Abstract: This study investigates the effectiveness of OASIS (Online Annotation and Argumentation Support for Inquiry System) in facilitating students’ argumentation skills. Students in two secondary four classes used OASIS as a tagging tool to read online texts and to evaluate the arguments of peers while studying a unit called Gene Screening in the Liberal Studies curriculum. Students’ end-of-unit essays were analyzed to assess the quality of their reasoning and the complexity of their argument structures. Students’ scores on an examination question testing their reasoning skills on a related topic were also collected. Multiple regressions show that students’ use of WHAT-tags was significantly related to quality of their argument structures and exam scores on reasoning. A relationship was found between their use of tags and the quality of their reasoning on their essays. Implications for further refinements in tool and task design for OASIS to facilitate argumentation skills are discussed.

Introduction

Given that argumentation pervades both daily life and academic life in the form of philosophical reasoning and scientific inquiry (uhn, 2011), the development of argumentation skills should be an important goal of education (Mercer, 2002). However, research indicates that students at all academic levels have difficulty with argumentation; even graduating high-school students have trouble producing, understanding and evaluating arguments (National Science Board, 2001). Given the recommendations that students be taught argumentation skills in school, a natural question is what to teach and how to teach it. What are considered to be good arguments? How can we integrate the teaching of argument skills into the regular curriculum? We sought in this study to foster the development of argumentation skills by embedding them in two basic learning activities—reading critically and evaluating arguments. The study investigated the effectiveness of OASIS, an argumentation tool designed to foster argumentation skills in reading and evaluation in Liberal Studies (LS), a new core subject in Hong Kong secondary schools.

Theoretical framework

Argumentation skills involve both thinking skills and discourse skills (uhn, 2011) and can be evaluated in terms of discourse structure and quality of reasoning (Erduran, 2011; uhn, 2007; Toulmin, 1958). Individuals exercise these skills with differing levels of expertise in formulating and evaluating arguments (Coldstein, Dowell, uhn, 2011).

Educational researchers have widely accepted Toulmin’s (1958) model of arguments as including claims, evidence, justification, and conclusions and have used it to investigate many areas of education (Chang chiu, 2011). A number of researchers have used Toulmin’s model to investigate argument structure as an indicator of argumentation skills. For example, Means and oss (1985) characterized argument structures as skeletal, enhanced, and elaborated. Skeletal structures, the simplest, only have a conclusion and a reason. Enhanced structures have a conclusion, a reason, and a qualifier, and elaborated structures have two conclusions with multiple reasons and qualifiers. In Chinn et al’s study (2012), argument structures are graded from low which have simple reasons to high which are composed of complex networks involving multiple arguments and rebuttals. Understanding the different parts of arguments provides a basis for evaluating the structures of arguments and can be linked to the age, academic performance, informal reasoning skills, and learning contexts of students (Chinn, Oonnell, Jinks, 2012; Means, oss, 2011).

Argumentation also involves the exercise of informal reasoning skills which arguers use to weigh different opinions in order to make decisions about issues in their daily lives (oss, Perkins, Segal, 2011). Quality of reasoning can be based on the soundness of arguments which can be determined by the degree of realism, and relevance of reasons used to support conclusions (Schwarz, euman, Ilya, yla, 2011; oss, et al., 2011). Quality of reasoning can also be based on the provision of grounding and arguments can be hierarchically coded based on the claim it has simple claims, grounded claims, qualified claims, and both grounded and qualified claims (Weinberger Fischer, 2011).
The ability to evaluate the arguments of others is an important argumentation skill. Although there are many occasions in daily life in which people must evaluate the written or spoken arguments of others, people in general tend to evaluate arguments poorly (Goldstein, et al., 21). For instance, Uhn (21) found that students cannot evaluate the epistemological characteristics of arguments effectively. She suggested that students tended to focus on the content of arguments as opposed to their form. She also found that students tended to evaluate the arguments of others based on their personal preferences as opposed to the epistemic strengths or weaknesses of the arguments themselves.

While most studies of argumentation have focused on artificial tasks in laboratory settings with significantly fewer focusing on authentic tasks in classroom settings, recent advances in computer technology have made it possible to support and record student argumentation in the classroom.

Argumentation tools, such as Belvedere, gigalo, convince Me, and Sense Maker provide external argumentation frames to scaffold students in their efforts to construct their own arguments (Scheuer, Coll, Pinkwart, McLaren, 21). By supporting exploration and negotiation, these tools can scaffold the efforts of students to construct effective arguments. They provide different types of argumentation frames to scaffold different argumentation skills and in so doing support and shape student arguments in different ways. For example, non-linear frames such as graphs and diagrams can support the construction of arguments based on abstract ideas (Suthers, 21), while linear frames such as lists and threaded discussions can support the construction of arguments based on face-to-face and online discussions.

Thus far, most argumentation tools have been designed to support scientific argumentation in the classroom as opposed to supporting the kinds of argumentation that is involved in addressing issues in the humanities. Thus, in developing argumentation tools to support meaningful inquiry learning in S classrooms, we designed tools to support the development of argumentation skills involved in reading and evaluating arguments. This study investigated whether OASIS (Online Annotation and Argumentation Support for Inquiry System) can foster the development of students’ argumentation skills by supporting their efforts to read critically and to evaluate arguments. We emphasized two argumentation skills: argument structure and quality of reasoning. This study focused on three questions: 1. Does reading with OASIS support the development of argumentation skills? 2. Does evaluating with OASIS support the development of argumentation skills? 3. Do high performance class (HP) and ordinary performance class (OP) students differ in argumentation skills?

Methodology

Participants

Students of two secondary four classes, one HP and the other OP, were chosen as convenience samples from schools participating in a university-school partnership project on the effectiveness of OASIS in S classrooms. Both classes followed the same S curriculum and used OASIS to support reading, writing, and peer evaluation. A total of students in the OP and students in the HP participated in this study.

Design of study

S is a core course that was introduced into schools in Hong Kong in 21. It covers six themes: Personal Development and Interpersonal Relationship, Hong Kong Today, Modern China, Globalization, Public Health, and Energy Technology and the Environment. It provides students with opportunities to explore issues relevant to the human condition in a wide range of contexts and enables them to understand the contemporary world and its pluralistic nature’ (Education and Manpower Bureau, 21).

The module unit examined in this study dealt with Gene Screening which belongs to the theme of Public Health. The unit was divided into sessions and OASIS was designed to scaffold learning processes by helping students: 1) highlight and tag passages in teacher-selected and self-selected articles, 2) organize and manage highlighted and tagged passages and integrate them into written arguments, and 3) evaluate (highlight and tag) the written arguments of peers. Three OASIS supported tasks were selected for further analysis. Task 1 required students to use OASIS in reading and analyzing teacher-assigned articles; task 2 required them to use OASIS to search for, select, read, and analyze more articles; task 3 required them to use OASIS to evaluate each other’s essays.

The highlighting and tagging features of OASIS facilitate the process of reading-to-argue. OASIS first prompts students to highlight passages in their readings and then prompts them to attach tags to these highlighted passages. Students can choose tags from a list of teacher defined (Task tags) tags or from self-defined (My tags) tags (See Figure 1). The complex process of selecting, highlighting and tagging passages helps students construct their own arguments.

OASIS also has a website that includes a series of features such as “my collection”, “my tags”, “my group” and “my task” that allow students to view, organize, manage, and synthesize their tagged passages.
Finally, “my report” enables students to view and export their tagged passages. Students can determine what to include in reports by choosing task, category, and even tags. They can export reports as Excel files and save them for future reference.

Figure 1: Screenshot of reading with argument tags in OASIS.

OASIS also supports evaluation tasks. The evaluation task here was designed to help students identify the key parts of arguments and to judge the quality of arguments. Students can use two sets of pre-defined tags in OASIS to evaluate each other’s work—ESIP-TIE-tags to identify the key parts of arguments and EAATIE-tags to evaluate the quality of arguments.

Data sources and analysis
Two types of data were collected. Annotation data from both teacher-selected and self-selected readings, and peer evaluations and 2. Students’ argumentation skills demonstrated in their essays about gene screening and in their answers to a related question on the mid-term exam.

Reading and evaluation data consisted of passages that had been tagged and highlighted. Total numbers of such passages were recorded for the three tasks. Same sets of tags were designed for task 1 and 2. They included WHAT, WHO, PURPOSES, POS, and OOS. Two sets of tags were designed for evaluation task—ESIP-TIE-tags which included AIM, EVIDENCE, POS, and POSITION and EAATIE-tags which included INSUFFICIENT EXPLANATION, EASONABLE EXAMPLE EXPLANATION, EASONABLE EXAMPLE EXPLANATION and INSUFFICIENT. To reduce the number of variables used in the regression analyses of tasks 1 and 2, similar tags such as WHAT, PO and O were collapsed as JSTIFICATION and in task 1, tags were collapsed into ESIP-TIE-tags and EAATIE-tags.

Students’ essays were examined with respect to level of reasoning and complexity of argument structure. These perspectives originated in Toulmin’s (1958) well accepted argumentation framework and have been further developed both bottom up and top down. Analysis of reasoning skills was adapted from the work of 65eh (1993) and gezisakaya and colleagues (1993), Anderson, McBurney, Nguyen-Jahiel, Archodidou, 65im, 2011). Six levels of reasoning were coded ranging from 0 to 5 where 0 means “no reasoning is provided that relates to the main topic”, and 5 means “claim(s) is/are related to main topic with either supportive evidence/example or supportive justification/explanation, or both; in a coherent style”. Coding for quality of argument structure was adapted from the work of Clark et al (2004) where structure was coded into 6 levels with “1” referring to “multiple claims with either evidence/example or justification/explanation” and “5” referring to “claim(s) and alternative theory(s) which include both evidence/example or justification/explanation and rebuttal”. Two research assistants coded the essays with an inter-rater reliability of .91.

A question dealing with the issue of “iver transfer in the general area of public health was selected from the Semester 2 mid-term exam in order to explore whether argumentation skills could be transferred to similar tasks. The question contained three parts and measured both application and reasoning skills. The first two questions called for the application of information from source readings and the third called for reasoning.

Descriptive analysis was used to characterize online reading and evaluation. Simple t-tests were run to determine whether the HP and the OP differed with respect to these measures. Finally, regression analysis was run to look for associations between online tagging and argumentation skills. The two control variables were class (HP, OP) and Semester 1 exam scores. The independent variables were types of tagging in different tasks, and the dependent variables were reasoning skills, argumentation structure, applying information performance and reasoning performance on the exam.
Results

Description analysis
The total number of argument tags on tasks 1 and 2 were about the same (M = 12 and 12 for tasks 1 and 2 respectively). More WHY-PRO-CON and WHAT-tags occurred in task 1 than in task 2. Students created significantly fewer ESSENTIAL-tags (M = 11), in task 1, as compared to ESSENTIAL-tags (M = 2).

Does reading an evaluation influence the development of argumentation skills?
Hierarchical multiple regression was run to test the relationship between online reading behavior and argumentation skills. Prior knowledge, was a significant predictor of reasoning in written essays and performance on exams (Essay reasoning: ΔR² = 12%, p < 0.01; Exam reasoning: ΔR² = 0.115, p < 0.01; Exam applying: ΔR² = 0.089, p < 0.05). However, prior knowledge did not predict argument structure significantly (ΔR² = 0.037, p > 0.05). Another control variable, class, was an insignificant predictor of all dependent variables.

Regression results indicated that online reading behavior accounted for about 8.4% of the variance of quality of argument structure, 14.8% of the variance of exam reasoning skills, and 14.5% of the variance of exam applying information skills. Among the different types of online reading behaviors, the number of WHAT-tags in Task 2 contributed significantly to argument structure quality (t = 2.501, p < 0.05) and exam reasoning skills (t = 2.175, p < 0.05); while the number of JUSTIFICATION-tags in Task 1 was significantly related to exam applying information skills (t = 2.545, p < 0.05). The tagging data in task 3 was not related to reasoning and applying information skills in mid-term exam.

Do HPC and OPC students differ in argumentation skills?
Although, we ran a series of t-tests to test whether the argumentation skills of HPC and OPC students differed with respect on written essays and mid-term exams, these measures did not reveal any significant differences between the two classes.

Discussion
This study examined the relationship between online reading and evaluation and argumentation skills demonstrated in written essays and exams. Student effort at understanding Gene screening, particularly with respect to self-selected articles, significantly contributed to their argumentation skills in both written essays and content-related exam questions. Gene screening was a difficult topic as most students had no prior knowledge about it. Thus, simply trying to understand Gene screening was not only a prerequisite but the most important factor affecting argumentation. In fact, most students attached WHAT-tags to highlighted passages that dealt with information and knowledge related to Gene screening or that dealt with such related concepts as “test-tube babies” or “embryo implantation”. Thus, students needed to master these concepts to understand the purpose and consequences of Gene screening in order to write their essays. Identifying relevant information in self-selected articles was also important. Students who couldn’t find relevant papers had trouble carrying out further investigation. Similarly, this tagging behavior was also related to reasoning skills on the three-part health question from the Semester 2 mid-term exam. This implied that students might be able to transfer this skill to similar tasks. Besides, assigning more JUSTIFICATION-tags (WHY-PRO-CON) in task 1, students were better at applying skills on the mid-term exam. Applying skills involves being able to recognize, organize, and summarize arguments. The required skills resembled those required in task 1 in which students had to identify claim, pro, and con.

The ability to write effective arguments is an essential feature of many subject domains. Children’s difficulty in writing arguments may be due to a number of reasons. They may lack basic literacy skills; they may find it difficult to examine and compare ideas within the same text; they may be unable to consider diverse opinions and select the most relevant one; they may be unable to anticipate objections or disagreements and they may be unable to rebut these objections (Muller Mirza, Perret-Clermont, Tartas, & Iannaccone, 2009). Developing the ability to construct argumentation structures while reading could help students overcome these problems. Writing arguments requires students to be able to read-to-argue. That is they must be able to interpret source materials by extracting and analyzing concepts and ideas, organize and compare multiple perspectives and opinions, and analyze and select relevant explanations for use in written arguments. At this stage, it is encouraging to see that reading with OASIS can help students construct better argument structures in their writing. The fact that reading with OASIS is not significantly related to reasoning skills may indicate that developing such skills might need lengthy practice and more extensive modeling.

Finally, evaluation is an important argumentation skill. However, evaluating the arguments of peers, either by identifying the relevant parts of their arguments or by critically evaluating them was not significant to
reasoning skills on the exam. The students’ limited use of EA UATIE-tags could be one of the reasons. Other possible reason could be that students were reluctant to criticize each other or that they were not given sufficient guidance on how to use EA UATIE-tags. Carson, Britt, and Urby (2009) found that students improved their ability to judge the quality of arguments when they received a little training on evaluating arguments and immediate feedback. Thus, more research is needed to determine how to design tasks and tools that more effectively support such processes. For instance, evaluating arguments and comparing them with those of teachers should first be modeled for students. The tools students use should support the visualization of such comparisons and should facilitate discussions of argumentation.

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