Fostering Learning through the Use of Argumentative Serious Games

Markos Hatzitaskos and Nikos Karacapilidis

IMIS Lab, MEAD, University of Patras, 26500 Rio Patras, Greece
mhatzitaskos@gmail.com,
nikos@mech.upatras.gr

Abstract. As broadly admitted in the related literature, argumentation can promote learning, teamwork and leadership skills. These skills are central to the future of both developed and developing countries; however, related work reveals that students have difficulties in creating logical arguments. Motivated by the above, this paper proposes an innovative learning technology that aims at supporting argumentation through the use of serious games. Serious games have been shown to engage and motivate users and can be built with limited resources in mind. We comment on the suitability of their features for argumentation purposes, and we discuss how their use on teaching argumentation can be beneficial.

Keywords: e-Learning, Argumentation, Serious Games, ICT, Edutainment.

1 Introduction

Argumentation, i.e., the coordination of evidence and theory to support or refute an explanatory conclusion, model or prediction, has been recognized as a critically important epistemic task and discourse process. It plays a central role to learning, in which students develop explanations and argue. Admittedly, argumentation develops knowledge and provides a rich environment for students to learn effective leadership and teamwork skills [1]. These skills are beneficial to fostering the development of countries, since students will be able to work more efficiently and as a team for the betterment of their counties in the future.

Students, however, show difficulties in creating logical and reasoned arguments. The related literature (e.g. [2]) calls attention to the fact that students may increase their learning when they are actively - rather than passively - acquiring new knowledge. In order to enable students to actively acquire new knowledge, just triggering argumentation is not enough; it is important to create environments in which meaningful arguments are rewarding.

Related research reveals that even when instructing students to ask questions, although the quantity of the argumentation increased, the quality did not. For instance, as discussed in [3] after conducting a series of studies in an educational setting, although students seemed able to engage in argumentation, they only did

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so in situations that served some useful goal. In other words, students engaged in argumentation only when they were motivated.

The approach taken by instructors in traditional classroom activities inhibits the social discourse of critically attending to, defending and evaluating understandings. These activities are largely characterized by the instructor asking a question, students answering and the instructor responding, preventing the students from arguing their positions with fellow students or the instructor. This teaching style does not promote the idea that students should understand each other's ideas and build upon each other's knowledge. Motivating and enabling students to do so is crucial to fostering argumentation [4].

Generally speaking, argumentation has two basic constituents, namely the sense making and the discourse. Both of these aspects constitute problems to students, as they may not be able to distinguish between theories and evidence that supports them, and may confuse evidence with coherence or plausibility [5]. For this aspect of argumentation to be tamed, students should be aided in order to distinguish and value evidence from theories.

As results from the above, in order to foster learning through the use of argumentation, we need to motivate and enable students to engage in student-to-student discussions through well-prescribed activities. In this paper, we propose the development and use of a serious game to explicitly cater for teaching argumentation. We believe that well-developed and properly used serious games can augment students' motivation, by immersing them in a situation that they find engaging, as well as guide them through the understanding of different ideas and the difference between theories and evidence. Furthermore, the serious game proposed can provide a unique environment for students to take up leadership roles and improve their teamwork skills, since, in the virtual wold, they can have official authority as well as be hold accountable, by other students, if not performing as agreed [6].

2 Related Work

As stated above, students show difficulties when engaging in argumentation as they construct discussions and/or produce arguments that are not targeted or meaningful. In most cases, no counterarguments are given in such discussions. Furthermore, students produce arguments through which no conflicts arise and, as such, they are not constructive since the argumentation cannot continue. This leads to students not nurturing their argumentation, teamwork and leadership roles that would otherwise help them in real-life situations and at improving their society as a whole.

Related work has shown that practical aspects of research in the field of argumentation in education seem to be undermined by the fact that situations that favor debates, argumentation and learning within a suitable topic are not present (e.g. [1], [4]). Researchers have identified that fostering motivation in students to attend to each other's ideas is of crucial importance to the outcome of the argumentation and knowledge building [3], [4].

More specifically, Veerman and her colleagues have focused on discovering principles for the design of educational tasks that provoke collaborative argumentation [3]. Their approach includes studies of groups of students working with and without instructors and computer-supported systems, being told to engage in argumentation. They conclude that each educational situation has specific needs that must be addressed to promote argumentation. More recent approaches concentrate on creating activities that motivate students to take into account each other's ideas and support the alignment between claims and evidence [1], [4] .

Gorlinsky et al [6] have taken Veerman's work one step further and research how to leverage online games for teaching student leadership and teamwork. They concentrate on business college classrooms of developed countries, where Internet and computer access is widely available, and thus propose a solution that has a relatively high cost of implementation. However, their research is very useful since it can aid the development of a low cost serious game for developing countries that will offer a similar experience to high cost serious games and also promote teamwork and leadership.

An alternative teaching method supporting argumentation is known as 'concept cartoons' [7]. In this method, alternative ideas regarding a scientific phenomenon are presented in a form of cartoon-style drawing in a poster. Thus, ideas are put forward by cartoon characters in a discussion format and the learners are invited to join the debate with the cartoon character. The criteria for concept cartoons is to focus on probable situations rather than theory, use minimal amounts of text, and promote every alternative as of equal status. Research findings show that this approach is effective with learners of all ages and backgrounds, as it provides an intriguing new perspective on familiar events. Furthermore, it can be used in both formal and informal everyday settings. However, the concept cartoons teaching method has two significant drawbacks. Firstly, the depth of the topics discussed is limited because of the minimal text on the posters, and secondly, the strategy's purpose is only to engage interest and provoke thoughtfulness. It is not used to actually present information on a topic.

Our approach to fostering learning builds upon the integration of the abovementioned studies with the features of serious games. We argue that this alternative approach will provide students with the missing motivation that other approaches did not yield and at a low cost. Serious games will engage students and make them interested in the outcome of argumentations on various subjects between fellow students. On the other hand, instructors will not need to push students to defend their positions or ask them to engage in argumentation, since students will be motivated to do so on their own. Contrary to the concept cartoons approach discussed above, our approach will support various informational levels on a topic and as such it could be used to present a topic thoroughly. The information provided for a topic would start simple as in the concept cartoons approach, but the learner would be able to go deeper into the subject that she is interested in.

3 Serious Games

Serious games is a general term, whose precise definition seems to vary depending on the area of practice in which they are applied. However, most would agree upon the definition that serious games are games used for purposes other than mere entertainment [8] They are not a new genre per se, but rather a new perspective into how the use of games can be used for the betterment of education. Although serious games can take many forms, in this paper we are interested in serious games through the use of ICT.

The main reason we argue that the use of serious games can foster learning is the immersion and engagement they attain and sustain from the users [9]. Successful serious games provide a unique learning experience that aid recall and information retrieval. Strategic skills, analytical skills and insight for a task can also be acquired by the use of serious games [10]. Furthermore, multiplayer technology in on-line community games also fosters the creation of collaborative knowledge and develops information-seeking habits [11]. The nature of the learning supported by games has been divided into three types: (i) learning as a result of tasks stimulated by the content of the games, (ii) knowledge developed through the content of the game, and (iii) skills arising as a result of playing the game [12]. Argumentation, leadership and teamwork can all be fostered though all three types as long as they are correctly supported by the game.

Although serious games are an effective way of learning, not all games are good for all learners and for all learning outcomes. That is why to date there are serious games that deal explicitly with various subjects, such as health, social issues, politics, etc. (see http://www.seriousgames.org/). There have been numerous examples where serious games have been successfully developed and used to improve learning (e.g. [13], [14]).

3.1 Argumentative Serious Games

Our approach on fostering learning is through the use of argumentative serious games. To the best of our knowledge, there has been no serious game developed or used so far to promote argumentation explicitly. In this subsection, we attempt to justify the reasons that support our approach. That is, why combining argumentation with serious games is coherent, meaningful and promising. To do that, we investigate the features of argumentation and how they can be effectively aligned with those of serious games to provide a richer learning approach.

Argumentation takes place between a proposition and a critic. One group puts an idea forward with supporting evidence, while another group tries to refute it with contradicting evidence to support a different idea. As such, a core feature of argumentation is its inherent competition between the proposition and the critic. Games, on their whole, are played between players that compete to win, much like the proposition and the critic. As serious games are games, they can support and enhance competition through the use of various techniques such as competitive scoring. This approach to competition can be accomplished in a way

that will promote fun and augment motivation for argumentation between the involved parties.

As previously stated, the proposition and the critic both support certain ideas, which they try to defend and justify. Thus, the proposition and the critic play different roles, approach an idea through different perspectives, and interact to reach a certain conclusion. Games, in general, require players to take up different roles and interact by role-playing. Serious games can well support these features of argumentation, by providing an interactive and role-playing environment. These features can be supported either in single player mode, where the computer can play the other roles, or in multiplayer mode, where human players interact. Multiplayer support also addresses the connectiveness between the subjects that argue since argumentation is a social activity (a rational activity between groups of individuals and ideas, which are connected).

Arguments are structured and their components can be modeled [15]. All arguments have a claim, some evidence and reasoning to connect the two. Some arguments are harder to follow than others and the ability to differentiate between claims, evidence and reasoning is crucial to both creating a valid argument and understanding one. The learning approach to this structure and the components can be accomplished in a fun and intuitive way through the use of serious games. Furthermore, different ability levels in argumentation can be effectively approached by the use of different difficulty levels in serious games.

In order to learn through argumentation, one has to have a grasp of understanding and identifying arguments and the goals of the participants, as well as identifying the premises from which conclusions are derived. Serious games can be used to promote learning through the acquiring of analytical, strategic skills and insight, in an amusing and intuitive way that engages players and increases replayability.

Three more characteristics that align perfectly in both argumentation and serious games are the following [6]. Both in argumentation and serious games individuals have to make quick decisions with incomplete information and be able to change course when it is necessary. Furthermore, serious games encourages students to take risks, even in the face of likely failure and at the same time risk-taking is inherit in argumentation as the proposition tries to persuade the critic to embrace an idea. Finally, both serious games and argumentation teach to plan first and act second. As is true in real life, individuals and teams may initially decide to approach a problem with an *ad hoc* way. However, they soon realize that failing occurs more often than succeeding and that thinking and planning a strategy beforehand will often save time and improve their chances of success.

3.2 Educational and COTS Serious Games

There are two kinds of serious games that can be used for our purposes. The first one concerns explicitly designed and implemented games that aim to be used mainly in a learning environment, whereas the second one concerns commercial off-the-shelf (COTS) games, designed for the entertainment market, that are

filtered to provide the learning required. Both kinds have arguments for and against them, which we discuss in this section, and also require instructor support as to how to be used in teaching [16].

Educational games: Educational games are designed and implemented explicitly to promote a learning outcome. They are built in accordance with pedagogical theories and may provide additional educational information as to how they may be used in a classroom or otherwise. Being games, they are build to provide the user with the correct amount of balance between fun and learning. Furthermore, they can be developed in such a way so as to address real-world problems, either explicitly or implicitly, and present how the skills learned can be used in real-world examples. This fact is crucial as students often complain that they see few real-world applications for what they learn [17].

As far as the development of educational games is concerned, it can be an expensive process, although there has been evidence that low-budget, with mediocre graphics, but well designed games have been used successfully to promote a learning outcome [13]. In our case, the most crucial issue when committed to this kind of games is to assure the proper integration of argumentation and pedagogical features.

COTS games: As argued in [8], a games purpose may be formulated by the user herself or by the game's designer, which means that COTS games, used for non-entertainment purposes, may be also considered as serious games as long as they are used in such a way. Using COTS as serious games has the benefit that there are minimal development costs. Successful COTS games encompass fun and have a high degree of engagement, which reduces the risks of creating a game with no such elements. The designer needs to think of ways to promote a particular learning outcome by creating learning activities or modifying the game in such a way so as to support the learning required. Integration of the appropriate argumentation features should comply with the above. On the down side, instructors must put a lot of effort into creating a lesson plan using COTS games. Information in games can range from fictitious to factual and can also present principles in a haphazard and disorganized fashion. Moreover, there may exist biases and preconditions that underlie these games. The instructor needs to discover and take all these facts into account.

3.3 Serious Game Features

Apart from deciding on whether to develop or use an existing game for our purposes, it is wise to look into what features the game should have. A core feature is stealth learning. Stealth learning can be defined as when the learners are so caught up in their goals that they do not realize they are learning [18]. To do so, it is crucial to disconnect the object of the game from the instructor's assessment mechanism. That is, the student should learn the necessary information in an implicit manner rather than just for an exam.

A 2008 TEEM report [12] produced a list of features that should be supported by serious games. Clear objectives and goals, tracking of player progression levels, restarting from a save point, catering for different ability levels of users and interactiveness were some of the features identified, which are also crucial in our case. Students in game progression should also be recorded to cater for instructor needs.

As far as the complexity of the proposed type of games is concerned, there are a number of variables to consider. Complex games, being more challenging in general, offer more potential for in-classroom activities. However, complex games tend to be time-consuming, whereas technically sophisticated games are difficult to incorporate in short lesson times [16].

Prensky [19] states that a feature approach to developing a serious game is flawed, because although these elements are indeed found in good games, just encompassing the list does not guarantee a good game. He suggests at looking into games that work and try to capture their style of putting these elements together. As such, a list of features is crucial, but should not be the only guideline to design. Thus, successful working examples, based on well-tried argumentation models and mechanisms, should also be studied and taken into account.

Serious games to address issues closely related to argumentation, such as decision making and collaboration, have been already developed. At the same time, various initiatives have been formed to promote serious games for particular sectors [20]. There is an ongoing list of serious games that deal with an ever increasing variety of issues. A list of serious games used for a number of learning outcomes can be found in [14].

4 Use of Serious Games in Formal Educational Settings

Several projects have been conducted aiming to understand the implications and potential use of serious games in formal education, so as to provide a strategy for future educational development requirements (e.g. [12], [21]). This strategy, as far as this paper is concerned, is the same for both developed and developing countries. The only difference lies in the designing and implementation of serious games for different available resources. Both students and instructors have reported that the use of games in lessons was motivating. Furthermore, the above-mentioned reports highlighted the numerous strengths that games have, including their ability to promote collaboration, foster engagement and develop students' thinking and skills, including leadership skills.

However, there were also some practical difficulties that needed to be addressed, such as the fact that the fixed length of most learning sessions was constraining in both the planning and the implementation of game-based learning. Moreover, the reports indicated that although instructors need a certain level of familiarity with the game used in their teaching, achieving educational and learning objectives through the game was more dependent on the instructor's knowledge of the curriculum to be taught, as well as other abilities related to teaching. The proposed integration of argumentation features has the potential to facilitate both instructors and students.

As serious games are entering the world of education and training, the role of the instructors will shift. Instructors will be faced with a changing profession and will need to be educated on how to teach using this new technology. In developing countries this poses a further problem as qualified instructors in formal education are exiguous and their training on how to teach using this new technology will be scarce. This problem is probably greater than the fact that there are very few physical resources where to deploy serious games. That is, even if there are enough computers to use in the classroom, if the instructor does not know how to incorporate and use the serious games available in his curriculum efficiently, the desired effect will not be achieved. As such, a solution proposed especially for serious games developed for developing countries is to design and implement games that would be intuitive for the instructor to learn, that would have clear goals so as to help the instructor to incorporate them in his class, as well as be low-budget and require low computing resources. Furthermore, serious games for developing countries should take into account the fact that there may be only one computer in every classroom.

The role that does stay the same for the instructor is the role of motivator (understanding students and their needs, and steering them in the most engaging direction). Style, passion and presentation abilities still remain key roles for instructors. Instructors however, as stated in [14], have to take the role of content structurer, as well as that of integrator and reformulator. This is because content, for serious games, must be presented in a very different approach (compared to traditional ones) to be effective. Furthermore, another role for instructors using serious games is that of the debriefer. As a debriefer, the instructor helps students reflect on what is being learned. This is necessary because even if serious games motivated students enough to go through the material, it would not always be clear that the conclusions they drew, as well as the mental models and ideas they learned, were the ones intended; moreover, whether they would be able to apply what they learned in future situations [14].

Creating an argumentative serious game to foster learning in formal educational settings should take into account the abovementioned issues and provide proper solutions for the diverse and complementary roles of the instructor. It should be an easy to use game, designed to be used within specific time limits. In addition, it should be helpful to the instructor in her work towards motivating students to engage in argumentation. This game should present the content to be learned under a different lens, where the instructor could potentially be an integral part of the game by encapsulating an in-game role and interactively playing the role of the motivator, content structurer and debriefer.

5 Conclusion and Future Work

In this paper, we have argued that using serious games can be an effective alternative approach to promote argumentation and foster learning, as well as nurture various other skills, such as teamwork and leadership. These skills can be of great assistance to the future of developing countries, as students who are

taught argumentation, teamwork and leadership correctly, will be able to work more efficiently and as a team for the betterment of their countries.

We looked into the importance of argumentation, as well as the current inability of students in creating logical and reasoned arguments. We also reviewed related literature on teaching argumentation and identified the lack of motivation that students have in attending to each other's ideas. We presented serious games, their benefits and how they could be used to motivate students and promote learning through argumentation. We discussed the different types of serious games and the features that games should entail. We finally looked into their use in formal educational settings.

Work still needs to be done towards pinpointing the learning principles that will be used to guide and support our goal of fostering learning through the use of argumentative serious games. We have to take into account the fact that instructors will need to structure non-traditional situations, through which the classroom will become a community of learning. Future work directions also include the design, implementation and testing of the proposed argumentative serious game in various educational settings in both developed and developing coutries.

References

1. Osborne, J., Erduran, S., Simon, S.: Enhancing the quality of argumentation in school science. Journal of Research in Science Teaching 41(10), 994–1020 (2004)
2. Roschelle, J.M., Pea, R.D., Hoadley, C.M., Gordin, D.N., Means, B.M.: Changing how and what children learn in school with computer-based technologies. Children and Computer Technology 10(2), 76–101 (2000) (Electronic Version)
3. Veerman, A.L., Andriessen, J.E.B., Kanselaar, G.: Collaborative argumentation in academic education. Instructional Science 30, 155–186 (2002)
4. Kuhn, L., Kenyon, L.O., Reiser, B.J.: Fostering scientific argumentation by creating a need for students to attend to each other's claims and evidence. In: Proceedings of the 7th international Conference on Learning Sciences, pp. 370–375 (2006)
5. Hogan, K., Maglienti, M.: Comparing the epistemological underpinnings of student's and scientists' reasoning about conclusions. Journal of Research in Science Teaching 38(6), 663–687 (2001)
6. Gorlinsky, C., Serva, M.A.: Leveraging online gaming for teaching student leadership and teamwork. In: Proceedings of the special interest group on management information system's 47th annual conference on Computer personnel research, pp. 73–76. ACM, New York (2009)
7. Naylor, S., Keogh, B., Downing, B.: Argumentation and primary science. Research in Science Education 37, 17–39 (2007)
8. Susi, T., Johannesson, M., Backlund, P.: Serious Games: An Overview, Technical Report HS-IKI-TR-07-001, School of Humanities and Informatics, University of Skovde, Sweden (2007)
9. Mitchell, A., Savill-Smith, C.: The use of computer and video games for learning: A review of the literature. Learning and Skills Development Agency, London (2004)
10. Squire, K., Jenkins, H.: Harnessing the power of games in education. Insight 3(1), 5–33 (2003)

11. Squire, K., Steinkuehler, C.: Meet the Gamers: They Research, Teach, Learn, and Collaborate. So Far, without Libraries. Library Journal 130(7) (2005)
12. McFarlane, A., Sparrowhawk, A., Heald, Y.: Report on the educational use of games. TEEM, Department of Education and Skills (2008)
13. Jenkins, H., Klopfer, E., Squire, K., Tan, P.: Entering the education arcade. Comparative media studies, MIT. ACM Computers in Entertainment 1(1) (2003)
14. Prensky, M.: Digital Game-Based Learning. Paragon House (2007)
15. Erduran, S., Simon, S., Osborne, J.: TAPing into argumentation: Developments in the application of Toulmins argument pattern for studying science discourse. Science Education 88(6), 915–933 (2004)
16. Sandford, R.: Teaching with Games: COTS games in the classroom. In: The proceedings of JISC Innovating e-Learning 2006: Transforming Learning Experiences, online conference (2006)
17. Holland, W., Jenkins, H., Squire, K.: Theory by design. In: Perron, B., Wolf, M. (eds.) Video Game Theory, pp. 25–46. Routledge, New York (2003)
18. Gee, J.P.: What video games have to teach us about learning and literacy. Palgrave Macmillan, Basingstoke (2003)
19. Prensky, M.: Computer Games and Learning. In: Raessens, J., Goldstein, J. (eds.) Handbook of Computer Game Studies, pp. 97–122. MIT Press, Cambridge (2005)
20. Serious Games Initiative, `http://www.seriousgames.org`
21. Sandford, R., Ulicsak, M., Facer, K., Rudd, T.: Teaching with Games: Using commercial off-the-shelf computer games in formal education. Futurelab Final Report (2006)