International Journal of Educational Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Educational Research

journal homepage: www.elsevier.com/locate/ijedures

The Use of Argument Maps as an Assessment Tool in Higher Education

Chrysi Rapanta[a,*], Douglas Walton[b]

[a] ArgLab, Institute of Philosophy, Universidade Nova de Lisboa (IFILNOVA), Lisbon, Portugal
[b] Centre for Research in Reasoning, Argumentation, and Rhetoric (CRRAR), Windsor, Ontario, Canada

ARTICLE INFO

Article history:
Received 19 January 2016
Received in revised form 29 February 2016
Accepted 7 March 2016
Available online xxx

Keywords:
Argumentation theory
Artificial intelligence
Argument maps
Diagramming tools
Assessment
Fallacies
Education

ABSTRACT

The use of argument diagrams to foster argumentation has been an object of research in education, as a way to support students' argumentative interaction and, potentially, learning. In this paper it is shown how argument analysis and evaluation assisted by means of argument diagramming tools, further developed in artificial intelligence (AI), can also support the assessment of argumentation skills in the classroom. A case study is presented to show how informal logic contributions on fallacies, in particular, can be combined with the data of an argument-diagramming task, to form a method of assessing students' weaknesses in reasoning about everyday issues using argument maps. Our contribution is mainly methodological, as we suggest an application of AI and argumentation theories in education.

1. Introduction

Argument-mapping tools are designed to help a user visualize the premises and conclusions of arguments in a graph structure, and display a sequence of connected arguments chained together to support an ultimate conclusion. More than fifty computational argument-mapping tools that can be used to assist an argument analyst are described by Scheuer, Loll, Pinkwart, and McLaren (2010).

Empirical research has shown that argument mapping is a useful learning and teaching methodology, mainly because of the importance of making reasoning explicit in different learning situations (Dwyer, Hogan, & Stewart, 2013; Maloney & Simon, 2006; Scheuer, McLaren, Weinberger & Niebhur, 2014; van Amelsvoort, Andriessen, & Kanselaar, 2007). For instance, argumentative interactions have an important place in collaborative learning, as students tend to make their arguments explicit and to change their premises as a result of their peers when reasoning together to solve a problem (Asterhan & Schwarz, 2009; Baker, 2009). But also in individual learning situations, either oral or written, students commonly use theories and explanations supported by evidence when faced with complex cognitive subjects (e.g. Berland & Reiser, 2009; Toth, Suthers, & Lesgold, 2002). More recently, computer-mediated argumentation in dyads or small groups of students using some type of chatting platform has also been the focus of research (Andriessen, Erkens, van de Laak, Peters, & Coirier, 2003; Kuhn, Goh, Iordanou & Schaenfield, 2008). In all these cases, teachers need to be able to assess student-generated arguments, distinguish them from other reasoning elements, e.g. explanations, and suggest ways for their improvement.

* Corresponding author.
E-mail address: crapanta@fcsh.unl.pt (C. Rapanta).

http://dx.doi.org/10.1016/j.ijer.2016.03.002
0883-0355/

Please cite this article in press as: C. Rapanta, D. Walton, The Use of Argument Maps as an Assessment Tool in Higher Education, International Journal of Educational Research (2016), http://dx.doi.org/10.1016/j.ijer.2016.03.002

Although argument maps have been broadly used as a way to support students' argumentation, through making their premises explicit, no evidence exists yet on the function of such tools for assessment purposes.

This paper presents a way of assessing students' argumentative reasoning through looking at their argument maps. To do that, we combined the use of an online argument-mapping tool called Rationale with the application of the recent theory of paraschemes (Walton, 2011a). The result of this "marriage" is a proposal of a thorough pedagogical assessment in the field of argument and education, as presented below.

This proposal may have a series of practical implications for educators at various levels, especially for the ones working with adolescents and young adults. The reason lies on the function of active argumentative writing from part of the students and the instructor-guided argument reconstruction that needs to take place for such writing to improve. The use of argument structuring and visualization processes in educational argumentation contexts has been widely used, as described in the next section. However, it is still unclear how the structured reconstruction of arguments by students using argument maps can be of further use for reasoning assessment and improvement purposes.

2. State of the Art

2.1. Argument mapping tools and education

The use of argument diagramming tools in education is a way to represent students' arguments in dyads, groups, or individually. It is explained by the two-dimensional format of such diagrams in which students can visualize their reasoning with boxes for premises and conclusions, and pro and con arrows for arguments. "This kind of representation is thought to support argumentation because visualizing an argument stimulates users to include evidential relations, to keep a balance between pro and contra arguments, to relate arguments and see inconsistencies and conflicts" (Munneke, Andriessen, Kanselaar, & Kirschner, 2007, p. 1076–1077).

In practice, the issue of whether use of argument mapping tools helps either individual or collaborative learning is controversial, as the findings of previous research are mixed. Some studies suggest that argument diagramming is helpful while others find little or no learning increment. One such experimental study (Pinkwart, Lynch, Ashley, & Aleven, 2008) used LARGO, an information technology system for legal argumentation that helps students to build argument diagrams to model the argumentation found in transcripts of US Supreme Court oral arguments. It was found that using Largo did not lead to superior learning as compared to a text-based note-taking tool. However, it was also found that use of the system could help lower-aptitude students. Other studies suggest a general connection between argument mapping and enhancement of critical thinking skills (e.g. Twardy, 2004; van Gelder, 2005) without concrete evidence on how students' arguments, argumentation dialogues, and learning outcomes are changed as a result of the mapping. Regarding the influence of diagrams and maps on argumentative interactions, Suthers (2003) found no significant influence on the depth of the interaction, whereas Munneke et al. (2007) described the argumentative activity taking place as result of a diagramming scaffold as "not really interactive" (p. 1086).

Nonetheless, argument maps have also been considered as useful scaffolds for critical thinking and writing. For instance, Okada and Buckingham Shum (2008) showed that the structuring and modeling provided by an argument map is helpful for science education, especially when it concerns evidence-based writing. Other researchers claim that the pedagogical function of maps increases when combined with other scaffolds. Marttunen and Laurinen (2007), for example, have found that secondary school students produce better argument maps by engaging in debate, as they become better acquainted with the diversity of viewpoints about the topic at hand. Following a similar approach, Scheuer et al. (2014) combined argument mapping with collaboration scripts that guide the student discussants through the process of analyzing and evaluating opposing positions on a contentious topic to help all parties to the discussion move forward towards the goal of collaboratively generating a well-reasoned conclusion.

All the above examples of use of argument mapping tools in education face the same challenge or lack: their use is limited to an intervention or scaffolding level without any explicit connection to the assessment of the arguments produced from an informal logic perspective. Most of the efforts provide a straightforward assessment of the students maps based on the quantity of the boxes completed. New computational argumentation systems developed in artificial intelligence have gone even further to support both argument evaluation and argument construction (Gordon, Prakken, & Walton, 2007; Gordon, 2010; Reed & Rowe, 2004; Reed, Walton, & Macagno, 2007). For example, the Carneades Argumentation System (CAS http://carneades.github.com/), named after the Greek skeptical philosopher, can both evaluate given arguments and construct (invent) new ones. A CAS argument graph is a bipartite, directed, labeled graph, consisting of statement nodes and argument nodes connected by premise and conclusion edges. CAS is a formal argument structure where argument graphs are evaluated, relative to audiences, to determine the acceptability of statements in a stage (Gordon, 2010). Conflicts between pro and con arguments are resolved using proof standards, such as preponderance of the evidence and clear and convincing evidence, inspired by the legal domain. CAS supports argument construction by generating new arguments automatically from a knowledge base of rules and facts.

In general, educational research that includes argument maps focuses on the use of specific diagramming tools either alone or in combination with other tools (e.g. scripts, chatting) as part of an intervention to enhance either arguments themselves or learning of scientific concepts (following the generally known distinction between "arguing to learn" and "learning to argue"). The recently proven value of argument maps as diagnostic methods of analysis and assessment has not

Please cite this article in press as: C. Rapanta, D. Walton, The Use of Argument Maps as an Assessment Tool in Higher Education, International Journal of Educational Research (2016), http://dx.doi.org/10.1016/j.ijer.2016.03.002