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The Effects of a Digital Dialogue Game on Higher Education Students' Argumentation-Based Learning

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***Abstract*—**Digital dialogue games have opened up opportunities for learning skills by engaging students in complex problem solving that mimic real world situations, without importing unwanted constraints and risks of the real world. Digital dialogue games can be motivating and engaging to students for fun, creative thinking, and learning. This study explored how undergraduate students engage with argumentative discourse activities which have been designed to intensify debate. A pre-test, post-test design was used with students who were assigned to groups of four and asked to debate a controversial topic with the aim of exploring various 'pros and cons' on the 'Genetically Modified Organisms (GMOs)'. Findings reveal that the Digital dialogue game can facilitate argumentation-based learning. The digital Dialogue game was also evaluated positively in terms of students' satisfaction and learning experiences.

***Keywords*—**Argumentation, dialogue, digital game, learning, motivation.

I. Introduction

WITH rapidly changing global problems and the expansion of information and communication technology accessible via the Internet and Web, it is inevitable in modern society to confront complex issues. To prepare society for tackling these complexities, professionals and experts from diverse disciplines need to collaborate in new learning and working contexts. This is also the case in education such that students need to gain ample experience working in learning groups to become capable and qualified professionals, who can actively participate in the knowledge society, analyse, synthesize, and cope with complex and societal issues. To do so, students need to be able to engage in dialogical argumentation, build arguments and support a position, to consider and weigh arguments and counter-arguments, to test, enlighten, and clarify uncertainties, and thus review misconceptions and correct false viewpoints. Argumentation is considered to be significant to education due to the importance of discourse in the acquisition of scientific knowledge [1]. The ill-defined nature of argumentation makes it quite difficult for learners to follow a set of strict rules on constructing arguments and responding to counter-arguments [2].

Various instructional approaches such as online argument awareness representations and computer-supported collaboration scripts have been proposed to help students learn the skills of argumentation and critical discussion for engaging in effective dialogical argumentation. A key element that is missing in most of the prior instructional approaches is motivating students to engage in these fantasy environments, to make their learning fun and appealing. This is striking since in real educational settings, motivational factors and willingness to argue play a key role in the extent to which students approach or avoid arguments [3]. Willingness to argue is associated with the learner's level of assertiveness, which may determine whether they engage in, or avoid, critical discussions and arguments [4]. Some students may be reluctant to oppose and disagree with their learning peers, while other learners may not appreciate to be critically challenged themselves [5], [6]. In addition, less assertive students engage less in arguments due to the competitive and disagreement aspects of argumentation [6], [7]. For all these students, the structuring of discussion within a game context may make a significant difference to their level of interactions with peers.

Argumentation willingness has a direct association with the student learning and problem-solving [6]. The ill-defined nature of argumentation makes it impossible for learners to follow a set of strict rules and unbending laws on constructing arguments, responding to counter-arguments, and engaging in transactive argumentation in order to gain and construct knowledge, drop false viewpoints, refine and modify claims, and eliminate misunderstandings and misconceptions about the issue at stake [2]. Furthermore, this is not an easy job for educators to teach argumentation skills with traditional instructional methods. The reason is that argumentation requires multiple competences such as the ability to analyse a scenario, to support claims and back them up with evidence, to acknowledge alternative perspectives and qualifiers, and to be able to respond to various counter-arguments. If students acquire such skills they may not only become better arguers (learning to argue) in learning groups but also enhance their domain-specific knowledge (argue to learn) on the discussed topic [2]. This study therefore creates conditions of intensified debate and measures the students' responses in the light of their motivation.

II. Methods

A. Context and Participants

The study took place at Wageningen University in the Netherlands, with a focus on the Life Sciences, especially food and health, sustainability, and the healthy living environment. The participants were 25 BSc students who enrolled for the 168-h course "Life-Science Communication and Learning in the Digital Age". The mean age of the participants was 22.00 (SD = 1.82), and the majority (80%) were female. Participants were divided into five groups of 4 students, and one group of 5

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students, taking into account their perspective on the controversial issue of the discussion. The topic for discussion was the application of GMOs in agriculture.

B. Learning Environment

The learning partners in each group were distributed over different locations of a classroom. A synchronous text-based discussion board called InterLoc was used in the study for the collaboration phase. InterLoc is a game-based web-enabled platform for dialogue and discussion that is used to stimulate discussions between members of a group in an active learning environment. This application contains game-based elements-restrictions on what can be said, when contributions can be made, and how responses can be made. It guides the interaction style for synchronous dialogue -promoting reasoning, critical discussion, and justified arguments- and allows the players to produce reusable content from their group experiences using a saved transcript (Fig. 1). The full description of the game and the roles of the players and tutors can be found in InterLoc literature [9]-[11].

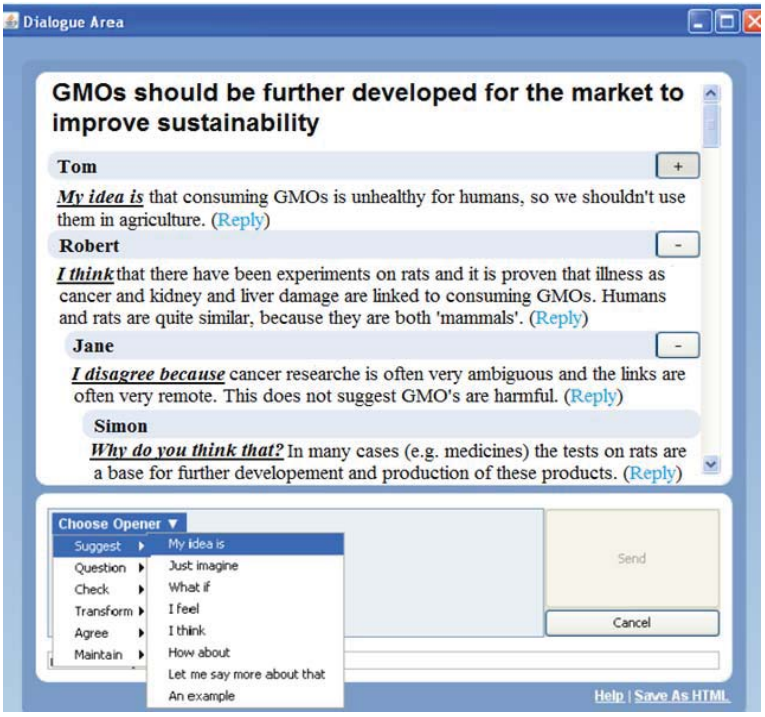

Fig. 1 A screenshot of the digital dialogue game with different sentence openers

C. Procedure

The session took 2.5 hours and consisted of three main phases.

1) During the introduction and pre-test phase, which took 20 minutes, students received introductory verbal explanations and completed several questionnaires on demographic variables, their preliminary opinion on the GMOs.
2) Then, in the test-phase, the game began and lasted for about 70 minutes.
3) During the post-test and debriefing phase (60 minutes), students were asked to fill out several questionnaires to assess their satisfaction with the learning experience and its outcomes (15 minutes).

Finally, there was a plenary session in which students expressed and shared their opinions on their learning experience using the digital game with their fellow classmates and also the teacher and the researcher (40 minutes).

D. Measurement of Students' Satisfaction and Learning Experiences

A questionnaire designed by Mahdizadeh [8] was adapted to assess students' satisfaction with the learning experience and its outcomes (Table I). This questionnaire consisted of four main sections and 22 items in total on a five-point Likert scale ranging from "almost never true" through to "almost always true". The reliability coefficient was high for all four scales of this instrument (Cronbach alpha = .87 in average).

E. Measurement of Argumentation-Based Learning

A content analysis coding scheme was adapted to measure quality of argumentation-based learning. This was done to assess how well the discussion notes of each student and also his/her group reflected the criteria of a scientific argument [12]-[18]. Every message posted during the online discussion on the GMO issue was coded as one of the following: externalization, elicitation (asking a question), agreement, integration, disagreement.

TABLE I
MEASUREMENT OF LEARNER SATISFACTION WITH LEARNING EXPERIENCE AND OUTCOMES

Perceived Outcomes of the Learning Task	"It motivated me to learn."
	"It provided useful social interaction."
	"It broadened my knowledge."
	"It improved my communication skills."
	"It improved the quality of my learning."
	"It had added value for students."
	"It was suitable for my learning."
	"It made me more interested in the topic."
	"It motivated me to do good work."
	"It helped me to learn a lot from peers."
Attitude towards Web-assisted Learning	"The quality of student learning is improved by using computers."
	"The quality of student learning is improved by using the platform."
	"I really enjoyed using the computer to support my learning."
	"I really enjoyed using the platform to support my learning"
Ease of Use of the Dialogue Game Application	Using the dialogue game application was easy."
	"Working with the dialogue game application was clear and understandable."
	"It takes only a short time to learn how to use the dialogue game application."
Satisfaction with the Learning Task	"I am satisfied with how much I learned while performing the learning task."
	"I am satisfied with how much group work was involved in performing the learning task."
	"I am satisfied with the quality of discussion in our group."
	"I am satisfied with the degree to which I shared knowledge with my partner."

III. RESULTS

The game appeared to facilitate argumentation-based learning. Overall, the proportions of student contributions during the game were highest for externalization (32%), and then agreement (21%), elicitation (17%) and integration (16%). The least proportion of student contributions during the game belong to disagreement (14%). In total, group 1 produced 61 messages, group 2 and 3 each produced 69 messages, group 4 produced 90 messages; group 5 produced 49 messages and group 6 produced 67 messages.

Learners' satisfaction with the learning experience and its outcomes appeared to be sufficiently high (around 3.5 on a five-point Likert scale) for all students. These positive results for students' satisfaction with the learning experience and its outcomes were also obtained during the plenary discussion sessions at the end of the experiment. During the plenary discussion sessions, students appreciated the game with regard to its dynamic nature, user-friendliness, and variation of the sentence openers. Furthermore, they said that the game was useful with respect to practicing, provoking and promoting their critical reasoning and argumentation skills.

IV. CONCLUSIONS AND SCIENTIFIC SIGNIFICANCE OF THE STUDY

This study attempted to create an intensified debate in a game-based learning environment by;

1) Choosing a controversial topic,
2) Creating groups that contain conflicting opinions,
3) Using a dialogue game to direct the conflict towards deeper reasoning and engagement.

Based on this study, we can claim that use of a digital dialogue game and an appropriate choice of controversial issue and sentence openers, stimulated argumentation-based learning, increased learner motivation and enhanced willingness to argue. It is also extremely likely that selection of group members to include opposite views played a part in increasing willingness to argue. Finally, we can conclude that learner motivation and satisfaction was high. Of course, further and more detailed research with larger sample of students is needed to confirm these indications, and determine if such similar games have more subtle effects on students' participation in such debates as were used here. Implementation of the digital dialogue game for debating a controversial issue was evaluated positively by undergraduate students as can be seen in their satisfaction with the learning experience and its outcomes. This was documented through both the survey and also the plenary discussion session at the end of the game.

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