document to the class teacher by email. The students' task was to examine the issue with the help of their previous analyses and to take a stand on it. The teacher evaluated the papers as either pass or fail. All small groups carried through their work and returned their joint position paper in time, so the task dropout rate was zero.

At the end of the course the students filled in a feedback questionnaire on whether the use of the digital and print scaffolds supported their reading and writing from sources. The questionnaire included the following five-point (Strongly disagree – Strongly agree) Likert-scale items providing descriptive knowledge to support the interpretation of the

research results: the scaffolds (digital and print) a) helped me to identify reasons equally both for and against the issue from the source texts; b) helped me to perceive how various issues in the texts were connected to each other; c) helped us to structure our position paper; and d) helped us to justify our stand well in our position paper.

7.5 Data analyses

The data for analysis comprised the students' collaboratively written position papers ($n = 112$).

7.5.1 *Depth and breadth of argumentation in the students' position papers*

To answer Research Question (RQ) 1, the students' position papers were analyzed for depth and breadth of argumentation (see Munneke, Andriessen, Kanselaar, & Kirschner 2007; Salminen, Marttunen, & Laurinen 2010; van Amelsvoort, Andriessen & Kanselaar 2007). The unit of analysis was the entire position paper ($n = 112$). *Depth of argumentation* refers to the number of reasons in the students' position papers. *Breadth of argumentation*, in turn, refers to the number of argumentation perspectives represented by these reasons. To analyze the depth of argumentation, all the single reasons for and against the claim included in the students' position papers ($n = 1\,703$) were identified. The reasons identified in the students' papers were then compared with the condensed reasons previously extracted from the source texts, and each student's position paper was assigned a value (max. 43) indicating how many of the source texts' condensed reasons were represented in it. Breadth of argumentation was determined by assigning each student's position paper a value (max. 11) indicating how many of the 11 argumentation

perspectives included in the source texts were represented in the separate reasons contained in the paper.

7.5.2 Stand and justifications in position papers

To answer RQ 2, the students' position papers were also analyzed for the nature of their stand and justifications for and against reduction. Students' stands on the claim "Class sizes should be reduced" were classified into one of four categories: 1) Supporting reduction (e.g. Class sizes should be kept small), 2) Resisting reduction (e.g. It is unwise to further reduce class sizes), 3) Conditional (e.g. Reducing class sizes alone is not enough; other factors should also be taken into account), and 4) Undefined. Further, to analyze how the stand was justified, reasons for and against a reduction in class sizes and related argumentation perspectives were counted.

7.5.3 Degree of transformation of the source texts' argumentation in the students' position papers

The analysis of how students transformed (RQ 3) the reasons and evidence of the arguments in the source texts in their position papers proceeded in three phases. In the first phase, we identified reasons and evidence (from now on reasons) supporting or opposing a reduction in class size or, alternatively, supporting the conditional stand on the issue. Thus, the unit of analysis was a reason presented in the position paper ($n = 1703$).

In the second phase, we matched each of the 1703 identified reasons against the 81 reasons/evidence identified in the three source texts (see section Task and Source

Texts). We were unable to track the origin of the reason for the position paper in the source texts in only a few instances (see Table 2; an example of a constructed reason).

In the third phase, we compared the reasons identified in the position papers with the condensed reasons and evidence in the source texts to determine the extent to which students had transformed the original reasons /evidence they had located in the source texts. Based on this comparison, the reasons in the students' position papers were classified into one of four categories (values 0–3) according to the level of sophistication of the transformation of ideas.

Reasons assigned to the lowest level “Literally or almost literally copied” (value 0) were either directly copied from the source texts, slightly modified (cf. “near copy”; Keck 2006), or included many of the same words and expressions as the condensed reason/evidence in the source text. The category “Condensed in one’s own words” (value 1) (cf. “closely paraphrased”; Shi 2004) included reasons presented in a shortened form but which did not include new information when compared with the source texts. Thus, students in the two lowest levels did not develop the content of the source texts at all.

In contrast, in the reasons categorized in the two highest levels, the students had developed the content of the source texts, a process requiring further active reworking, reflection on, and revision and organization of thoughts and ideas during the composing process itself (Bereiter & Scardamalia 1987). The category “Condensed and own thinking added” (value 2) included a new contribution by the writers, e.g. an example or a conclusion elaborated or inferred from the original argument element presented in the source text. Reasons classified in the highest category of the degree of transformation, “Constructed” (value 3), were not directly linked to any particular reason/evidence presented in the original source texts. For example, students could have used one or

multiple source texts in constructing their reasons. The analysis categories are illustrated in Table 2.

Table 2. Analysis Categories for “Degree of Transformation of the Source Texts’
Argumentation” (Argumentation Perspective: School Achievement)

<i>Analysis category</i>	<i>Argumentation in the source text</i>	<i>Student’s reason in the position paper</i>	<i>Interpretation</i>
<i>Value 0</i> Literally or almost literally copied	In big classes, the teacher has not enough time (Reason presented in Text 1).	In big classes, the teacher has not necessarily enough time for everyone (Reason no. 192)	Almost the same words as in the source text
<i>Value 1</i> Condensed in one’s own words	Many meta-analyses have shown that students in grades 1 to 3 benefit most from studying in small classes (Evidence presented in Text 3)	Small class sizes benefit most pupils in grades 1 to 3 (Reason no. 23)	The evidence presented in the source text has been condensed but no new contribution has been added
<i>Value 2</i> Condensed and own thinking added	Research results have shown that girls succeed better than boys despite the size of the class and school and that the difference in favor of girls increases as the size of the class and the school increases (Evidence presented in Text 3)	The difference in school achievement in favor of girls increases as class size increases which diminishes educational equality between the genders (Reason no. 418)	The evidence presented in the source text has been condensed and a relevant conclusion (own thinking) has been added
<i>Value 3</i> Constructed	<i>Text 1:</i> Several reasons for reducing class sizes <i>Text 2:</i> Several reasons against reducing class sizes <i>Text 3:</i> Research-based evidence that could be used either for or against reducing class sizes	Class size and its effects on teaching and learning are not always unambiguous. Research results on the topic are contradictory and so we think that they cannot be directly generalized across all practical situations, teachers and students (Reason no. 492 supporting conditional stand)	A new reason has been constructed on the basis of ideas presented in one or more source texts

7.5.4 Type of structure in position papers

For the type of structure (RQ 4), the students' papers were classified into one of four categories. In papers categorized as (1) "Perspective-based", the text was mainly organized around various argumentation perspectives on class sizes in schools. In these papers, almost all the perspectives included reasons both for and against. In papers categorized as (2) "Argumentative orientation-based", the starting point for writing was the position taken on class size, and reasons for and against were mainly presented independently. In "Source-based" papers (3), the source articles were reviewed in a sequence of paragraphs, one paragraph for each source, and in (4) "Unstructured" papers, no consistent organizational criteria were observed. Instead, the source texts, individual reasons, and various argumentation perspectives appeared somewhat coincidentally.

7.5.5 Reliability of the analyses

The variables based on qualitative classification of the data were tested for reliability. For the variable "Degree of transformation", two independent raters classified 10% of the data, reaching 86.7% agreement (Cohen's kappa, $\kappa = .592$). For the variables "Type of structure" and "Nature of stand" two raters classified 15% of the data, reaching 76.5% agreement (Cohen's kappa, $\kappa = .684$) for the former and 82.4% agreement (Cohen's kappa, $\kappa = .721$) for the latter (Cohen 1960). All the data for the reliability analysis were selected at random and the raters conducted their analysis blind to condition (digital/print scaffolding).

7.5.6 Statistical analyses

Depending on the nature of the dependent variables, three statistical tests (t-test, U-test, and Fisher's Exact Test) were used to compare position papers composed by the digital and print scaffolding groups. Independent samples *t-test* was used to evaluate differences in means for the depth and breadth of argumentation, and for the justifications for and against reduction in the position papers. As the variable "Degree of transformation of source texts' argumentation" is an ordinal scale variable, a nonparametric *Mann-Whitney U-test* was used for the group comparisons. For the variables "Type of structure" and "Nature of stand", dichotomous variables (categories "yes" and "no") were formed based on the categories of the original variables. *Fisher's Exact Test* (one-tailed) for each dichotomous variable was used to examine the associations of each type of structure (4 variables) with nature of stand (4 variables) in the position papers and by study group (digital vs. print scaffolding).

8. Results

8.1 Depth and breadth of argumentation in students' position papers

From the total of 43 condensed reasons or pieces of evidence identified from the original source texts, students included, on average, 12.8 ($SD = 6.0$) reasons in their position papers indicating the depth of argumentation. In respect to the breadth of argumentation, the reasons in the students' position papers contained, on average, 6.3 ($SD = 2.0$) of the 11 argument perspectives identified in the source texts.

Students in the digital scaffolding group included slightly more reasons ($M = 12.9$, $SD = 5.9$) in their position papers than peers in the print scaffolding group ($M = 12.6$, $SD = 6.2$). However, this difference was not significant ($t = 0.31$, $p = .759$, $d = 0.050$). Moreover, the reasons in the digital scaffolding group included slightly more argument perspectives ($M = 6.5$, $SD = 1.8$) than the reasons in the print scaffolding group ($M = 6.1$, $SD = 2.2$). Again, the difference was not significant ($t = 1.05$, $p = .298$, $d = 0.120$).

8.2 Stands and justifications in students' position papers

The students' position papers most frequently (31.3%) supported a reduction in class sizes (Table 3). A conditional stand was taken in about one-fourth (25.9%) of papers and a stand opposing reduction in about one-fifth (20.5%). Likewise, almost one-fifth (22.3%) of the students presented an undefined stand. The differences in stands between the digital and print scaffolding groups were not statistically significant.

Students who had presented either a supporting or resisting stand on a reduction in class sizes justified their stand reasonably well, those with a supporting stand somewhat better than those with a resisting stand. The supporting stand was justified with an average of 10.2 reasons representing 5.3 out of 9 argumentation perspectives, and the resisting stand was justified with an average of 7 reasons representing 4 out of 8 argumentation perspectives. For conditional or undefined stands, the results showed that reasons for (means of 8.4 and 6.6) were consistently more common than reasons against (means of 5.6 and 3.9) reduction, in both the digital and print scaffolding groups. The higher number of reasons in favor of reduction than against it may, however, be explained by the higher

number of reasons in favor of reduction included in the source texts. No differences between the scaffolding groups were observed.

For counterargumentation, i.e. reasoning against one's own stand, it was observed that students possessing a resisting stand for reduction of class sizes put forward reasons against their own stand more often than students possessing a supporting stand for reduction (6.7 vs. 2.5). Again, the different scaffolding groups did not differ significantly from each other.

Table 3. Means of Reasons (R) and Argumentation Perspectives (AP) for and Against the Reduction of Class Sizes in Students' Position Papers

Stand	Digital scaffolding groups ($n = 63$)				Print scaffolding groups ($n = 49$)				Total ($n = 112$)			
	<i>For reduction</i>		<i>Against reduction</i>		<i>For reduction</i>		<i>Against reduction</i>		<i>For reduction</i>		<i>Against reduction</i>	
	R	AP ¹	R	AP ²	R	AP ¹	R	AP ²	R	AP ¹	R	AP ²
Supporting reduction (31.3%; $n = 35$)	9.1	5.1	2.6	1.8	11.7	5.5	2.3	1.6	10.2	5.3	2.5	1.7
Resisting reduction (20.5%; $n = 23$)	7.5	4.6	7.2	4.3	5.6	3	6.8	3.6	6.7	4.0	7.0	4.0
Conditional (25.9%; $n = 29$)	8.6	5.1	5.2	3.2	8.1	4.2	6.2	4.1	8.4	4.7	5.6	3.6
Undefined (22.3%; $n = 25$)	7.1	4.2	4.6	3.2	6.2	4.0	3.3	2.8	6.6	4.1	3.9	3.0

Note: ¹ max = 9; ² max = 8

8.3 Degree of transformation of source texts' argumentation in students' position papers

Figure 2 shows the degree of transformation in the students' position papers. Most of the reasons (64.1% of all reasons) in the students' papers were condensed from the reasons or evidence presented in the source texts whereas the two highest levels of transformation (Condensed and own thinking added; Constructed) were seldom observed. In general, the degree of transformation was significantly higher in the digital scaffolding group ($U = 336411.0$, $z = -2.14$, $p = .032$, $r = 0.20$). The proportion of condensed reasons with students' own thinking added was more than double in the position papers composed by the digital (10.7%) than in those composed by the print scaffolding group (4.1%).

Figure 2 here

8.4 Structure of position papers

As Figure 3 shows, students most commonly structured their position papers based on argumentation perspectives: 42% of papers were structured in this way. It is noteworthy that 31% of the students' papers were unstructured. About one-fifth (19%) employed an argumentative orientation and only 8% a structure based on the source texts.

Students in the print scaffolding groups significantly more often composed unstructured essays than those in the digital scaffolding groups (41% vs. 24%, Fisher's

Exact Test, $p = .043$). Calculation of the odds ratio showed that the odds of composing an unstructured essay were 2.21 times higher if the students' work was supported with a print compared to digital scaffolding, and thus a small effect size was found for scaffolding type (Chen, Cohen, & Chen 2010; Ellis 2010).

Figure 3 here

9. Discussion

This study explored ways of supporting students' argumentative source-based writing in small groups. Students were provided with text materials representing different points of view on a controversial educational topic and carried out a sequenced writing task. The task phases reflected the academic source-based writing practices of selecting, analyzing, comparing, contrasting, and organizing arguments, and composing a position paper (Wingate 2012). The students' argumentative source-based writing was supported with either print (matrice) or digital (graph) scaffolding. We will first discuss the findings at a general level and similarities and differences found between the position papers composed by the digital and print scaffolding group, and then consider the limitations and instructional implications of the study.

Overall, the results suggest that, early in their academic careers, the students in both scaffolding groups were moderately capable of identifying relevant reasons representing diverse perspectives on a controversial issue in source texts and using them to build an argument in their position papers. Although students have been shown to struggle in identifying components of arguments in texts (Larson, Britt, & Larson 2004), it seemed that the present students' ability to identify reasons and evidence in the source texts was facilitated when they were given a claim (school class sizes should be reduced) to ponder when analyzing the texts. Students were also able to negotiate with their peers over what counts as a reason, and their argumentation was also consistent with the stand they had taken. However, the papers supporting reduction contained very few counter-reasons whereas in the other papers the argumentation was more balanced. Even though the source texts included a larger number of reasons supporting reduction (55 condensed reasons) than reasons resisting reduction (26 condensed reasons), the source texts offered a reasonable number of reasons that students could have used in counter-argumentation. This result is in line with previous research that even at a higher education level some students have difficulties in taking counterarguments into account (Liu & Stapleton 2014; Wolfe & Britt 2008).

The results suggest that most of the students (78%) did not develop reasons that they identified from the source texts - that is they literally copied or presented a reason in a condensed form. Thus, they rarely linked their own thoughts to the reasons (7.9%) or presented reasons constructed on the basis of the source texts (14.3%). These results are consistent with other studies showing that students find the elaboration and integration of ideas challenging when working with multiple sources (Howard, Serviss, & Rodrigue 2010; Mateos et al. 2018). This finding suggests that students largely applied the so-called

transmission model of writing, which, according to White and Bruning (2005), means that knowledge is mainly transmitted directly from the author to the reader independently of the writer. Students seem to need further writing practice, particularly in writing which applies the transaction model (White & Bruning 2005) in which knowledge and meaning are actively constructed by the writer through the integration of new knowledge, found, for example, in the source text, with the writer's previous knowledge on the topic (Bereiter & Scardamalia 1987).

However, at least to some extent, the online inquiry tool may have supported the transformation of source text content. In particular, the papers by the students in the digital scaffolding group contained a higher proportion of condensed reasons combined with their own thinking compared to the print scaffolding group. This result suggests that students may benefit from the digital tool when instructed towards the transaction model of writing. In the present study, students had limited time to fill in the graph of the Online Inquiry Tool. Consequently, they did not actively use the synthesis boxes that were designed to promote the synthesis of reasons within each argument perspective. However, previously (Barzilai et al. 2020; Luna et al. 2020) online supports have been successfully used to promote students' synthesizing of reasons for and against the topic in their argumentative writing. Thus, the full potential of the Online Inquiry Tool supporting the transaction model of writing remains to be examined in more controlled settings and in situations where students have more time to process the reasons.

Of note, more than one-half of the position papers were either unstructured (31%) or followed simple structures, either argumentative orientation-based (19%) or source-based (8%). A more complicated structure of the kind required at the university level (cf. Wingate 2012), in this case a perspective-based structure, was found in 42% of the

position papers. Compared to the source-based and orientation-based strategies, the perspective-based strategy can be regarded as a more preferable way to organize academic writing because it enables two types of integration that are characteristic of high-level argumentative writing. First, it affords intertextual integration that is connecting disparate pieces of information representing a particular perspective across the sources (List, Du & Lee, 2021). Second, organizing arguments by perspectives facilitates argument-counterargument integration that is an essential element in reflective writing, where the focus is on exploring and integrating various sides of an issue to reach a reasoned (Nussbaum 2008) and an integrative (Luna et al. 2020) conclusion.

Digital scaffolding may have helped students in structuring their essays as the digital scaffolding group showed, on average, a smaller proportion of unstructured essays (24%) than the print scaffolding group (41%). This result was somewhat expected as the digital tool used in the study was deliberately designed to guide students to pay special attention to structuring their papers. The tool explicitly prompted students to organize reasons according to various perspectives, and even to name the perspectives by themselves which also supported their reflective writing. However, students seemed to utilize these affordances only partly as, contrary to our expectations, the perspective-based writing strategy occurred equally often in the position papers produced by both scaffolding groups. Unfortunately, we do not have any process data, such as students' discussions, that would reveal why many student groups were not able to utilize the affordances of the online inquiry tool. One reason could be that students did not watch the instructional video given as a homework assignment that explained the affordances of the online inquiry tool. Another reason might be that some students were not fully

cognitively or affectively engaged and only invested the minimum effort in completing the writing task (see List & Alexander, 2018).

10. Limitations and future directions

This article reports on the outcome of a study embedded as a part of an undergraduate course in education. However, investigating learning activities in an authentic teaching context has its limitations. For ethical reasons, we did not have a non-scaffolded control group as all the participating students were offered some type of support. Nor were students randomly assigned to groups or conditions. Moreover, students' writing skills before using the scaffolds were not controlled for in the statistical analyses. Due to these limitations, we cannot draw conclusions on to what extent the two types of scaffolding helped students to improve their source-based writing. Further research should incorporate randomly selected experimental and control groups together with pretest-posttest measures on students' reading-writing performance to get a deeper understanding of different ways of scaffolding to support students' writing and thinking.

Further, because of the limited number of class hours set for the course, some of the activities were completed as home assignments (reading the articles and noting arguments, writing a position paper), thereby reducing control over the learning activities (e.g. time used). Students were also given a limited time to analyze the source texts and thus may not have been able to take full advantage of the digital scaffolding and fill in the synthesis boxes that were designed to support the integration of reasons. In addition to the constraints of the research design, the study was limited as it examined the elements

of high-quality source-based writing separately. Future studies could examine the relations between the breadth and depth of argumentation, degree of transformation, and essay structure. Despite these limitations, we believe that scaffolding both reading and writing activities is a useful practice (cf. Weston-Sementelli, Allen, & McNamara 2018).

Instructions emphasizing the importance of a careful analysis of the source texts seemed to help students' reading and writing. In the feedback questionnaire filled in after the studies, the majority of the students reported that the scaffolds (digital and print) helped them to identify reasons equally both for and against the issue from the source texts (72.4% of the students), perceive how various issues in the texts were connected to each other (61.6%), structure their position paper (78.9%), and justify their stand well in their position paper (67.3%).

Our results suggest that students need instruction that supports the adoption of the knowledge-transforming strategy of writing. This is to say that the successful identification of source texts' arguments, which students demonstrated in this study, only forms the basis for high-quality source-based writing. In addition to cognitive prompts embedded in scaffolds, students seem to need explicit models (cf. Davey, 1983) on how to synthesize arguments, counterarguments, and one's own ideas in a way that supports the construction of new knowledge. Providing students with explicit instruction on how to engage in textual integration has also been shown to be a promising pathway to support students (List et al., 2021).

As more than half of the position papers lacked a clear structure or relied on a simple structure, students also need support in structuring their essays. Different structuring strategies could be made more explicit and combined with careful explanations of what is expected and why. The problems in structuring the essays may

relate to poor planning that is often typical for novice writers (Bereiter & Scardamalia 1987). Thus, it is important to demonstrate the value of planning the essay structure in advance. Even though the Online Inquiry Tool was designed to support students' organization of reasons according to argument perspectives, only 40% of students took advantage of this scaffolding feature in their writing. This result suggests that the Online Inquiry Tool could more effectively be used to practice perspective-based structuring of reasons when combined with more detailed instructions.

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Figure 1. The online inquiry tool

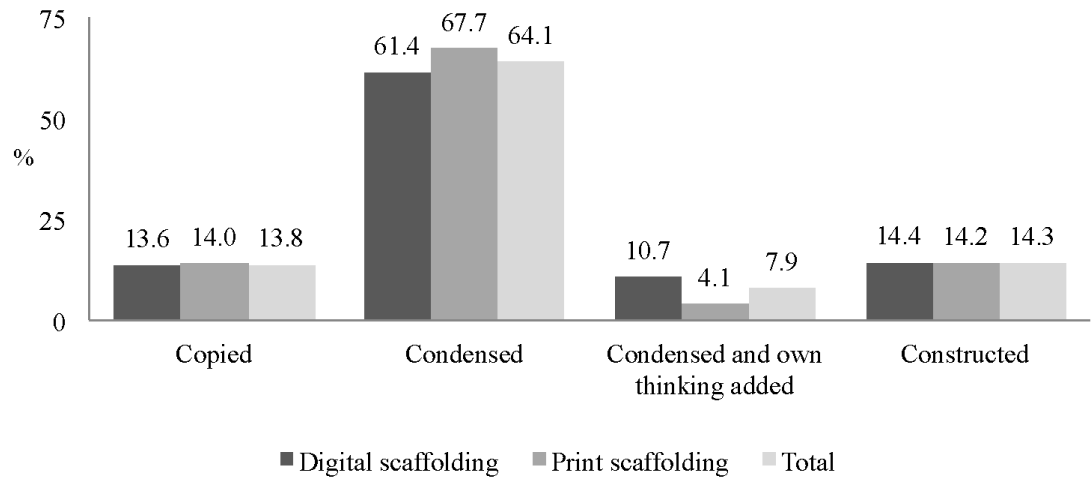


Figure 2. Degree of transformation of reasons in position papers

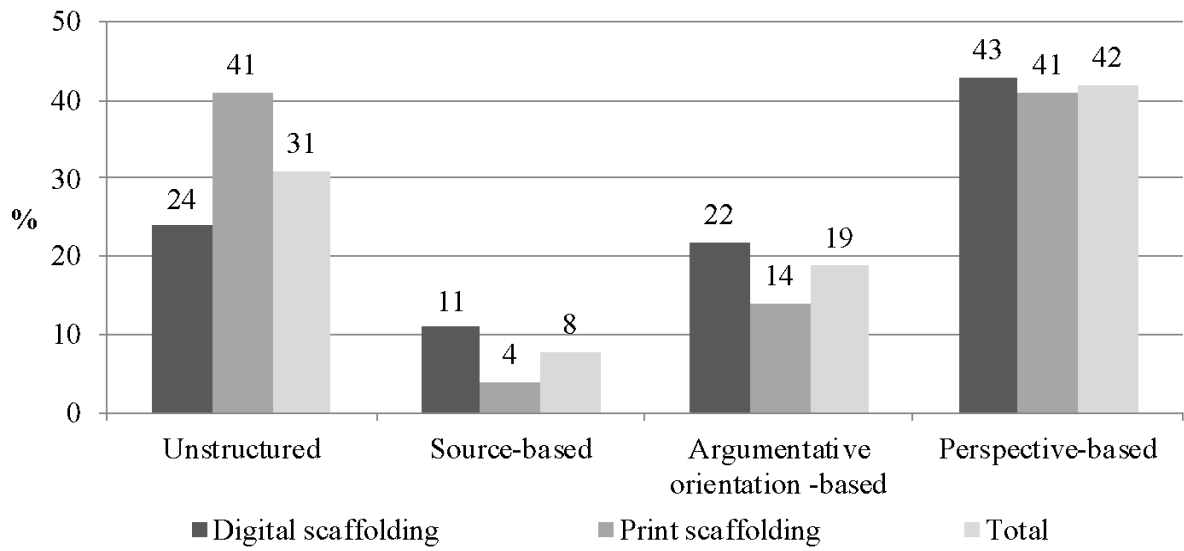


Figure 3. Structure of students' position papers