Developing Argument Skills Through the SOCRATES Learning Environment

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Abstract: The SOCRATES web-based learning environment, which aims to support the development of argument skills, is described here. Also, a study (in progress) is described where 5th graders (11 year olds) engaged (a) in electronic argumentive dialogs with classmates who held an opposing view on the topic, and (b) in some evidence-focused reflective activities, based on transcriptions of their dialogs, in the context of the SOCRATES learning environment. Participants' epistemic cognition, epistemic emotions and argument skills are examined.

Introduction

Engagement in argument from evidence features as one of the fundamental objectives of science education throughout the K-12 range, from kindergarten through grade 12 (The Next Generation Science Standards, 2013). There is a general consensus that there is a need to move away from practices that support the mere transmission of facts to students for consumption, to practices that promote scientific thinking.

Various approaches have been developed to help students learn how to participate in scientific argumentation with mixed results (Zohar & Nemet, 2002). Some efforts to support argumentation focused on teaching students the structure of a "good" argument, based on Toulmin's argumentation model, (Mc-Neill et al., 2006; Sampson & Clark, 2009; Zohar & Nemet, 2002). Yet, the modest gains of instruction to support argumentation (Osborne, Erduran & Simon, 2004; Zohar & Nemet, 2002) point to the challenge of supporting the development of scientific argumentation and to the need for further research to gain a better understanding on how to support students to develop the ability to engage in skilled argumentation. Some other efforts to support argumentation focused on offering professional development to teachers (Osborne, Simon, Christodoulou, Howell-Richardson, & Richardson, 2013) and studying teachers' practices in order to gain an understanding of what kind of practices support scientific argumentation (McNeill, Pimentela, & Strauss, 2013; Ryu & Sandoval, 2012). Yet, the work of Osborne et al. (2013) showed that relying solely on teachers, without any particular curriculum, is not always a successful means to promote students' argumentation.

Besides direct teaching and offering traineeship to teachers to support students' argument skills, computer supported collaborative activities have been employed to support students' argument skills (Bell & Linn, 2000). Iordanou and Constantinou (2015) developed the SOCRATES web-based learning environment which supports the development of students' argument skills through engagement in electronic argumentation and scaffolding. Students have the opportunity to engage in electronic argumentation, through a chat tool that is embedded in the learning environment, and then reflect on the product of their argumentation using electronic scaffold sheets. The SOCRATES learning environment supports both students' ability to construct counterarguments and their ability to employ evidence to support their claims and critique. Students are not directly asked to use evidence in their arguments; they are asked instead to reflect on whether they had used evidence in their arguments when engaged in a dialog with peers and to revise their arguments, in respect to employing evidence to back up their claims. Reflection is facilitated by having participants arguing on the computer, through instant messaging software, which has the benefit of providing an immediately available, permanent record of the discourse for participants to reflect on, in contrast to the conditions of real-time verbal discourse.

In the work of Iordanou and Constantinou (2014) the SOCRATES learning environment was employed to support pre-service teachers' argument skills. 66 Junior (third-year) students who attended an undergraduate program in Education engaged in an argument-based intervention in the context of the SOCRATES learning environment over 13 sessions. Same-side peers collaborated in that study in arguing on the computer against successive pairs of peers on the opposing side of an issue on the topic of Climate Change and engaged in explicit reflective activities on the use of evidence. In this study meta-level awareness regarding the use of evidence in discourse was supported by having same-side peers collaborating in arguing on the computer against successive pairs of peers on the opposing side of an issue on the topic of Climate Change and by engaging in explicit reflective activities on the use of evidence. Results showed that by the end of the intervention participants exhibited significant advances both in their skill of producing evidence-based arguments and counterarguments and regarding the accuracy of the evidence used. Advances were also observed at the meta-level, reflecting at least implicit understanding that using evidence is an important goal of argumentation. Another group of pre-service

teachers, who studied about the role of evidence in science in the context of regular curriculum and served as a control condition, did not exhibit comparable advances in the use of evidence in argumentation.

In order to gain a deeper understanding of the process of development Iordanou and Constantinou (2015) examined high school students while engaging in argumentive and reflective activities in the context of SOCRATES learning environment, using the microgenetic method. The aim of this study was to examine how students used evidence in argumentation when they engaged in argumentive and reflective activities in the context of a web-based learning environment. Sixteen 11th graders, working with a partner, engaged (a) in electronic argumentive dialogs with classmates who held an opposing view on the topic, and (b) in some evidence-focused reflective activities, based on transcriptions of their dialogs. Another 16 11th graders, who studied the data base in the learning environment but did not engage in argumentive discourse activity, served in a comparison condition. Students who engaged in an evidence-focused dialogic intervention increased the use of evidence in their dialogs, used more evidence that functioned to weaken opponents' claims and used more accurate evidence. Experimental condition students exhibited also gains in meta-level communication about the use of evidence in dialog over the course of intervention dialogs. Analysis of participants' dialogs over the course of the intervention was particularly insightful in revealing considerable gains in evidence use in argumentation after participants engaged in reflective activities about their dialogs. This finding suggests that reflective activities on evidence use might be an important feature of the intervention that supported the development of students' ability of using overall more evidence in argumentation and particularly evidence which functioned to critique other's position.

The present study

In the present study we extend previous work by examining participants' epistemic beliefs and epistemic emotions while they engage in an argument-based intervention in the context of the SOCRATES learning environment. Martinovski and Mao (2009) point to the cognition-emotion interface by maintaining that emotions serve as an argumentation engine. The category of emotions which most closely exemplify the cognition-emotion interface, are epistemic emotions. Epistemic emotions refer to emotions that are triggered by the knowledge-generating aspects of cognitive tasks (Pekrun & Stephens, 2011). Thus far, the studies that have tapped into epistemic emotions, have examined their relation to epistemic beliefs (Muis et al., 2015), problem-solving (Muis, Psaradellis, Lajoie, Di Leo, Chevrier, 2015) and reasoning (Blanchette, 2014). Also epistemic emotions have been subject to exploration regarding their antecedents and outcomes (D'Mello, Zehman, Pekrun & Graesser, 2012) during simulated collaborative learning situations. Yet, epistemic emotions is still an under-explored category of emotions (Muis et al., 2015) and further research is required to illuminate our understanding of the interplay between epistemic emotions, reasoning and learning. The current research aims to address this gap in the literature, by examining the interplay between epistemic understanding, epistemic emotions and argumentation.

Methods

Sample

40 fifth graders (11 year olds) participate in the present study. Participants are students from two classrooms from a public elementary school in Cyprus.

The SOCRATES web-based learning environment

The SOCRATES web-based learning environment that was developed by Iordanou and Constantinou (2015) is employed in the present study. The learning environment was designed by a group of researchers and teachers - two elementary school teachers and two high school Biology teachers. Researchers had the leading role in the development of the educational curriculum, while teachers contributed substantially to the development of the knowledge base − finding relevant data and adapting them to be appropriate for high school students.

The SOCRATES learning environment is hosted on the platform of Stochasmos (Kyza & Constantinou, 2007). Stochasmos offered two main environments. The first is the Inquiry Environment, where a knowledge base for the topic of climate change was developed. The knowledge base includes different types of information − short texts, graphs, tables and images (e.g., a graph of Earth's temperature over years).The second is the WorkSpace environment, which hosts the reflective templates "Finding Evidence", "Own argument" and "Other argument" where students were asked to construct evidence-based arguments and reflect on the arguments they produced while they were engaging in dialogic argumentation. Stochasmos offered students the opportunity to transfer information from the Inquiry Environment to the WorkSpace environment, and vice versa, using the "Data capture tool". The platform also incorporated a chat tool, which was used for conducting students' dialogic argumentation. For more details regarding the SOCRATES learning environment see Iordanou and Contstantinou (2015).

Procedure

Initial and final assessments

Students' argumentation skills were assessed at both initial and final assessments. Two socio-scientific topics, solar energy vs. natural gas (intervention topic) and genetically modified food (transfer topic), were used for assessing students' individual argument skills. Students' positions and supporting arguments regarding the two topics were assessed individually in writing, after a short passage introducing the scenario had been presented. Each scenario presented two opposing positions regarding the topic, solar energy vs. natural gas, and for or against consumption of genetically modified food. Students have been asked to indicate their position by choosing among three options: the two alternative positions of each topic and the option "Undecided". Then an individual essay assignment followed for each topic.

Participants' epistemic cognition was examined through individual interviews, based on the interviews employed by Pluta, Chinn and Duncan (2011). Participants' epistemic emotions while they were engaging in different activities in the intervention were examined through a questionnaire based on Epistemic Emotions Scale, developed by Muis, Psaradellis, Lajoie, Di Leo, and Chevrier (2015).

Intervention

The intervention took place over 13 sessions. Students had available a learning environment which had been developed for the purposes of the present study. The mission of students was to get prepared for a final showdown that would be conducted by the end of the intervention to inform students and their parents about alternative sources of producing electricity.

Finding Evidence

In the first sessions students were asked to review the information included in the learning environment and construct evidence-based arguments, with the help of the "Finding Evidence" reflection sheet. The purpose of preparing those arguments, they were told, was to get prepared for the series of discussions that would follow. The "Finding Evidence" reflection sheet asked students to state a claim and to provide evidence from the LE to support their claim. A separate reflection sheet was used for each argument they made. All the reflection sheets constructed were saved by the system in each student's account to be available for students to access them when they would engage in electronic discussions.

Argumentation

Then students engaged in a series of electronic dialogs with an opposing side pair. In each of these sessions participants discussed with a different opposing pair. Participants were asked to engage in these dialogs with the goal to persuade their interlocutors, who hold an opposing position, that their own position was right. After the completion of each dialog participants reflected on an electronic transcript of their dialog, with the help of two electronic reflection sheets the "Own Argument" and the "Other Argument". The reflection sheets are based on the reflection sheets that were used in Iordanou (2010) and Iordanou and Constantinou (2014; 2015) studies.

Showdown

The culminating point of the curriculum activities was a class level electronic debate between students holding opposing positions.

Results

The study is in progress. The results of the study will be presented at the conference.

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