Defending either a Personal or an Assigned Standpoint: Role Play in Supporting Secondary School Students' Argumentation Face to Face and through Chat

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Abstract

This study clarifies whether a specific type of role play supports upper secondary school students' collaborative argumentation. Data consist of 12 dyadic face-to-face and 12 chat debates. Data analysis focused on the quality of students' argumentation. Comparisons were made between students who defended standpoints at variance with their personal opinions on the topics, between the two study modes and topics, and by gender. When the students defended a standpoint differing from their personal opinion, the male students engaged in counterargumentation more often than the female students. When, in turn, the students defended their personal standpoint, they produced both counterargumentative and non-argumentative speech turns equally often, and their arguments were more poorly elaborated than when they defended an assigned standpoint. The study suggests that role play in which both counterargumentation and students' personal standpoints on an issue are taken into account is a viable means to support students' high quality argumentation.

Keywords: argumentation; collaborative learning; computer chat; role play; standpoint; upper secondary school

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1. *Introduction*

In public debates on many societal topics, such as environmental and ethical issues, we are often asked to take a stand on the issue at stake. For discussion to be productive, it would be important to evaluate the validity and adequacy of the arguments put forward by other people before deciding what side to take in the argument. This evaluation process requires ability in argumentation, and is often mentioned as one of the most important aims of education at different school levels (e.g., Marttunen, Laurinen, Litosseliti, and Lund 2005). University and secondary school students' argumentation skills have, however, been found to be rather weak (Larson, Britt, and Larson 2004; Marttunen 1997; Marttunen et al. 2005). Further, because the skills involved in argumentation appear to be complex (Kuhn and Udell 2007; Walton 1989), argumentation is a demanding competence both to learn and teach (Chinn 2006).

Argumentation, as a demanding socio-cognitive task, rarely occurs spontaneously in school contexts (Andriessen and Schwarz 2009). Namely, motivation to engage in argumentation depends on who you are arguing with, what you are arguing about, what context you are arguing in, and why you are arguing (Muller Mirza, Perret-Clermont, Tartas, and Iannaccone 2009). The topics to be learned in school may not always be that motivating; the knowledge-centered school context might lack the emotional aspects central to engagement in argumentation (Andriessen, Baker, and van der Puil 2011; Baker, Andriessen, and Järvelä 2013; Ben-Ze'ev 1995), and students may feel that argumentative situations in school are artificial and unconnected to their daily lives (Zohar and Nemet 2002). Consequently, students may see no point in arguing.

Moreover, even in cases where students are willing to engage in argumentation, the result might not always be effective from the point of view of learning (e.g., Arvaja, Rasku-Puttonen, Häkkinen, and Eteläpelto 2003; Schwarz 2009). Such debates may, for example, be biased, with students tending to put forward more arguments in favour of a position they personally support than arguments on the other side (Stein and Bernas 1999). This is problematic for the collaborative sharing and constructing of knowledge, and for sustaining and maintaining productive argumentation from different perspectives on the issue at stake.

Many studies showed also gender differences in peer-to-peer argumentation. For example, females seem to focus more on collaboration during argumentative discussions than males (Asterhan, Schwarz, and Gil 2012; Erkens and Janssen 2008; Salminen, Marttunen, and Laurinen 2012). On the other hand, males seem to be more inclined to respond to critiques, expressed by females, in particular, with rebuttals (Jeong and Davidson-Shivers 2006) and show more openness to argue in general (Jeong 2007) than females. However, Allan Jeong (2006) point out that other factors, such as task structure and group composition by gender, may also affect the way men and women engage in argumentation.

Over the past 15–20 years many online environments and software tools have been developed and used successfully when teaching and supporting argumentation (e.g., Scheuer, Loll, Pinkwart, and McLaren 2010; Noroozi, Weinberger, Biemans, Mulder, and Chizari 2012). However, as argumentation as such is a demanding activity which requires high-level interaction and hard cognitive endeavours, the use of instructional technology as an arena for argumentation may cause extra cognitive load to students (van Bruggen, Kirschner, and Jochems 2002). For example, the need to coordinate discussions, and establish and maintain common ground induces additional cognitive burden for students in collaborative online learning situations (Dillenbourg and Bétrancourt 2006). The lack of non-verbal cues in online environments, compared

to face-to-face communication, may also hinder to achieve productive argumentative interaction among students (Burnett 2003).

All these factors indicate that schools currently face challenges for creating practices that support productive argumentation and that more research on pedagogical means to promote students' engagement in collaborative argumentation is urgently needed (Chinn and Clark 2013). This study contributes to remedying this situation by experimentation with a specific type of role play carried out face-to-face and through online chat.

2. *Role Play as a Means to Stimulate Argumentation*

Role play refers to arranged learning situations in which students participate in 'as if' or 'simulated' actions and situations by assuming a viewpoint or character identity that they would not normally adopt (Yardley-Matwiejczuk 1997). As engaging students in productive argumentation is a demanding task, role play is often used as a pedagogical stimulus to this end. Role play promotes argumentation by providing a clear socio-cognitive structure for argumentative discussion and an atmosphere that allows emotional engagement for considering multiple perspectives on the issue at hand (Marttunen and Laurinen 2001).

From the socio-cognitive perspective, discussions through role play seem to generate argumentation, develop arguments further, and reduce cognitive load (e.g., Holsbrink-Engels 2001). The results of the study by Laurence Simonneaux (2001) indicated that in discussions on animal transgenesis, role characters (like a fish farmer, a researcher, a young mother) helped upper secondary vocational students to develop their arguments on the topic. The pre- and post-tests showed that the students used stronger arguments after the role play than before it. Respectively, the results by Miika Marttunen and Leena Laurinen (2001, 2002) suggest that role play (protagonist vs. antagonist) carried out face-to-face or by email is an effective means to promote

argumentation skills in higher education. According to the students who took part in the studies, it was easier to engage in a discussion when the standpoint was fixed in advance and the other students knew that the position assigned to a student did not necessarily represent her/his own personal opinion on the issue in question. As the students had the possibility to hide behind a role, they presented stronger and clearer arguments than would otherwise have been the case. Furthermore, computer-based role play seems to decrease high cognitive load during the solving of social problems by giving opportunities for reflection and by developing interpersonal skills (Holsbrink-Engels 2001).

Role play, however, is not always an appropriate means to support argumentation and knowledge construction. In the study by Maarit Arvaja et al. (2003), secondary school students used historical role characters in studying imperialism in a Web-based environment. It was found that shared knowledge construction was rather weak among the students, as cognitively high-level activities, such as explaining, challenging, and reasoning, rarely occurred in their discussions. Further, the students' social relations in the classroom seemed to guide their online interaction more than their role characters. The students' existing social relations directed with whom and how actively they discussed issues with each other. Sue O'Connor and Anne Ross (2004), in turn, compared role play in face-to-face and asynchronous computer-mediated (WebCT) learning environments. In their study, university students working in groups liked playing non-familiar roles and appreciated the range of stakeholder views in both environments. However, the problem in the computer-mediated environment was the lack of immediacy. The students put a wide range of contributions on the bulletin board that made it difficult to follow multiple discussion threads and to respond to all the other students' comments. As a result, the students' knowledge construction from multiple perspectives was not supported despite the use of role play as a learning method.

In general, when comparing computer chat and face-to-face interaction, it has been found that during a face-to-face discussion it is easier for the students to maintain coherent discourse when a variety arguments are put forward (Schweizer, Paechter, and Weidenmann 2003). On the other hand, chat interaction may help students to express more relevant, well-grounded, and logical arguments (Morgan and Beaumont 2003), and to produce more counterargumentative speech acts (Veerman 2000).

From an emotional aspect, role play offers the possibility to understand other people's points of views, as you have to place yourself in their situation (Kolstoe 2000). For example, Andrew Vincent and John Shepherd (1998) found that in learning about Middle East politics students' empathy improved when they assumed role play characters with views strongly opposing to their own political attitudes. Mei Lim et al. (2011) conclude that technology-enhanced role play seems to be a good means to support social and emotional learning in complex social situations without risks that learners face in authentic social situations.

3. *Role Play in This Study*

In this study, students' argumentative debates were stimulated by means of a role play carried out face-to-face and through synchronous chat. The students were divided into a protagonist and an antagonist roles such that they defended either their personal standpoint on an issue or a standpoint opposed to their own.

From the point of view of learning, getting students to genuinely collaborate and successfully carry on mutually argumentative dialogues is a widely acknowledged problem (e.g., Arvaja et al. 2003). Supporting the counter-argumentative nature of debate is one means to foster argumentative discussion. Disagreements, diverging viewpoints, or alternative proposals may evoke argumentative discussion and lead to learning gains (Dillenbourg and Schneider 1995). However, argumentative discussion, even in cases of disagreement, cannot easily be sustained between students (e.g.,

Asterhan and Schwartz 2009). Learning through argumentation may be hindered by myside bias (Perkins 1985) in argument production. Myside bias refers to the tendency of people to generate more arguments in favour of a position they personally support than one they do not support (Perkins 1985; Toplak and Stanovich 2003). Nancy Stein and Ronan Bernas (1999) found that arguers, independent of age, generated approximately twice as many reasons for support of their own position as they generated for support of the opposite position. Thus, to trigger productive argumentation it may be appropriate to use a role play in which students defend standpoints contrary to their personal opinions on the issue discussed.

On the other hand, myside bias is not necessarily a problem in argumentation-based learning. The significance of discussion topic and situation for students' argumentation has been noticed in many studies. Topics which include authentic problems or provide relevant connections to students' lives may foster their argumentation performance (Salminen, Marttunen, and Laurinen 2012; Udell 2007; Zeidler, Sadler, Applebaum, and Callahan 2009; Zohar and Nemet 2002). Previous studies have also shown that even young children understand and are able to generate the main components of an argument in social situations personally significant to them (see Stein and Albro 2001). Personally significant situations may be those which connect to a person's daily life and goals. Stein and Elizabeth Albro (2001) point out that in situations where the arguers believe that their own position is better than their opponent's position, their argumentation includes more overt justifications and explanations for their own position. Thus, it seems that persons are well motivated to argue as long as the situation or the discussion topic is personally meaningful to them.

Further, when arguers are allowed to defend their personal opinion their mental load (cognitive load theory; Sweller, van Merriënboer, and Paas 1998) may be reduced, as they may find the learning situation more authentic than otherwise. The participants may also produce more arguments when they can support their own standpoints (Stein

and Bernas 1999), which may broaden the discussion. Thus, to evoke productive argumentation it would also be appropriate for students to retain their own standpoints on personally meaningful topics in debates. Consequently, in the present study we compared argumentation produced by students who defended their personal standpoint in an argumentative discussion with students who were asked to support a standpoint contrary to their personal opinion.

4. *Research Questions*

In this study, upper secondary school students studied two environmental topics (nuclear power, genetically modified organisms) by engaging in argumentative debates in dyads face-to-face and through synchronous chat. The discussions were carried out within a role play design in which the students defended either their personal standpoint or a standpoint assigned to them. The study aimed in particular to clarify whether the use of this kind of role play would be associated with the quality of the students' argumentation in terms of argumentativeness and argument elaboration. Furthermore, the study aimed to clarify whether topic (nuclear power, genetically modified organisms), study mode (face-to-face, chat), or gender affected argumentation quality. The following research questions were addressed:

1) What was the quality (argumentativeness, argument elaboration) of the argumentation generated in the students' debates?
2) What kinds of effects did the role play design (personal or assigned standpoint) have on students' argumentation?
3) What associations, as a part of the role play design, gender, topic, and study mode had on students' argumentation?

5. *Method*

5.1 *Teaching Experiment*

The subjects, 27 Finnish upper secondary school students (18 females and 9 males; aged between 16 and 17 years; 2nd study year), took part in a cross-curricular teaching experiment to practice argumentative discussion. The experiment was conducted in a course that combined curricular content from the subjects of Finnish Language and Religious Education. The course was planned and carried out in collaboration with the researchers and teachers of those subjects.

At the beginning of the teaching experiment, the students took a test on argumentation skills including four tasks: analysing an argumentative text, composing arguments, commenting on an argumentative text, and judging arguments and conclusions (see Marttunen et al. 2005). On the basis of the test results, the students were divided into two equal gender groups with similar skills in argumentation.

According to Caroline Golder and Delphine Pouit (1999), in order to bring about argumentative dialogue, the discussion topic must be debatable. A debatable topic leaves space for negotiation because it does not offer objective truths. For this reason, environmental issues – nuclear power, and genetically modified organisms – were selected as topics of argumentation as they offer multiple perspectives from which they can be viewed and good possibilities for ethical considerations. In addition, increasing nuclear power is constantly a topical issue in public discussion in Finland, whereas genetic modification is a current issue not only in Finland but also at the level of the European Union.

*** Insert Table 1 here ***

The experiment was carried out over two days (Table 1). On the first day the topic was nuclear power (NP), and on the second day genetically modified organisms (GMO). The study mode (face-to-face vs. computer chat) was different for each groups on the different days. The students' work was organized so that it proceeded in three phases during both days: 1) Reading and analysing source articles, 2) Presenting one's

individual opinion on the topic, and 3) Engaging in dyadic discussion. Due to pedagogical reasons, the instructions provided to the students somewhat varied between the topics.

Phase 1: Reading and analysing source articles (60 minutes). During the course, five articles on each topic, taken either from the newspapers or the Internet, were read and analysed. The students worked with the articles in two different ways. When the topic was nuclear power (Day 1), the students were divided into five small groups (5-6 students/group) and each group was given one article to read and analyse. For each article, the students were asked to identify the different stakeholders and their opinions, along with supporting arguments, on nuclear power. After having read and analysed the articles, each group presented the main points of the article and the results of their analysis to the other students. When the topic was GMO (Day 2), the students worked in pairs (n = 12). Six pairs read and analysed the two longest articles while the other six pairs worked with the three shortest articles. In this way the all students had approximately an equal amount of text to read. The students were asked to find arguments for and against GMO. After working, the pairs presented their analyses of the articles to the whole class.

Phase 2: Presenting one's individual opinion on the topic (30 minutes). When the topic was nuclear power, the students wrote their personal opinion on the topic following the instruction: "Write your opinion on building a new nuclear power station in Finland. Remember to carefully justify your opinion. Why should we increase nuclear power, or if not, why not? Consider also the points of views of different stakeholders, such as industry, politicians, conservationists. In addition, please offer a possible critique of your opinion." When the topic was GMO, the students expressed their personal opinion on the topic in the form of an argument diagram (e.g., Author, 2010). The students were instructed to include in their diagrams a claim, grounds in support of the claim, and counterarguments criticizing the claim.

Phase 3: Engaging in dyadic discussions (20 minutes and 30 minutes). The students both in the face-to-face and computer chat groups were divided into pairs on the basis of their personal opinions on the topic (either for or against) defined on the basis of their opinion writings and diagrams produced in the previous phase. Working in pairs was chosen because it has been shown that dyadic interaction increases cognitive engagement in thinking and enhances the quality of reasoning about the topic (Kuhn, Shaw, and Felton 1997). The pairs were formed so that as many students as possible could defend their personal standpoint. Further, in each pair the students had to represent opposite standpoints (protagonist vs. antagonist). As a result (Table 2), 58% of the students defended their personal standpoint and 42% of the students defended an assigned standpoint when they engaged in the debates on both topics. Approximately a half (11 out of 24) of the student pairs were mixed gender pairs and another half (13 out of 24) same gender pairs: There were five girl-boy pairs, five girl-girl pairs, and two boy-boy pairs in the debates on nuclear power, and six girl-boy pairs and six girl-girl pairs in the debates on GMO.

Because of the differences between the communication media (oral vs. written), the time allocated for the debate varied: the face-to-face students discussed the topic for 20 minutes and the computer chat students for 30 minutes. In both topics the students' task was to defend their standpoint, whether personal or not, in the debate. In the case of nuclear power, the question discussed was "Does Finland need a new nuclear power station?", while the GMO question was "Should we allow genetically modified organisms or not?" The face-to-face debates were carried out in a Finnish language classroom and the chat debates in a computer lab.

*** Insert Table 2 here ***

5.2 *Data*

The face-to-face debates were tape-recorded and transcribed, and the chat debates were saved automatically to a file. The data consisted of 12 dyadic face-to-face and 12 chat debates (2 417 speech turns in total). The face-to-face debates comprised 1 044 speech turns (423 turns on nuclear power; 621 turns on GMO) and the chat debates 1 373 speech turns (474 turns on nuclear power; 899 turns on GMO). On average, the face-to-face debates contained 1 120 words, and the chat debates 674 words.

5.3 *Data Analysis*

As the interest of the study focused not only on the quality of students' argumentative interaction but also on factors associated with it, both qualitative and quantitative methods were combined in the data analysis. To study the quality of argumentation in the students' debates, the students' speech turns (n = 2 417) were analysed for argumentativeness and argument elaboration. The further analyses were conducted using statistical methods.

5.3.1 *Argumentativeness.* All the speech turns were categorized into one of the following categories: argumentative, counterargumentative, or non-argumentative. A speech turn was coded as *argumentative* if it included a claim or an argument that directly supported the student's personal or assigned standpoint, and if it included elaboration of an argument on the topic. Further, a speech turn was coded as *counterargumentative* if it included a counterargument or either elaboration or refutation of the counterargument. Finally, a speech turn was coded as *non-argumentative* if it concerned descriptive topic-related non-argumentative interaction (e.g., stating, requesting, or clarifying opinions on the topic), managing the task (e.g., planning what is to be discussed), managing the interaction (e.g., who will speak and when, topic shifting, time management), managing social relations (e.g., establishing (un)friendliness, politeness, laughing, playful joking), or any interaction not related to

the topic or the task (see Baker et al. 2007). Two coders cross-analysed 10% of the speech turns. The inter-rater reliability of the analysis was 0.88 (Cohen's kappa). Examples of the analytical categories are presented in Tables 3–5.

*** Insert Table 3 here ***

*** Insert Table 4 here ***

*** Insert Table 5 here ***

5.3.2 *Argument elaboration.* The students' speech turns were analysed according to the level of elaboration (poor, good, no elaboration) of arguments that directly supported the student's personal or assigned standpoint (see Baker, Quignard, Lund, and van Amelsvoort 2002). A speech turn was deemed to contain *poor elaboration* if the argument was merely mentioned in the speech turn. If the argument mentioned in the speech turn also included at least one explanation, clarification, or example, or if the argument in question was further elaborated later during the dialogue, the speech turn was deemed to contain *good elaboration*. All speech turns not associated with arguments directly supporting or questioning the main claim were coded as *no elaboration*. The inter-rater reliability of the analysis was 0.81 (Cohen's kappa). Examples of poor and good elaboration are presented in Table 6.

*** Insert Table 6 here ***

5.3.3 *Statistical analyses.* The purpose of the statistical analyses was to clarify whether the independent variables were associated with the dependent variables. Because the independent and dependent variables were predetermined and categorical in nature, logit analyses (Kennedy 1988) were used. The dependent variables were formed so that they divided the speech turns into two categories according to whether the property in question appeared in a speech turn or not. Three dichotomous dependent variables for measuring the argumentativeness of the speech turns were formed (Argumentative,

Counterargumentative, and Non-argumentative; Table 7), and three such variables were formed for measuring argument elaboration (Poor elaboration, Good elaboration, and No elaboration). The independent variables were Standpoint, Topic, Study mode, and Gender.

*** Insert Table 7 here ***

Fifteen separate logit analyses were carried out. The logit analyses were performed by starting from the saturated model, in which all the possible main and interaction effects of the independent variables with a single dependent variable were taken into account. Owing to the limited amount of data, it was not possible to include all four independent variables in one single logit analysis. For this reason, several logit analyses were carried out for a maximum of three independent variables at a time. Next, all the statistically non-significant parameters were excluded from the model step by step, according to the hierarchy principle, by starting from the higher order terms and ending with the minimal acceptable model that fitted the data ($p > .05$) and included as few statistically significant parameters as possible. The minimal acceptable models of the logit analyses with statistically significant parameters are presented in the appendix. When interaction effects between independent variables were found, the main effects were not reported in the results (Kennedy 1988).

6. *Results*

6.1 *Quality of Students' Argumentation in General*

During the debates, 67% (n = 1 608) of the students' speech turns were non-argumentative, consisting of descriptive topic-related (36%), interaction management (15%), task management (3%), social relations (3%), and off-task (10%) talk. The proportion of argumentative speech turns was 8% (n = 197), and 25% (n = 612) of the speech turns were counterargumentative (Table 8).

The results also showed that 83% (n = 1 998) of the students' speech turns contained no elaboration of arguments and the remaining speech turns (17%, n = 419) were elaborative. Of the 419 elaborative speech turns, 74% (n = 310) showed good elaboration and 26% (n = 109) poor elaboration (Table 8).

*** Insert Table 8 here ***

*** Insert Table 9 here ***

6.2 *Quality of Students' Argumentation by Standpoint and Gender*

Gender played a significant role together with the standpoint (personal/assigned) when examining the quality of the students' argumentation. The logit analyses (analysis 5 in the appendix) showed that variables Standpoint and Gender had a significant interaction effect on the proportion of counterargumentative speech turns (variable 2 in Table 9): when the students defended an assigned standpoint (a standpoint contrary to their personal opinion) in the discussion, the male students produced counterargumentative speech turns more often than the female students (42% vs. 22%). However, when defending their personal standpoint, the male and female students' speech turns were nearly equally often counterargumentative (26% vs. 27%).

Standpoint and Gender also had a significant interaction effect on the proportion of non-argumentative speech turns (logit analysis 8): when the female students defended an assigned standpoint in the discussion they produced non-argumentative speech turns (variable 3 in Table 9) more often than the male students (72% vs. 50%). However, when defending their personal standpoints, the male and female students produced non-argumentative speech turns equally often (65% vs. 65%).

Examples of speech turns by male and female students when their task was to defend an assigned standpoint are presented in Table 10.

*** Insert Table 10 here ***

The examples above show that it was easier for the male students to defend an assigned standpoint by counterarguments than for the female students who, by contrast, in that role often put forward non-argumentative speech turns.

Logit analyses 10 and 11 (see appendix) also revealed that the variable Standpoint was associated with poor elaboration of arguments. The results indicated that when the students defended their personal standpoint they put forward poor elaboration of arguments (variable 4 in Table 9) more often than when their standpoint was assigned to them (5% vs. 3%). No statistically significant parameters were found neither for good nor for no elaboration of arguments.

6.3 *Quality of Students' Argumentation by Topic and Gender*

Logit analysis 1 (see appendix) revealed that the variable Topic was associated with the appearance of argumentative speech turns (variable 1 in Table 9) in the students' discussions. The students put forward more argumentative speech turns on genetically modified organisms than on nuclear power (10% vs. 6%). Furthermore, logit analysis 10 (see appendix) revealed that the variable Topic was also associated with poor elaboration of arguments (variable 4 in Table 9). The results indicated that the students' level of elaboration was poor more often in the discussions on nuclear power than in those on GMO (7% vs. 3%; Table 9).

Gender played also a significant role together with the topic when examining the quality of the students' argumentation. The logit analyses (analysis 6 in the appendix) showed that variables Topic and Gender had a significant interaction effect on the proportion of counterargumentative speech turns (variable 2 in Table 9): the male students more often put forward counterargumentative speech turns on genetically modified organisms than the female students (22% vs. 16%). When the topic was nuclear power, the situation was the reverse, favouring females (40% vs. 34%). Furthermore, logit analysis 9 revealed an interaction effect of Topic and Gender on the

proportion of non-argumentative speech turns (variable 3 in Table 9). This result showed that the female students put forward more non-argumentative speech turns than the male students on genetically modified organisms (75% vs. 67%). However, during the discussions on nuclear power, the reverse was observed (55% vs. 59%).

Examples of speech turns illustrating interaction effects between gender and topic are presented in Table 11.

*** Insert Table 11 here ***

The examples above show that the male students are more inclined to put forward counterarguments on GMO than the females who, in turn, merely presented counterarguments for a topic nuclear power which provided them a possibility to engage emotionally in argumentation.

In addition, logit analysis 15 showed that the variables Topic and Gender had an interaction effect on the proportion of speech turns containing no elaboration (variable 6 in Table 9): the male students produced non-elaborative speech turns more often than the female students during the discussions on nuclear power (84% vs. 79%), whereas during the discussions on genetically modified organisms, the situation was the reverse (80% vs. 85%).

6.4 *Quality of Students' Argumentation by Study Mode and Gender*

The results revealed that counterargumentative speech turns (variable 2 in Table 9) were more common among the male students during the face-to-face discussions (31% vs. 21%), whereas during the chat discussions the corresponding proportions were almost equal (26% vs. 28%).

In addition, logit analyses 7 and 9 (see appendix) showed that the Study mode had a main effect on the proportion of non-argumentative speech turns (variable 3 in Table 9): the students produced non-argumentative speech turns more often during face-to-face than chat discussions (69% vs. 64%).

7. *Discussion*

The study showed that in designing classroom practices for enhancing argumention complex patterns need to be taken into account. Namely, not only the standpoint defended (role play) but also gender in particular along with the discussion topic and the study mode were associated with the quality of the students' argumentation.

The results indicated that when the students defend their personal standpoint, their elaboration of arguments was poorer than when they defended non-personal, assigned standpoints. Regardless of the fact that elaboration of arguments among the students in the study was quite rare this result is interesting: Although previous studies indicate that people generate more arguments for their own position than for the opposing position (Perkins 1985; Stein and Bernas 1999; Toplak and Stanovich 2003), this study suggests that students tend to elaborate their arguments when they defend an assigned standpoint, rather when the standpoint defended is in line with their personal opinion. One reason for this result may be that when students defend assigned standpoints they are under more of an obligation to explicate and explain their position than students who defend their personal standpoints. This may be due to the need to structure their knowledge of the issue, to broaden their understanding of the issue, and to be better able to engage in argumentative discussion with their interlocutors (de Vries, Lund, and Baker 2002). Explaining, in turn, can be regarded as an activity that supports learning. Explaining can stimulate learners' understanding (Webb 1989) and self-explanations (Chi, Bassok, Lewis, Reimann, and Glaser 1989) of an issue. Learners can, for example, explain difficult things to each other or to themselves by using more familiar words or by giving examples. Further, explanation with argumentation has been linked to knowledge co-construction and conceptual understanding (de Vries, Lund, and Baker 2002). Thus, assigning students such positions in argumentative discussion that do not represent their

personal opinions seems to be a suitable pedagogical means to enhance their understanding on the topic of interest.

When the students defended a standpoint assigned to them, the male students produced counterargumentative speech turns more often than the females, whereas the females produced non-argumentative speech turns more often than the males. When the students defended their personal opinions no gender differences existed. These results suggest that male students seem to be able to engage in argumentative debates whether or not they defend their personal opinion on the discussion topic. On the contrary, for female students it seems to be a bigger challenge to defend a standpoint at variance with their personal opinion. This gender difference may be explained by findings indicating that, in general, men have a greater preference for rational reasoning than do women, who, conversely, prefer more experiential reasoning (Epstein 2003; Sladek, Bond, and Phillips 2010). Experiential reasoning refers to faith in intuition, experiences of affects, positive emotions, and avoidance of negative emotions (Sladek et al. 2010). Further, on the relationship between emotions and argumentation, Aaron Ben-Ze'ev (1995: 191) points out that emotions typically arise when individuals perceive highly significant changes in their situation. Michael Baker, Jerry Andriessen, and Sanna Järvelä (2013), in turn, emphasize that the way we represent given situations is related to our affects in those situations; in a collaborative learning situation this means that students' representations of the task and of co-learners will relate to the emotions felt, expressed, and regulated while interacting and performing the task, and this will associate with the quality of the task performance. In light of these notions, it is conceivable that the male students in this study tended mainly to ground their argumentation on evidence and the rules of logic, whereas the female students' argumentation was more often affected by their personal opinions on the discussion topic. Thus, for the female students to engage in constructive argumentative debate, it was important that they could defend a standpoint representative of their personal opinion.

From the point of view of learning, it seems that the female students' performance was hindered by myside bias (Perkins 1985). That females had difficulties in defending a standpoint which was not their own was manifested by a bigger number of non-argumentative and lower number of counterargumentative speech turns compared to males. In this kind of learning situation, the female students might also have experienced mental load, as the situation was neither authentic nor personally significant for them (Stein and Albro 2001). However, previous studies by Marttunen and Laurinen (2001, 2002) have shown that university students of education benefited rather than otherwise from arguing for a position counter to their personal opinions. However, it is worth noticing that in these studies the topics were drawn from the field of education and were, thus, both relevant and motivating for student debate.

The results also showed that, when the discussion topic was nuclear power, the female students produced more counterargumentative speech turns than the males whereas the reverse was found when the students discussed genetically modified organisms. The female students also produced more non-argumentative and non-elaborative speech turns than the males when the topic was GMO. However, during the discussions on nuclear power the proportion of non-elaborative speech turns was greater among the male students. These results suggest that nuclear power as a discussion topic, rather than GMO, stimulated the female students in particular to engage in elaborative argumentation. This gender difference is understandable, as a review of 36 studies by Debra Davidson and Wiluam Freudenburg (1996) found that females express more concern about nuclear power than males. In general, females (young people and adults) possess stronger attitudes and behaviors towards environmental responsibility than males (Uitto, Juuti, Lavonen, Byman, and Meisalo 2011; Zelezny, Chua, and Aldrich 2000). GMO, particularly for the females, was the less stimulating topic from the point of view of arguing and the elaboration of arguments. It is possible that the students did not have enough knowledge on GMO to be able to engage in broad and deep

argumentation. In fact, Jerry Andriessen, Michael Baker, and Dan Suthers (2003) concluded that during an argumentative discussion participants do tend not to bring in more knowledge than they feel relatively certain about, often with the result that engagement in the discussion remains on a superficial level. In addition, females, compared to males, tend to be more critical of GMO, even to that extent that for females more knowledge on the issue often also means a more hesitant attitude (Moerbeek and Casimir 2005).

A review by Fleur Prinsen, Monique Volman, and Jan Terwel (2007) found that in the context of computer-supported collaborative learning female students tend to be more willing to share their intuitive conceptions in discussions while males prefer more authoritative statements. Such contributions by females seem to stimulate people to engage in constructive argumentative discussion. For example, females may start a discussion by expressing their personal experiences on the topic, which may have resonance for the other discussants. Thus, the use of mixed gender pairs, with a selection of such topics that inspire females in particular, would seem to be wise as a way of promoting learning. Topics of these kinds can be assumed to be personally meaningful. Using authentic problems, which are related to learners' daily lives, may foster learners' argumentation skills (e.g., Udell 2007; Zeidler et al. 2009).

Further, the results also showed that the male students produced more counterargumentative speech turns face-to-face than the females, whereas during the chat discussions this gender difference was absent. These results suggest that gender differences in argumentative communication may be levelled out when a network environment is used. Previous studies have shown that students' counterargumentativeness increased when they practised argumentation in the electronic mode and this gain was also successfully transferred to the face-to-face mode (Iordanou 2013; Guiller, Durndell, and Ross 2008). On the other hand, while in the previous studies male students have been found to be dominating and to have a more assertive,

competitive, and adversarial conversation style compared to females (Prinsen et al. 2007; Carr, Cox, Eden, and Hanslo 2004), female students have been found to be more attuned to the task and willing to collaborate (Prinsen et al. 2007). Thus, from the point of view of learning through constructive argumentation, gender differences in communication styles should not be seen as an obstacle but, rather, as a benefit for both male and female students (Robertson, Hewitt, and Scardamalia 2003; Salminen, Marttunen, and Laurinen 2012). Males, through their assertive and adversative communication style can provide a challenging space for knowledge construction, while females, for their part, can maintain argumentative discussion and facilitate argument elaboration through collaborative efforts.

To conclude, planning an appropriate educational design to promote argumentative activities is a rather demanding task (Andriessen and Schwarz 2009). Several factors, such as discussion topic, study mode, gender, prior knowledge and opinions, are all involved in such a learning task, and, thus, may either trigger or hamper students' engagement in productive argumentation. Nevertheless, the present study suggests that role play, in which both the dialectical nature of argumentation and the importance of students' personal standpoints on an issue are taken into account, is a workable means to support high quality student argumentation in the classroom. The study also suggests that, in particular, the emotional engagement of females in argumentation can be enhanced by offering them topics with personal relevance. Furthermore, a network environment seems to be a suitable study mode for productive argumentation, as it seems to level out gender differences in communication.

However, the results of this study should be viewed with caution since the number of participants was rather small ($n = 27$). Due to the small number of participants generalization to a larger population, to other ages, topics, and tasks is not warranted. Thus, the results should be viewed to characterize the discussions among the students of this study only. However, this study may guide further research.

The study also focused on examining whether a very specific role play setting used for pedagogical purposes stimulated students to argue, and did not assess whether students' argumentation skills improved or what they actually learned. Thus, future research might additionally focus on learning outcomes. Another limitation is that the students' topic beliefs might have affected their preparation for the debates and their argumentation. Matthew McCrudden and Phillip Sparks (2014) found that argumentative task instructions may even polarise students' topic beliefs when their beliefs are already quite strong. This means that sometimes an argumentative task assignment is not enough to promote the learning of critical thinking. Although, in the present study, the students' personal standpoints on the topics were ascertained, it was not investigated how strong or weak their topic beliefs were. Thus, in future studies it may be important to measure students' topic beliefs as well. It would also be interesting to examine more closely the role of emotions in argumentation, particularly from the point of view of gender comparisons. Future research could also focus on the possible gender-relatedness of different discussion topics when seeking to induce productive argumentation. Overall, the results of this study point to efforts to design further argumentative activities for learning purposes.

References

Andriessen, Jerry, Michael Baker, and Dan Suthers. 2003. "Argumentation, Computer Support, and the Educational Context of Confronting Cognitions." In *Arguing to learn: confronting cognitions in computer-supported collaborative learning environments*, ed. by Jerry Andriessen, Michael Baker, and Dan Suthers, 1–25. Dordrecht: Kluwer.

Andriessen, Jerry, Michael Baker, and Chiel van der Puil. 2011. "Socio-Cognitive Tensions in Collaborative Working Relations." In *Learning across sites: new tools, infrastructures and practices*, ed. by Sten Ludvigsen, Andreas Lund, Ingvill

Rasmussen, and Roger Säljo, 222–242. London: Pergamon.

Andriessen, Jerry, and Baruch Schwarz. 2009. “Argumentative Design.” In *Argumentation and learning. Theoretical foundations and practices*, ed. by Nathalie Muller Mirza, and Anne-Nelly Perret-Clermont, 145–174. Dordrecht: Springer.

Arvaja, Maarit, Helena Rasku-Puttonen, Päivi Häkkinen, and Anneli Eteläpelto. 2003. “Constructing Knowledge Through a Role-Play in a Web-based Learning Environment.” *Journal of Educational Computing Research* 28 (4): 319–341.

Asterhan, Christa S. C., and Baruch B. Schwarz. 2009. “Argumentation and Explanation in Conceptual Change: Indications from Protocol Analyses of Peer-to-Peer Dialog.” *Cognitive Science* 33: 374–400.

Asterhan, Christa S. C., Baruch B. Schwarz, and Julia Gil. 2012. “Small-Group, Computer-Mediated Argumentation in Middle-School Classrooms: The Effects of Gender and Different Types of Online Teacher Guidance. *British Journal of Educational Psychology* 82: 375–397.

Baker, Michael, Jerry Andriessen, and Sanna Järvelä. 2013. “Introduction: visions of learning together.” In *Affective Learning Together: Social and Emotional Dimensions of Collaborative Learning*, ed. by Michael Baker, Jerry Andriessen, and Sanna Järvelä, 1–30. New York, NY: Routledge.

Baker, Michael, Jerry Andriessen, Kristine Lund, Marije van Amelsvoort, and Matthieu Quignard. 2007. “Rainbow: A Framework for Analysing Computer-Mediated Pedagogical Debates.” *International Journal of Computer-Supported Collaborative Learning* 2 (2–3): 315–357.

Baker, Michael, Matthieu Quignard, Kristine Lund, and Marije van Amelsvoort. 2002. “Designing a Computer-Supported Collaborative Learning Situation for Broadening and Deepening Understanding of the Space of Debate.” In *Proceedings of the Fifth International Conference of the International Society for*

the Study of Argumentation, Amsterdam, June 2002: 55–61. Amsterdam: Sic Sat Publications.

Ben-Ze'ev, Aaron. 1995. "Emotions and Argumentation." *Informal Logic* 17 (2): 189–200.

Burnett, Cathy. 2003. "Learning to Chat: Tutor Participation in Synchronous Online Chat." *Teaching in Higher Education* 8: 247–261.

Carr, Tony, Lenda Cox, Andrea Eden, and Monique Hanslo. 2004. "From Peripheral to Full Participation in a Blended Trade Bargaining Simulation." *British Journal of Educational Technology* 35 (2): 197–211.

Chi, Michelene T. H., Miriam Bassok, Matthew W. Lewis, Peter Reimann, and Robert Glaser. 1989. "Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems." *Cognitive Science* 13 (2): 145–182.

Chinn, Clark A. 2006. "Learning to Argue." In *Collaborative learning, reasoning, and technology,* ed. by Angela M. O'Donnell, Cindy E. Hmelo-Silver, and Gijsbert Erkens, 355–383. Mahwah, NJ: Erlbaum.

Chinn, Clark A., and Douglas B. Clark. 2013. "Learning through Collaborative Argumentation." In *The international handbook of collaborative learning,* ed. by Cindy E. Hmelo-Silver, Clark A. Chinn, Carol K. K. Chan, and Angela M. O'Donnell, 314–332. New York, NY: Routledge.

Davidson, Debra J., and Wiluam R. Freudenburg. 1996. "Gender and Environmental Risk Concerns: A Review and Analysis of Available Research. *Environment and Behavior,* 28: 302–339.

de Vries, Erica, Kristine Lund, and Michael Baker. 2002. "Computer-Mediated Epistemic Dialogue: Explanation and Argumentation as Vehicles for Understanding Scientific Notions." *The Journal of the Learning Sciences* 11 (1): 63–103.

Dillenbourg, Pierre, and Mireille Bétrancourt. 2006. "Collaboration Load." In *Handling*

complexity in learning environments: Research and theory, ed. by Jan Elen, and Richard Edward Clark, 142–163. Amsterdam, The Netherslands: Elsevier.

Dillenbourg, Pierre, and Daniel Schneider. 1995. "Collaborative Learning and the Internet." ICCAI 95, 1995. Retrieved from http://tecfa.unige.ch/tecfa/research/CMC/ colla/iccai95_1.html.

Epstein, Seymour. 2003. "Cognitive-Experiential Self Theory of Personality." In *Handbook of psychology: Vol 5. Personality and social psychology*, ed. by Theodore Millon, and Melvin J. Lerner, 159–184. Hoboken, NJ: Wiley.

Erkens, Gijsbert, and Jeroen Janssen. 2008. "Automatic Coding of Dialogue Acts in Collaboration Protocols." *International Journal of Computer-Supported Collaborative Learning* 3 (4): 447–470.

Golder, Caroline, and Delphine Pouit. 1999. "For a Debate to Take Place the Topic Must Be Debatable." In *Foundations of argumentative text processing*, ed. by Jerry Andriessen, and Pierre Coirier, 137–148. Amsterdam: Amsterdam University Press.

Guiller, Jane, Alan Durndell, A., and Anne Ross. 2008. "Peer Interaction and Critical Thinking: Face-to-Face or Online Discussion?" *Learning and Instruction* 18: 187–200.

Holsbrink-Engels, Geralien. 2001. "Using a Computer Learning Environment for Initial Training in Dealing with Social-Communicative Problems." *British Journal of Educational Technology* 32 (1): 53–67.

Iordanou, Kalypso. 2013. "Developing Face-to-Face Argumentation Skills: Does Arguing on the Computer Help?" *Journal of Cognition and Development* 14 (2): 292–320.

Jeong, Allan. 2006. "Gender Interaction Patterns and Gender Participation in Computer-Supported Collaborative Argumentation." *The American Journal of Distance Education* 20 (4): 195–210.

Jeong, Allan. 2007. “The Effects of Intellectual Openness and Gender on Critical Thinking Processes in Computer-Supported Collaborative Argumentation.” *Distance Education* 22 (1): 1–18.

Jeong, Allan, and Gayle Davidson-Shivers. 2006. “The Effects of Gender Interaction Patterns on Student Participation in Computer-Supported Collaborative Argumentation.” *Educational Technology, Research, and Development* 54: 543–568.

Kennedy, John J. 1988. “Applying Log-Linear Models in Educational Research.” *Australian Journal of Education* 32 (1): 3–24.

Kolstoe, Stein D. 2000. “Consensus Projects: Teaching Science for Citizenship.” *International Journal of Science Education* 22: 645–664.

Kuhn, Deanna, Victoria Shaw, and Mark Felton. 1997. “Effects of Dyadic Interaction on Argumentative Reasoning.” *Cognition and Instruction* 15: 287–315.

Kuhn, Deanna, and Wadiya Udell. 2007. “Coordinating Own and Other Perspectives in Argument.” *Thinking and Reasoning* 13 (2): 90–104.

Larson, Meredith, M. Anne Britt, and Aaron A. Larson. 2004. “Disfluencies in Comprehending Argumentative Texts.” *Reading Psychology* 25: 205–224.

Lim, Mei Y., Karin Leichtenstern, Michael Kriegel, Sibylle Enz, Ruth Aylett, Natalie Vannini, Lynne Hall, and Paola Rizzo. 2011. “Technology-Enhanced Role-Play for Social and Emotional Learning Context – Intercultural Empathy.” *Entertainment Computing* 2: 223–231.

Marttunen, Miika. 1997. *Studying Argumentation in Higher Education By Electronic Mail*. Jyväskylä Studies in Education, Psychology and Social Research 127. University of Jyväskylä, Jyväskylä.

Marttunen, Miika, and Leena Laurinen. 2001. ”Promoting Argumentation Skills in University: Comparing E-Mail and Face-to-Face Studies.” In *Human-centered technology and learning*, ed. by Hannakaisa Isomäki, Jouko Kari, Miika

Marttunen, Antti Pirhonen, and Jyrki Suomala, 17–53. University of Jyväskylä. Department of Teacher Education. Jyväskylä: Jyväskylä University Printing House.

Marttunen, Miika, and Leena Laurinen. 2002. ”Quality of Students’ Argumentation by E-Mail.” *Learning Environments Research* 5: 99–123.

Marttunen, Miika, Leeena Laurinen, Lia Litosseliti, and Kristine Lund. 2005. ”Argumentation Skills as Prerequisites for Collaborative Learning Among Finnish, French, and English Secondary School Students.” *Educational Research and Evaluation* 11 (4): 365–384.

McCrudden, Matthew, and Phillip Sparks. 2014. “Exploring the Effect of Task Instructions on Topic Beliefs and Topic Belief Justifications: A Mixed Methods Study.” *Contemporary Educational Psychology* 39: 1–11.

Moerbeek, Hester, and Gerda Casimir. 2005. “Gender Differences in Consumers’ Acceptance of Genetically Modified Foods.” *International Journal of Consumer Studies* 29 (4): 308–318.

Morgan, Wendy, and Glenn Beaumont. 2003. “A Dialogic Approach to Argumentation: Using a Chat Room to Develop Early Adolescent Students’ Argumentative Writing.” *Journal of Adolescent and Adult Literacy* 47 (2): 146–157.

Muller Mirza, Nathalie, Anne-Nelly Perret-Clermont, Valérie Tartas, and Antonio Iannaccone. 2009. “Psychosocial Processes in Argumentation.” In *Argumentation and learning. Theoretical foundations and practices*, ed. by Nathalie Muller Mirza, and Anne-Nelly Perret-Clermont, 67–90. Dordrecht: Springer.

Noroozi, Omid, Armin Weinberger, Harm J. A. Biemans, Martin Mulder, and Mohammad Chizari. 2012. “Argumentation-based Computer Supported Collaborative Learning (ABCSCL): A Synthesis of 15 Years of Research.” *Educational Research Review* 7 (2): 79–106.

O’Connor, Sue, and Anne Ross. 2004. “WebCT Role-Playing: Immediacy Versus E-

Mediacy in Learning Environments." *Learning Environments Research* 7: 183–201.

Perkins, David N. 1985. "Postprimary Education Has Little Impact on Informal Reasoning." *Journal of Educational Psychology* 77: 562–571. Retrieved from http://search.proquest.com/docview/614285539?accountid=11774

Prinsen, Fleur R., Monique L. L. Volman, and Jan Terwel. 2007. "Gender-Related Differences in Computer-Mediated Communication and Computer-Supported Collaborative Learning." *Journal of Computer Assisted Learning* 23: 393–409.

Robertson, Olivia, Jim Hewitt, and Marlene Scardamalia, M. 2003. *Gender participation patterns in Knowledge Forum: an analysis of two graduate-level classes*. Poster presented at the IKIT Summer Institute 2003, Toronto.

Salminen, Timo, Miika Marttunen, and Leena Laurinen. 2010. "Visualising Knowledge From Chat Debates in Argument Diagrams." *Journal of Computer Assisted Learning* 26 (5): 379–391.

Salminen, Timo, Miika Marttunen, and Leena Laurinen. 2012. "Argumentation in Secondary School Students' Structured and Unstructured Chat Discussions." *Journal of Educational Computing Research* 47 (2): 175–208.

Scheuer, Oliver, Frank Loll, Niels Pinkwart, and Bruce M. McLaren. 2010. "Computer-Supported Argumentation: A Review of the State of the Art." *International Journal of Computer-Supported Collaborative Learning* 5 (1): 43–102.

Schwarz, Baruch B. 2009. "Argumentation and Learning." In *Argumentation and learning. Theoretical foundations and practices*, ed. by Nathalie Muller Mirza, and Anne-Nelly Perret-Clermont, 91–126. Dordrecht: Springer.

Schweizer, Karin, Manuela Paechter, and Bernd Weidenmann. 2003. "Blended Learning as a Strategy to Improve Collaborative Task Performance." *Journal of Educational media* 28 (2–3): 211–224.

Simonneaux, Laurence. 2001. "Role-Play or Debate to Promote Students'

Argumentation and Justification on an Issue in Animal Transgenesis." *International Journal of Science Education* 23 (9): 903–927.

Sladek, Ruth M., Malcolm J. Bond, and Paddy A. Phillips. 2010. "Age and Gender Differences in Preferences for Rational and Experiential Thinking." *Personality and Individual Differences* 49: 907–911.

Stein, Nancy L., and Elizabeth R. Albro. 2001. "The Origin and Nature of Arguments: Studies in Conflict Understanding, Emotion, and Negotiation." Discourse Processes 32 (2–3): 113–133.

Stein, Nancy L., and Ronan Bernas. 1999. "The early emergence of argumentative knowledge and skill." In *Foundations of argumentative text processing*, ed. by Jerry Andriessen, and Pierre Coirier, 97–116. Amsterdam: Amsterdam University Press.

Sweller, John, Jeroen van Merriënboer, and Fred Paas. 1998. "Cognitive Architecture and Instructional Design." *Educational Psychology Review* 10: 251–296.

Toplak, Maggie E., and Keith E. Stanovich. 2003. "Associations Between Myside Bias on an Informal Reasoning Task and Amount of Post-Secondary Education." *Applied Cognitive Psychology* 17: 851–860.

Udell, Wadiya. 2007. "Enhancing Adolescent Girls' Argument Skills in Reasoning About Personal and Non-Personal Decisions." *Cognitive Development* 22: 341–352. Retrieved from http://www.sciencedirect.com/science/journal/08852014/22/3

Uitto, Anna, Kalle Juuti, Jari Lavonen, Reijo Byman, and Veijo Meisalo. 2011. "Secondary School Students' Interests, Attitudes and Values Concerning School Science Related to Environmental Issues in Finland." *Environmental Education Research* 17 (2): 167–186.

van Bruggen, Jan M., Paul A. Kirschner, and Wim Jochems. 2002. "External Representation of Argumentation in CSCL and the Management of Cognitive Load." *Learning and Instruction* 12 (1): 121–138.

Veerman, Arja. 2000. *Computer-Supported Collaborative Learning Through Argumentation.* Unpublished doctoral dissertation. Utrecht University, The Netherlands.

Vincent, Andrew, and John Shepherd. 1998. "Experiences in Teaching Middle East Politics via Internet-based Role-Play Simulations. *Journal of Interactive Media in Education* 98 (11). Retrieved from http://www-jime.open.ac.uk/98/11/

Walton, Douglas N. 1989. "Dialogue Theory for Critical Thinking." *Argumentation* 3, 169–184.

Webb, Noreen M. 1989. "Peer Interaction and Learning in Small Groups." *International Journal of Education Research* 13: 21–39.

Yardley-Matwiejczuk, Krysia M. 1997. *Role Play: Theory and Practice*. London: Sage.

Zeidler, Dana L., Troy D. Sadler, Scott Applebaum, and Brendan E. Callahan. 2009. "Advancing Reflective Judgment Through Socioscientific Issues." *Journal of Research in Science Teaching* 46: 74–101.

Zelezny, Lynnette C., Poh-Pheng Chua, and Christina Aldrich. 2000. "New Ways of Thinking about Environmentalism: Elaborating on Gender Differences in Environmentalism." *Journal of Social Issues* 56 (3): 443–457.

Zohar, Anat, and Flora Nemet. 2002. "Fostering Students' Knowledge and Argumentation Skills Through Dilemmas in Human Genetics." *Journal of Research in Science Teaching* 39: 35–62.

Appendix. Summary of Logit Analyses (Minimal Acceptable Models)

Parameter	**Estim.**	***SE***	***Z***	***p***
Argumentativeness variables				
Analysis 1 (X1 Argumentative, X7 Standpoint, X8 Topic, X9 Study mode): $G2 = 5.15$, $df = 6$, $p = .524$				
X1 (Argumentative)	2.26	.09	25.77	***
X1 by X8 (Topic)	.51	.17	3.07	**
Analysis 2 (X1, X7, X9, X10 Gender) and analysis 3 (X1, X7, X9, X10): no statistically significant parameters (ns.)				
Analysis 4 (X2 Counterargumentative, X7-X9): $G2 = 5.40$, $df = 5$, $p = .370$				
X2 (Counterargumentative)	1.40	.08	18.49	***
X2 by X8 (Topic)	-1.03	.10	-10.72	***
X2 by X9 (Study mode)	.30	.10	3.03	**
Analysis 5 (X2, X7, X9, X10): $G2 = .55$, $df = 2$, $p = .759$				
X2 (Counterargumentative)	1.17	.10	11.31	***
X2 by X7 (Standpoint)	-.79	.23	-3.47	**
X2 by X9 (Study mode)	-.30	.17	-1.75	ns.
X2 by X10 (Gender)	-.32	.14	-2.27	*
X2 by X7 by X10	1.03	.26	4.00	***
X2 by X9 by X10	.66	.21	3.13	**
Analysis 6 (X2, X8, X9, X10): $G2 = 4.41$, $df = 2$, $p = .110$				
X2 (Counterargumentative)	1.28	.12	10.68	***
X2 by X8 (Topic)	-.56	.16	-3.47	**
X2 by X9 (Study mode)	-.11	.18	-.63	ns.
X2 by X10 (Gender)	.15	.15	.98	ns.
X2 by X8 by X10	-.72	.20	-3.55	***
X2 by X9 by X10	.58	.21	2.70	**
Analysis 7 (X3 Non-argumentative, X7, X8, X9): $G2 = 1.35$, $df = 4$, $p = .853$				
X3 (Non-argumentative)	-.80	.07	-11.15	***
X3 by X7 (Standpoint)	-.21	.09	-2.27	*
X3 by X8 (Topic)	.74	.09	8.32	***
X3 by X9 (Study mode)	-.25	.09	-2.74	**
Analysis 8 (X3, X7, X9, X10): $G2 = 6.84$, $df = 3$, $p = .077$				
X3 (Non-argumentative)	-.57	.08	-6.95	***
X3 by X7 (Standpoint)	.62	.22	2.77	**
X3 by X9 (Study mode)	-.14	.09	-1.58	ns.
X3 by X10 (Gender)	.03	.11	.25	ns.
X3 by X7 by X10	-.91	.25	-3.67	***
Analysis 9 (X3, X8, X9, X10): $G2 = 3.03$, $df = 3$, $p = .387$				
X3 (Non-argumentative)	-.66	.10	-6.44	***
X3 by X8 (Topic)	.40	.15	2.73	**
X3 by X9 (Study mode)	-.24	.09	-2.64	**
X3 by X10 (Gender)	-.32	.13	-2.55	*
X3 by X8 by X10	.51	.19	2.74	**
Argument elaboration variables				
Analysis 10 (X4 Poor elaboration, X7, X8, X9): $G2 = 10.12$, $df = 5$, $p = .072$				
X4 (Poor elaboration)	3.21	.15	20.86	***
X4 by X7 (Standpoint)	.50	.22	2.28	*
X4 by X8 (Topic)	-.71	.20	-3.61	***
Analysis 11 (X4, X7, X8, X10): $G2 = 5.17$, $df = 6$, $p = .523$				
X4 (Poor elaboration)	2.90	.12	24.93	***
X4 by X7 (Standpoint)	.46	.22	2.12	*
Analysis 12 (X4, X7, X8, X9): ns.				
Analysis 13 (X5 Good elaboration, X7, X8, X9): ns.				
Analysis 14 (X6 No elaboration, X7, X9, X10): ns.				
Analysis 15 (X6, X8, X9, X10): $G2 = 1.37$, $df = 3$, $p = .713$				
X6 (No elaboration)	-1.38	.12	-11.54	***
X6 by X8 (Topic)	-.31	.19	-1.66	ns.
X6 by X9 (Study mode)	.05	.11	.40	ns.
X6 by X10 (Gender)	-.38	.15	-2.54	*
X6 by X8 by X10	.71	.23	3.05	**

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 1

Design of the Study

Group	Day 1	Day 2
Group 1	Nuclear power (face-to-face)	GMO (computer chat)
Group 2	Nuclear power (computer chat)	GMO (face-to-face)

Table 2

Frequencies and Proportions of Students Defending either Their Personal Standpoint or an Assigned Standpoint During the Debates

	Topic											
	Nuclear power						Genetically modified organisms					
	Face-to-face		Chat		Total		Face-to-face		Chat		Total	
Standpoint	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Personal	7	58	7	58	14	58	6	50	8	67	14	58
Assigned	5	42	5	42	10	42	6	50	4	33	10	42
Total	12	100	12	100	24*	100	12	100	12	100	24*	100

*All students (n = 27) did not participate in the debates on both days.

Table 3

Example of an Argumentative Speech Turn

Claim	Argument	Interpretation
It would be profitable to build a 5th nuclear power station in Finland, because…	*it would make the price of energy cheaper* (speech turn 878)	An argument (in italics) directly supporting a claim relating to the discussion topic. (The student's role was to defend the need for a new power station.)

Table 4

Example of a Counterargumentative Speech Turn

Argument	Counterargument	Interpretation
[It would be profitable to build a 5th nuclear power station in Finland, because…] it would lower the price of energy (speech turn 878)	*nuclear power stations destroy the natural environment, so that making the price of energy quite high* (speech turn 879)	A counterargument (in italics) against the argument produced in the previous speech turn (878). (The students's role was to oppose the building of a new power station.)

Table 5

Examples of Non-Argumentative Speech Turns

Non-argument	Interpretation
My role is that more nuclear power is needed in Finland and you are against it (speech turn 33)	A non-argumentative speech turn indicating managing the task.
ha-haa – you lost (speech turn 240)	A non-argumentative speech turn referring to managing social relations.

Table 6

Examples of Poor and Good Elaboration

Claim	Argument	Level of elaboration	Interpretation
It would not be profitable to build a 5th nuclear power station in Finland, because…	*nuclear waste is always a source of pollution* (speech turn 883)	Poor	The argument (in italics) is only mentioned.
	the building of nuclear power is risky, as we already saw in Russia [Chernobyl] *or somewhere there* (speech turn 886)	Good	The argument (in italics) includes an example (Chernobyl).

Table 7

Variables Used in the Statistical Analyses

Independent variables	Dependent variables	
	Argumentativeness of the speech turns	Argument elaboration in the speech turns
X7 Standpoint X8 Topic X9 Study mode X10 Gender	X1 Argumentative X2 Counterargumentative X3 Non-argumentative	X4 Poor elaboration X5 Good elaboration X6 No elaboration

Table 8

Frequencies and Proportions of Speech Turns in the Different Categories by Standpoint, Study Mode, Topic, and Gender

	Standpoint				Study mode				Topic				Gender					
	Personal		Assigned		Face-to-face		Chat		Nuclear power		GMO		Male (n = 9)		Female (n = 18)		Total	
Analysis category	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Argumentativeness																		
Argumentative	133	9	64	7	80	8	117	9	53	6	144	10	77	9	120	8	197	8
Counter-argumentative	393	26	219	24	240	23	372	27	338	38	274	18	224	27	388	24	612	25
Non-argumentative	969	65	639	69	724	69	884	64	506	56	1102	72	516	63	1092	68	1608	67
Total	1495	100	922	100	1044	100	1373	100	897	100	1520	100	817	100	1600	100	2417	100
Argument elaboration																		
Poor elaboration	78	5	31	3	38	4	71	5	58	7	51	3	36	4	73	5	109	4
Good elaboration	194	13	116	13	144	14	166	12	110	12	200	13	113	14	197	12	310	13
No elaboration	1223	82	775	84	862	83	1136	83	729	81	1269	84	668	82	1330	83	1998	83
Total	1495	100	922	100	1044	100	1373	100	897	100	1520	100	817	100	1600	100	2419	100

Note: GMO = Genetically modified organisms

Table 9

Significant Associations (Logit Analyses) of the Independent Variables with Argumentativeness and Argument Elaboration

	Significant associations of independent variables						
	Main effects				Interaction effects		
Dependent variables	Standpoint	Topic	Study mode	Gender	Standpoint by Gender	Topic by Gender	Study mode by Gender
Argumentativeness							
Argumentative (variable 1)		NP 6% GMO 10%					
Counter-argumentative (variable 2)	PS 26% AS 24%	NP 38% GMO 18%	F2F 23% Chat 27%	Male 27% Female 24%	Male: PS 26%; AS 42% Female: PS 27%; AS 22%	Male: NP 34%; GMO 22% Female: NP 40%; GMO 16%	Male: F2F 31%; Chat 26% Female: F2F 21%; Chat 28%
Non-argumentative (variable 3)	PS 65% AS 69%	NP 56% GMO 73%	F2F 69% Chat 64%	Male 63% Female 68%	Male: PS 65%; AS 50% Female: PS 65%; AS 72%	Male: NP 59%; GMO 67% Female: NP 55%; GMO 75%	
Argument elaboration							
Poor elaboration (variable 4)	PS 5% AS 3%	NP 7% GMO 3%					
No elaboration (variable 6)				Male 83% Female 82%		Male: NP 84%; GMO 80% Female: NP 79%; GMO 85%	

Note: PS = Personal standpoint; AS = Assigned standpoint; NP = Nuclear power; GMO = Genetically modified organisms; F2F = Face-to-face

Table 10

Examples of Speech Turns by Students Defending an Assigned Standpoint

Gender	Standpoint	Analysis category of the speech turn	Speech turn	Description
Male	Assigned (against nuclear power)	Counter-argumentative	*but in the long run, we will basically manage on them* [wind and water power] *and we could get ready for that situation* (speech turn 4)	A counterargument for the previously presented argument: *in this moment, wind and water power are not so effective that we will get enough power for the whole country* (speech turn 3).
Male	Assigned (for nuclear power)	Counter-argumentative	*nuclear waste should just be pushed so deep that there is no any harm of it* (speech turn 650)	A counterargument for the previously presented argument: *even one power station produces so much nuclear waste that we must stash it somewhere* (speech turn 649).
Female	Assigned (for nuclear power)	Non-argumentative	*yeah* (laughing), *this topic is quite difficult* (speech turn 244)	A non-argumentative speech turn indicating managing the task. The female student regards debating on nuclear power as a demanding task.
Female	Assigned (for nuclear power)	Non-argumentative	*nuclear power does not belong to my everyday life* (speech turn 534)	A non-argumentative speech turn indicating clarifying opinions on the topic.

Table 11

Examples of Speech Turns Illustrating Interaction Effects between Gender and Topic

Gender	Topic	Analysis category of the speech turn	Speech turn	Description
Male	GMO	Counter-argumentative	*but how well these new varieties will get along with each other when human being even now destroys varieties at a fast rate* (speech turn 1012)	A counterargument for the previously presented argument: *by gene technology we can develop new varieties that acclimatize to changing conditions* (speech turn 1011).
Female	Nuclear power	Counter-argumentative	*Don't you care your descendants at all? Their living will be quite hell if we now revel whichever way* (speech turn 485)	A counterargument for the previously presented argument: *in future, people will anyway think of a solution* (for nuclear waste). *Motto: Have now fun and die young!* (speech turn 484).
Female	GMO	Non-argumentative	*well, bear in mind that I don't know anything about the topic, I just put forward something…;)* (speech turn 2106)	A speech turn indicating non-argumentative interaction. The student feels that she does not have enough knowledge on GMO.
Male	Nuclear power	Non-argumentative	*should we still try to discuss that topic more?* (speech turn 587)	A non-argumentative speech turn indicating managing the interaction.