Adaptive Interactive Narrative Model to Teach Ethics

Rania Hodhod, Daniel Kudenko and Paul Cairns
University of York, UK

ABSTRACT
Promoting ethical, responsible, and caring young people is a perennial aim of education. Efforts have been done to find other teaching ways other than traditional ones such as games and role play. Narrative-based computer games have found their way as engaging learning platforms that allow collaboration of humans and computers in the creation of innovative experiences. In this paper, we focus on the design of an adaptive, interactive narrative model that makes use of a student model to provide an individualized story-path and an individualized learning process. In other words, we aim to have strong learning objectives underpinned by effective story telling. The adaptive narrative model has been deployed in the educational game environment, AEINS, along with the use of the Socratic Method and pedagogical agents to help teaching in the ethics domain. Evaluation results indicate the usefulness of the design and provide evidence on the development of moral reasoning and the transfer of moral virtues to its users.

Keywords: educational games, interactive narrative, intelligent tutoring, ethics, Socratic Method.

INTRODUCTION
Computer game worlds have become more complex over the years as computer technology has evolved. It is a very dynamic field that has moved on significantly since the simplicity of Pong with many improvements and expansions. Since the 1950s, computer and cognitive scientists have developed the idea that the computer can be used by a student to learn independently and that computer programs can teach a student, for example McGrenere (1996) investigated whether games could be utilized to assist learning and others explored the appropriate game types and game elements to be used as educational tools (Amory et al., 1999). Some researchers consider educational games only effective if the interaction is monitored and directed by teachers (Klawe, 1998) or if the games are integrated with other more traditional activities such as pencil-and-paper exercises. Other researchers believe that effectiveness is related to the features, preferences and behavior of a particular user (McGrenere, 1996).

In the last few decades, games became a strong supplement to teaching by virtue of their concrete experiences leading to learning. Studies on the use of games in education (Amory et al., 1999; Shaffer, 2005; Gee, 2005; Tan et al., 2005; Gómez-Martín et al., 2005; Fasili and Michalakopoulos, 2005; Egenfeldt-Neilson, 2005; Shaffer, 2006; Gee, 2006) have proven that games constitute a medium that motivates students to try to develop their knowledge while they put it into practice. Instead of being taught about topics, students are engaged with the topics and play them out. Within such environments, players can learn while being engaged in an entertainment activity (Maragos and Grigoriadou, 2005) and thereby create their own

experiences and get feedback on their specific actions in a safe environment (Egenfeldt-Neilson, 2005).

As obvious, not all users share the same preferences or styles when interacting with a game or when solving game-problems. This leads to the importance of adaptation in the sense that the behavior of each play-instance of a game depends on the actions of an individual player. Student modeling plays a central role in providing a personalized learning process for the individual student by considering his needs, strengths and weaknesses. The telling of stories within these environments has an important role in engaging the player, transferring tacit knowledge to the student and supporting adaptation through providing personalized implicit feedback that fosters self reflection and helps the students to discover any course of contradiction themselves.

Stories and interactive narrative have been used for a long time now to entertain children and teach them, for example, in classrooms for primary and secondary school curricula, both on their own and as a support for other subjects (Bolton, 1999; Bayon et al., 2003). Simpson (1998) in her article emphasizes the importance of stories in our lives and their role in tightening human relationships: ``*Stories are connections to the past and yet carry us into the future; they speak of relationships, of human connections, and to what gives a quality to our lives*.'' This has been also emphasized through role playing and discussions that have been used effectively in helping students to transfer their knowledge and beliefs into actions, in addition to helping them to see how their decisions affect other people and things (McBrien and Brandt, 1997).

Interactive narrative allows teachers to introduce sensitive issues in a safe and stimulating way. It has proven to be successful in creating enriching experiences for its users, sparking problem-solving skills, individual and group decision-making skills, and encouraging pupils to develop strategies to deal with different issues in different disciplines. For these reasons, interactive narrative has mainly been used as a common tool to teach in ill-defined domains such as design, history, law and ethics. The Socratic Method is the most widely used pedagogy in telling these stories. Ethics and citizenship is an important ill-defined domain that can not be easily taught through dictating concepts. It needs more than the traditional methods of teaching to allow the children to draw the required analogies and relate them to their real life experiences. According to Kohlberg, if children get engaged in enough independent thinking they will eventually begin to formulate conceptions of rights, values, and principles by which they evaluate existing social arrangements (Colby et al.,1983; Willard et al., 1996).

We argue that the development of virtues requires practicing the same way other skills such as reading or writing does, in addition to the fact that learning about ethical virtues is different from applying them. As Watson (2003) clarifies: "*Getting high scores in an ethical course does not guarstakese at all the actual behavior of that student*." This goes well with our opinion that children need to practice moral reasoning by involving them in different moral situations, though existed in a safe environment, which allows them to act according to their beliefs. Accordingly, by presenting the effect of their actions on themselves and others may help them to eventually begin to formulate their own conceptions of rights, values and principles. Another important point Watson (2003) mentioned is the desire for good: "*The trick lies not solely with knowing what is right and good but also in building a love for the good and the worthwhile.*" Watson points out that by giving the students the chance to see successful people do what is right and good, chances are better that students will be biased to follow suit themselves than they might otherwise. In other words, students can even advance to the kinds of thinking that characterize some of the great moral leaders and philosophers who have at times advocated civil disobedience in the name of universal ethical principles (Crain, 1985).

This paper focuses on the role of the student model to provide an adaptive, interactive narrative model within which students can express their characters through problem solving, decision making, and conflict resolution present in moral dilemmas. The proposed model has been applied to AEINS, a learning environment that allows the student to practice various moral virtues. The environment involves the students in interactive moral dilemmas that focus on virtues and moral exemplars; the students are involved in independent thinking processes that help them to identify what is good and bad. Moreover, the paper discusses how learning theories, such as Bloom's Taxonomy, Keller's ARCS model and Gagné's Principles assisted and guided the design and the implementation of AEINS. It also focuses on the role of the Socratic Method as a teaching pedagogy, and the role of pedagogical agents in supplying the educational process. AEINS promotes the acquisition of skills and knowledge in a pleasant interactive way, as shown from the evaluation results.

ADAPTIVE INTERACTIVE NARRATIVE

Interactive narrative is an engaging learning medium that allows collaboration of humans and computers in the creation of innovative experiences. Interactive narrative can be seen as an engaging hawk where the player feels in control and can see his actions affecting how the story unfolds.

A model of dual narrative that combines dynamic generated and graph structured narratives has been designed. The dynamic generated narrative generates a story that is not a part of a learning objective but rather as a step of making contact. It serves the purposes of transitioning between objectives and increasing causal relatedness, thus improving cohesiveness (Niehaus and Reidl, 2009). Planning has been used to generate the dynamic narrative as it is more variable than the other types and able to generate different narratives for different users, and also different narratives for the single user on subsequent play turns. In other words, for every possible way the student can violate the story plan, an alternative story plan is generated.

Scripted narrative is another type of narrative generation that can be seen as a good representation for semi-directed stories that allow following the student's actions and make an assessment on them, in the form of a step by step follow up. It characterizes by the presence of unexpected ends that raise the student's curiosity during the interaction course. Although scripting narrative is a hard process that can be time consuming, it allows defining decision points that reflect the student's mental state at the time of the interaction. In other words, identify those actions that should be taken by the student reflecting his current knowledge and skills. Ideally, each path in the scripted narrative is a story in which the protagonist is the student in the role of making moral decisions. This kind of narrative allows students to pursue different procedures for solving the problem, which arises from allowing different perspectives based on students' perceptions and interpretations of the nature of the problem (Shin & McGee, 2003).

Adaptation to individual users in computer-based learning environments has been successfully applied. Student modeling is the core of this process that mainly aims to guide the adaptive learning process based on the student's current skills. It aims at identifying the student's characteristics, needs, and situation in an automatic way, using student's behaviour and actions in order to automatically infer the relevant information (Graf et al., 2009) and provides tailored feedback. A reliable student model is necessary, but getting enough information about a student is quite challenging (Graf et al., 2008), such as dealing with the student's mental state.

So the suggested model manages to integrate both dynamically generated narrative and scripted narratives to form one continuous story. The dynamic generated narrative engages the student and ties scripted narratives together in one dramatic coherent story from the start to the end (one continuous story). The scripted narratives allow pursuing different story paths with unexpected ends and the use of the student model that assesses the student's actions and helps to provide a personalized learning process. The continuous story allows the presence of evolving agents that play an important role as pedagogical facilitators. The student's understanding gained through this process is situated in their experience and can best be evaluated in terms relevant to this experience (Thomas & Young, 2007). The model has been applied to the educational game, AEINS, to evaluate the validity of the model.

AEINS

The AEINS architecture has been designed in a way that allows the generation of interactive narrative at run time, forming the main story, and is flexible enough to allow the presentation of interactive teaching moments based on the current student model.

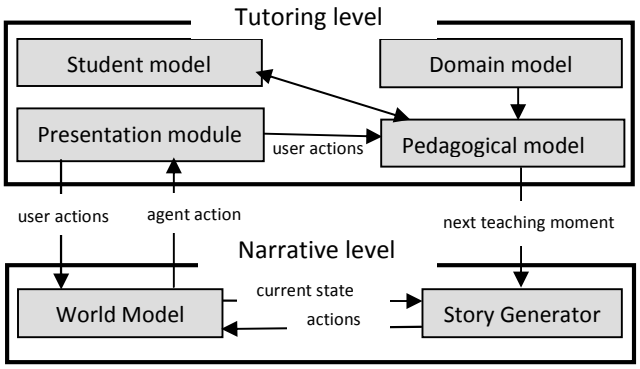

Fig.1: AEINS Architecture

AEINS is an adaptive educational game that aims to foster character education. AEINS is a problem solving environment that helps 8-12 year old children to be engaged effectively in interactive moral dilemmas. AEINS main aim is to allow students to practice various moral virtues and exercise resolving moral conflicts. In other words, give the students the opportunity to move from the state of making moral judgments to the taking moral actions state, from the knowing state to the doing state, which we consider an important step in moral education.

As seen in fig.1, AEINS architecture consists of six modules; four modules to serve the educational targets and two modules for generating the story and storing information about the story world. AEINS starts by generating a story within which the student can act and affect how the story unfolds. Based on the student's actions the world current state changes, the new state is presented to the student through the presentation module. To initialize the student model, the student is asked to choose his friends from the agents inhabiting the world.

Based on the current student model together with the domain model, the pedagogical model decides which moral dilemma (teaching moment) to present next to the student. Each teaching moment is associated with educational and narrative prerequisites that need to be satisfied in order to the teaching moment to be presented. If the current state of the world allows the presentation of the teaching moment (TM), the narrative preconditions of the TM are part of the current world state, the student can start the interaction with the TM right away. If this is not the case, the story generator develops a plan that after execution will transfer the current world state

to a state that allows the TM to be presented as part of the main story (the TM would be logically and coherently interleaved). Manipulating the teaching moment's priority is done through production rules as follows:

Trigger: teaching moment X_1 has not been presented
and teaching moment X_2 has not been presented
and value Y is not held by the user
and value X is held by the user
Action: set priority to teaching moment X_2

The capital letters in the rules represents variables and the representation denotes that if (a) a specific pattern of teaching moments has not been presented to the student yet and (b) user holds certain values and does not hold others, the action part of the rule executes (the next teaching moment priority is identified).

The pedagogical model tracks and assesses the student's actions and updates the student model accordingly. Research suggested that students benefit from being encouraged to consider a collection of evidence and coordinate their theoretical ideas with supporting or contradictory evidence as they engage in argumentation (Koslowski, 1996; Bell and Linn, 2000; Shin and McGee, 2003). In addition, students must have opportunities to choose among different options and to reason which criteria lead to the option chosen (Kuhn, 1993). AEINS follows these approaches in designing the pedagogical model and uses the Socratic Dialogue as it has been shown to be a highly effective approach (Elkind and Sweet, 1997) to help children develop new ideas and gain new insights. With ill defined problems, development is a change in the way a person thinks not is the case of acquiring more knowledge. Therefore, the pedagogical model has been developed in the form of production rules that give the system specific cognitive operations to reason about the student and the teaching process. The model specifies how a student ideally would use the system and how the system reacts to his actions. According to the student's actions, the model assesses the student's skills and adjusts the student model accordingly. In order to design the pedagogical model, the problems structure and what exactly needed to be modeled has to be specified. An example of the pedagogical model assessment rules is as follows:

If action ("TM_1", "agree_to_lie")
and if action ("TM_1", "insist_to_lie")
and if action ("TM_1", "lie_for_friend_sake")
and if action ("TM_1", "agree_lying_is_bad)
Then skill ("do_not_lie", "acquired", 0.5)

The teaching moments are crucial components of AEINS that aim to provide concrete settings for the student to practice abstract concepts. They can be thought of as a variety of ethical problems that require tough decisions. The idea behind the current design is based on analyzing moral dilemmas and transforming them to a story graph structures, and then specifying the decision points that should reflect the required skills. While designing the teaching moments, we took into account that they should emphasize good models and examples, hopefully, after which the students could model their own behavior. Ideas from Kohlberg's dilemmas and other moral situations designed specifically for school students were used to author the teaching

moments. Analyzing these situations and transform them to graph structures is not a straight forward process. In fact, it can be considered the bottleneck of the system's development phases. An example of the narrative preconditions is as follows:

```
If at_the_shop ("student")
and at_the_shop (char(X))
and at_the_shop (char(Y))
and friend ("student", char (X))
and char_personality (char (X), not(value_hold("steal")))
and friend ("student", char (Y))
and char_personality (char (Y), value_hold("steal"))
Then present ("dilemma", "TM1")
```

The Socratic Method as the Teaching Pedagogy

Students of all ages use questions in their learning of topics (http://question.eu/); questions act as transition means between the observation and hypothesis stages. The Socratic Method is one way of using questions in order to develop moral thinking and provides opportunities for personal discovery through problem solving. In classroom environments, the Socratic Method is dramatic and entertaining. It triggers lively classroom discussion and helps students make choices based on what is right instead of what they can get away with. It allows an appropriate amount of choices during ill-structured and authentic investigations that lead to the development of inquiry skills (Avner et al., 1980).

The Socratic Method displays its strengths when the students make a bad choice. Through discussion, students should then be forced to face the contradictions present in any course of action not based on principles of justice or fairness (Troup, n.d.). This method requires a delicate balance between letting the students make decisions, and demonstrating the limits in their reasoning (Nucci, 2008). Finally, ''raising the stakes", which is defined as introducing consequences, is a tactic followed if a student sticks with the unethical choice. For example, if we would like students to investigate the effects of stealing, we could pose the problem of shoplifting and ask what they would do if they were the owners.

In Lynch et al. (2008), it has been shown that even in domains where it is impossible to make sharp distinctions between good and bad solutions due to the lack of ideal solutions or a domain theory, solution differences are meaningful. In our opinion, the students' different answers to a Socratic Dialog are also meaningful and reflect their own beliefs and thoughts. The Socratic Method has been applied previously in the intelligent tutoring system, CIRCISM-TUTOR that teaches how the cardiovascular reflex system that stabilizes blood pressure functions (Kim, 1989; Yang et al. 2000). It has been shown that applying the Socratic Method positively influences the learning process. The Socratic Method can be woven in interactive narrative contexts, which has proven to be successful in creating enriching experiences for its users.

AEINS uses misconception in favor of the learning process, where it had been shown that when students face evidence that they believe to be true is, in fact, false and a misconception, students often are interested in resolving the discrepancy (Bergin, 1999). AEINS also words the question from the perspective of the student to provide a meaningful context and facilitate the activation of prior knowledge; this technique has shown its usefulness in the learning process as shown in Anderson & Pichert (1978). For example, if we would like students to investigate

stealing effects, we could pose the problem of shoplifting and what if they were the owners themselves.

AEINS uses the Socratic Method as its main teaching pedagogy. The Socratic Method has been easily weaved into the teaching moments' story lines. It provides a medium that encourages the student to think critically in order to solve the discrepancies encountered in the moral situations presented to them. Evaluation of AEINS shows positive and encouraging results from using this method. The Socratic Method forces the student to face the contradictions present in any course of action that is not based on principles of justice or fairness. The voice of Socrates comes from the moral agent participating in the current teaching moment. When the student performs a wrong choice, a text dialogue starts between the moral agent and the student that tries to emphasize the wrong beliefs and encourage the good actions. The moral agent presents opinions and asks questions in order to lead the student to discover themselves any contradiction(s) present in any course of action that is not based on moral principles. The dialogs continue till the story ends with either a negative reward or a positive one based on the computation model of the student's actions. The student model is updated after each student's action; however this information is only used by the pedagogical model after the teaching moment ends.

It has been also noticed that raising the stakes strategy in the Socratic Method enforces the students to think differently, consider issues that were not considered before and see things from different perspectives. Actually this is interesting because this means that the medium was able to allow practicing the required skills rather than being dictated to the students.

Pedagogical Agents in AEINS

Agents are entities that can perform a task or a set of tasks. Pedagogical agents are those agents that can communicate and interact in learning environments. They can have a set of normative teaching goals and plans for achieving these goals (e.g., teaching strategies) (Giraffa and Viccari, 1998)., and associated resources in the learning environment (Thalmann et al., 1997).

The purpose of educational agents is not to perform tasks for users or to simplify tasks, but rather to help users learn how to accomplish tasks (Sklar, 2003). Agents, with different roles, have been used in many intelligent tutoring systems to support education. For example agents can be used to observe the students actions and assess them, in addition to providing feedback, explanations and demonstrations to the student (Hospers et al., 2003; Abbas and Sawamura, 2009). Others have used emotional agents to support student system interactions and provide human-like tutoring (Nkambou, 2006; Neji et al., 2008).

Giraffa and Viccari (1998) have pointed out some interesting properties for agents that allow them to act as life –like characters, such as having mobility to go to different physical places, be flexible and accept other agents interventions, being characters with personalities, have social ability via some kind of agent communication language, act proactively and have some kind of reactivity. These life-like agents have significant motivational benefits and can also play an important pedagogical role by acting as virtual learning companions (Maragos and Grigoriadou, 2005) and increase problem solving effectiveness by providing students with customized advice (Lester et al., 1997). Agents that hold one or more of these properties enrich the learning environment by being believable active and reactive characters and engage the student in the educational process without interfering.

The game-like nature of AEINS allows the incorporation of non-playing characters and objects in the AEINS story world. The non-playing characters can be referred to as semi-

autonomous agents where on one hand they are able to act and react according to their state and the current world state. On the other hand, the story generator can dictate, when required, what they should do in order to preserve the coherence and dramatic tension of the whole story. The presence of a continuous story with characters' personalities evolving during the story helps with the mental and emotional engagement of the student, same way as fairytale stories do.

The AI of the non-playing characters is represented in the form of rules. These rules can be modified during the story as a result of certain actions. For example, a character who is a friend to the student can become an enemy as a result of a student action, or an unethical character can change to become a good character as a result of some interactions with the surrounding world.

The student and the agents are responsible for the story unfolding as it is generated based on their actions. When it is time to present a teaching moment, the currently involved agents in the main story will take the corresponding roles (that fits their current personalities and relationship to the student). If there is a role that is still needed, but there is no agent to take that role, the story world with the assistance of the story generator will allow the inclusion of another agent smoothly through the narrative.

As mentioned previously, the predominant teaching pedagogy is the Socratic Method. The Socratic Voice is used by the moral agent to provide discussion, hints and feedback to the student. The text dialog produced encourages the student to think critically in order to solve the discrepancies encountered in the moral situation(s) they are facing. In addition, students have opportunities to choose among different options and to reason which criteria lead to the option chosen (Kuhn, 1993). When the teaching moment ends, the student along with the non-playing characters are free to act again influencing how the main story unfolds.

Learning Theories in AEINS

Incorporating learning theories in the design of educational learning environments has its positive effects. It helps and leads the way to implementing well structured learning objects considering the learning environment to meet its intended educational goals. This yields the student to acquire the required new skills or knowledge. There are three theories that appear to be most closely aligning with the generally accepted game design principles: Bloom's Taxonomy (Bloom and Krathwohl, 1956), Keller's ARCS model (Keller, 1987) and Gagné's Principles of instruction (Gagné et al., 2005). Gagne's three principles for successful instruction are as follows:

[Providing instruction on the set of component tasks that build toward a final task] This principle is tackled in designing the teaching moments, where coaching is afforded using the Socratic Method and by providing personalized feedback. Such a teaching strategy contributes to the building of skills required for mastering the task.

[Ensuring that each component task is mastered] This principle has been attempted in AEINS using the pedagogical model that tracks the student's learning process and evaluates his moves. Accordingly, if the component is still not mastered, the model chooses another educational object that attempts to address the misconceptions the student has.

[Sequencing the component tasks to ensure optimal transfer to the final task] This principle has been addressed by representing the domain model using hierarchal frames that allow partial ordering of the domain concepts and defining the relationships between them.

The second learning theory used was Bloom's taxonomy. Bloom was determined to develop a practical means for classifying curriculum goals and learning objectives. This has been divided into six levels; knowledge, comprehension, application, analysis, synthesis, and evaluation. We

argue that AEINS is capable of attempting the higher levels of Bloom's taxonomy. Through being involved and interacting in moral situations (teaching moments), the student is able to see the moral values (concepts) involved in the situation context, and see in what pattern they are framing the situation. Accordingly, he is able to aggregate parts together, evaluate the situation and make judgments about the value of ideas. Based on the idea pictured, he started acting to solve the problem encountered. These skills are part of the higher levels; analysis, evaluation and synthesis.

The last learning theory inspired this work is Keller's ARCS model, which relies on four foundational categories that are to be applied when designing instructional activities. ARCS is an acronym that represents these four classes: Attention, Relevance, Confidence/Challenge, and Satisfaction/Success. The details of how each attribute has been attempted are as follows:

[Attention] is an aspect that relates to gaining and keeping the student's attention. AEINS presentation module addressed this aspect by capturing the student's attention through a graphical user interface. Curiosity arousal is achieved through involving the student in the story generation where he is able to affect how the story unfolds. Moreover, AEINS used teaching moments with a series of thought provoking questions, and have different endings based on the student's actions.

[Relevance] Simply put, students need to be able to understand implicitly how the activity relates to their current situation, and/or to them personally. This is the first step in most instructional design models that rely on an understanding of student attributes as a part of the analysis process. AEINS tackled this attribute by designing and implementing teaching moments that contextually discuss situations the student is familiar with or there is high probability for the student to face at some point. To present the student with the appropriate teaching moment, a motive matching procedure is done through initializing the student model based on the first interactions between the student and the system. Based on this, the educational material that suits the student skills level is presented. The teaching moment story is evolved based on the student's actions. This gives the chance to the student to see that the upcoming activities are based on his own actions and decisions.

[Confidence/Challenge] This attribute aims to provide the right level of challenge to the student. If students believe they are, somehow, incapable of achieving the objectives because it will take too long, or, conversely, that the challenge is beneath them, their motivation will most assuredly decrease. AEINS has various teaching moments that tackle different student knowledge levels. Based on the student model, the appropriate teaching moment that targets the current level of the student's knowledge and skills is presented. The student has control over his virtual character that is able to act and influence the story within every single teaching moment.

[Satisfaction/Success] Students must attain some type of satisfaction or reward from the learning experience. AEINS attempted this by providing positive and negative rewards as part of its teaching pedagogy. These rewards take the form of formative and summative feedback that is part of the teaching strategy within the teaching moments.

Analytical Evaluation

The student model is the central component to provide adaptivity in the designed model. In the design of the scripted narratives (teaching moments), we assume that all student misconceptions are expressed in the interaction with the system (e.g. lying when the student believes that lying is okay). The student model has been evaluated using the following assumptions:

- The student modeling has a positive result if the process is able to determine correctly the participant's misconceptions or missing conceptions that underlie unethical action or choice, and provides the appropriate feedback.
- The student modeling has a negative result if the process fails or is unable to determine the participant's misconceptions and consequently does not provide the right feedback corresponding to the participant's actions.

The level of success of the student model component depends on how comprehensive the implemented rules are and the rules complexity for determining the participant's misconceptions. A well designed student model offers good help for a class instructor to use to categorize the participants in his/her class. It also gives the instructor a guide to the most suitable dilemma to prepare for the next class; a dilemma that tackles misconceptions of most of the class participants. Moreover, personalized reports can be produced at the end of the student-game interaction that can help the tutor to easily identify the most common students' misconceptions.

It has been found that the presence of the student model allows a personalized learning process where the teaching moments were presented to the student according to his needs; some of the teaching moments are not be presented if the learner's skills do not require it. With the absence of the student model, the teaching moments will be presented in a certain order to all the students without any consideration to individual differences and needs. With this evidence, it can be said that the student modeling has a positively affect the learning process.

Empirical Evaluation

A full study has been completed to test AEINS for different criteria such as AEINS the technical infrastructure, its functioning, its ability to support or enable specific activities, and generate predicted educational outcomes. The study was conducted on 20 children aged 8 to 12 year old to test the hypothesis of building an educational game that is able to develop new thoughts of the participants to promote character education. The children were of different origins and had different cultural backgrounds, for example Egypt, UK, China, Malaysia and Fiji. In each assignment, the student has been left to explore and interact with the system at their own pace. The student is not merely learning about a process or concept undertaken by an ethics teacher, but he experiences that process himself.

In designing this study, it was determined that, currently, the best way to approach it was to rely on a qualitative research method. This is due to the fact that qualitative research methods are ideal for getting into users' thoughts, and that is what exactly needed to satisfy the aim and objectives listed above. In each assignment, the participant was been left to explore and interact with the system at their own pace. The children were monitored during their interaction with AEINS to see if one of the following appears: engagement, losing interest, forget about the outside world, boredom. The participants were then post interviewed, the interviews were semi structured based upon a designed questionnaire to gain feedback from the participants about the way they perceived the game. All discussions were recorded in order to be analyzed in detail later.

According to what AEINS aims to achieve and the data provided, it has been found that it will not be interesting to tackle every single question on its own as sometimes some questions did not produce enough rich data. Instead the results are organized around the main themes reflected by the data. These themes are: AEINS Architecture and implementation, Social aspects in AEINS, and Learning deployed in AEINS and educational achievements.

For the purpose of this paper we are going to focus only on the evaluation results of the learning deployed in AEINS and educational achievements. This theme is very important as it tends to show that AEINS is an effective learning environment and is able to deliver effective learning, in other words develop the participant's reasoning process.

The use of Socratic Method as the teaching pedagogy shows success. In every teaching moment, since the voice of Socrates comes from one of the involved characters who exhibit certain personality characteristics, mostly one of the student's friends, to raise the moral conflict, pushes the student to think harder to solve the discrepancy inherent in these situations. For example, from P11's log file, it has been found that the student followed the following path in the shoplifting dilemma: agree to help his friend to take a chocolate bar without paying for it, then undertake a discussion with the good moral character that uses the Socratic Voice. The discussion ends by a change in the student behavior where he admitted he did a mistake and asked his friend to return the chocolate. Such attitude reflects the power of the Socratic Method in forcing the student to face the contradictions present in any course of action not based on good moral principles. In the post interview with P11, he mentioned that he did a mistake by helping Gina (the immoral character in the shoplifting dilemma) to take the chocolate. This goes well with the results obtained from the log file.

One participant liked the fact that she can interact with the teaching moments and is able to see the effect of her decisions on herself and others. This interviewee has asked to restart the game when she has been faced by negative consequences as a result of one of her choices. This shows that although the feedback was implicitly provided in the story, it manages to deliver the message (you did something wrong). In the post interview, it seems that the interviewee has an explicit representation about taking stuff. This appears in her final comment: P13:"Taking other people stuff is stealing and we should not take something without asking first."

We claim that the interactive teaching moments were able to provide the appropriate hints about various moral actions and situate the students in different mental and emotional states. Moreover this allows the student to attempt the high levels in the adapted version of Bloom's taxonomy such as Analysis. For example the participants were analyzing the situations where conflict exists, and tried to find a solution to the current dilemma. For example, P4: "It was difficult to take a decision as this can make my friend upset."

The participants were also relating ideas to the real world and applying their beliefs For example, participant 17 was nearly choosing all bad actions to do; accordingly he was faced with negative consequences as a feedback. He said the following in the post interview P17:"I hope if there was no law." This shows that although he chose to do the bad actions the feedback provided made him think of the law and the consequences of such actions in real life. Another interesting point raised while talking to participant 5 is that they were able to show high intellectual reasoning to provide support to their acts For example Participant 5 does not like to disagree with his friends as they become angry with him. "I do not want them to stop being my friend." When asked if they even do wrong things, he replied "Yes, because everyone does wrong stuff." However, Participant 5 does not seem to be worried about other things rather then losing a friend. We claim that this illustrates some ideas transfer as a result of interacting with AEINS. The following quote supports this claim "I used to lie on my little sister to come out of trouble, now I think with lying I can be in a bigger trouble." When asked about what he is going to do now, he answered: "Tell the truth."

Transferring the knowledge to the real world is the main aim of AEINS although this is very difficult to be assessed as it needs very long term evaluation. However, the interviews provided

some insight about what AEINS has achieved in this area. It has been shown that some of the students are thinking of taking the experiences from the game to real experiments. For example, when one participant was asked about what she thinks she will take away out of this experience, she answered P7:"I will think about the situations I have been involved in and what can happen if I really get involved into one." Another participant commented: P6:"I think this can help me solving school problems." These quotes show the possibility of learning transfer and the sparking of new thoughts and/or deeper ones. This also fits well with Gee (2004) in that when people are faced with a new situation in the world, aspects or elements of this situation remind them of aspects or elements of experiences they have had in the past. They use these elements of past experience to think about the new situation. Sometimes they can just apply past experience pretty much as is to the new situation, other times they have to adapt past experience to be able to apply it.

CONCLUSION

Educational games area gained much attention in the last few decades for its powerful engaging property and the ability of these platforms to deliver learning in various domains. They offer an advantage over traditional schooling, where connection between perception and action that is a highly prototypical form of knowledge, can be represented in the following form of production rules: If this is the current situation, do these. Therefore, immersing the student in a (simulated) environment provides a much richer experience than a worksheet or other homework assignment could.

Different narrative techniques provide various advantages. This paper highlights the synergy of integrating both dynamic narrative and scripted narrative techniques and how a student model can be used to provide an adaptive, interactive narrative model. The model has been applied to the educational environment, AEINS, which interacts with every single participant on an individualized basis. AEINS offers a compelling virtual world and virtual identity, at some level, where deep learning may occur. Moreover, it managed to provide adaptation based on the student's explicit actions and the inferred intentions. AEINS has been built considering the learning theories of Gagne's Events of Instruction, Bloom’s Taxonomy and Keller’s ARCS Motivational Model.

The AEINS system tightly integrates gaming and learning whereby the boundaries between both are blurred. It can be noticed that the children were able to build a powerful bridge between their real identity and this virtual identity in the game. They did have emotional responses that transfer their real world responses to the game. This goes quite well with Gee's discussion about learning and identity and his illustration about the importance of the ability of children to build these bridges in order not to make the learning imperiled.

In summary, we think that considering the learning theories in the design and the implementation phases of AEINS helped to build the learning tasks within appropriate learning frames. The students were actively participating in the construction of their knowledge. Finally, AEINS evaluation shows promising results and provides support for the effectiveness of the use of evolving characters and the Socratic Method in supplying the educational process.

REFERENCES

Abbas, S. & Sawamura, H. (2009). Developing an argument learning environment using agent-based ITS (ALES). *In proceedings of The Second International Conference on Educational Data Mining (EDM09).* Cordoba, Spain.

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of Computer Games as an educational tool: 1. Identification of appropriate game types and game elements. *British Journal of Educational Technology*, 30(4), 311-322.
Anderson, R. C. & Pichert, J. W. (1978). Recall of previously unrecallable information following a shift in perspective. *Journal of Verbal Learning and Verbal Behavior*, 17, 1-12.
Avner, A., Moore, C., & Smith, S. (1980). Active external control: A basis for superiority of CBI. Journal of Computer-Based Instruction 6(4), 115-118.
Bayon, V., Wilson, J. R., Stanton, D, & Boltman, A. (2003). Mixed reality storytelling environments. *Virtual Reality Journal*, Springer London , 7(1).
Bell, P., & Linn, M. C. (2000). Scientific arguments as learning artifcats: Designing for learning from the web with KIE. *International Journal of Science Education*. 22(8), 797-817.
Bergin, D. A. (1999). Influences on classroom interest. *Educational Psychologist Journal*, 34(2), 87-98.
Bloom, B. S., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. *Handbook 1: Cognitive domain*, New York, Longmans.
Bolton, G. (1999). Acting in classroom drama: A critical analysis. London: Heinemann.
Colby, A. and Kohlberg, L. and Gibbs, J. and Lieberman, C. (1983). A longitudinal study of moral judgment. *Journal of Monographs of the Society for Research in Child Development*, 48.
Crain, W. (1985). Theories of development. Kohlberg's stages of moral development.
Prentice Hall International, 118-136. Retrieved from http://faculty.plts.edu/gpence/html/kohlberg.htm
Egenfeldt-Neilson, S. (2005, February). Beyond Edutainment: Exploring the educational potential of computer games. Doctoral dissertation, University of Copenhagen.
Fasli, M., & Michalakopoulos, M. (2005). Supporting active learning through game-like exercises. *In proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies (ICALT05)*, 730-734.
Gagné, R. M., Wager, W. W., Golas, K. G., & Keller, J.M. (2005). Principles of instructional design. Fourth edition, Toronto, ON: Thomson Wadsworth.
Gee, J. P. (2005). Learning by design: Good video games as learning machines, ELearning Journal, 2(1).
Gee, J. P. (2006). *Are video games good for learning?*. Keynote address at Curriculum Corporation 13th National Conference. Retrieved from http://www.curriculum.edu.au/verve/_resources/Gee_Paper.pdf
Giraffa, L., & Viccari,R. (1998). The use of agents techniques on intelligent tutoring systems. *In proceedings of the XVIII International Conference of the Chilean Computer Science Society.*
Graf, S., Yang, G., Lin, T., & Kinshuk. (2008). The relationship between learning styles and cognitive traits - Getting additional information for improving student modeling. *Journal of Computers in Human Behavior*, 24, 122-137.

Graf, S., Yang, G., Lin, T., & Kinshuk. (2009). Automatic, global and dynamic student modeling in a ubiquitous learning environment. *Knowledge Management & E-Learning: An International Journal*, 1(1).
Gómez-Martín, M. A., Gómez-Martín P. P., & González-Calero P. A. (2004). Game-
Driven Intelligent Tutoring Systems. *In proceedings of ICEC 2004*. M. Rauterberg (Ed.): LNCS 3166, 108-113.
Elkind, D. H. and Sweet, F. (1997). The Socratic Approach to Character Education, appeared in Educational Leadership. Retrieved from http://www.goodcharacter.com/Article_2.html
Hospers, M., Kroezen, E., Nijholt, A., op den Akker, R., & Heylen, D. (2003). Developing a generic agent-based intelligent tutoring system. *In proceedings of the Third IEEE International Conference on Advanced Learning Technologies (ICALT'03).*
Keller J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, 10(3), 2-10.
Kim, N. (1989). Circsim-tutor: an Intelligent Tutoring System for Circulatory Physiology. Illinois Institute of Technology, Adviser-Martha, W. E., Chicago, IL, USA.
Klawe, M. (1998). *When Does the Use of Computer Games and Other Interactive*
Multimedia Software Help Students Learn Mathematics?, Paper presented at the Dep. of Computer Science, the University of British Columbia.
Koslowski, B. (1996). Theory and Evidence: The Development of Scientific Reasoning, Cambridge MA: MIT Press.
Kuhn, D. (1993). Science as Argument: Implications for Teaching and Learning Scientific Thinking. Science Education Journal, 77(3), 319-337.

Lester, J., Converse, S., Stone, B., Kahler, S., & Barlow, T. (1997). Animated pedagogical agents and problem-solving effectiveness: A large-scale empirical evaluation. *In proceedings of the 8th World Conference on Artificial Intelligence in Education*, Kobe, Japan.
Lynch, C., Pinkwart, N., Ashley, K., & Aleven. V. (2008, June). What do argument diagrams tell us about students' aptitude or experience? A statistical analysis in an ill-defined domain. *In proceedings of the workshop held during ITS-2008. The 9th international Conference on Intelligent Tutoring Systems*. Montreal, Canada.
Maragos, K., & Grigoriadou, M. (2005). Towards the design of intelligent educational gaming systems. *AIED workshop5, held at the 12th International Conference on Artificial Intelligence in education*, Amsterdam.
McBrien, J. L., & Brandt, R. S. (1997). The Language of Learning: A Guide to Education Terms. Association for Supervision and Curriculum Development, Alexandria, 17–18.
McGrenere, J. L. (1996, June). *Design: Educational Electronic Multi-Player Games*
A Literature Review. Paper presented at the Dept. of Computer Science, University of British Columbia.
Neji, M., Ben Ammar , M., Alimi, A.M. and Gouardères, G. (2008). Agent-Based framework for affective intelligent tutoring systems. *In proceedings of the ITS2008*. Woolf et al. (Eds.), LNCS 5091, 665–667.
Niehaus, J., & Riedl, M. (2009). Toward scenario adaptation for learning. *In* proceedings *of the 14th International Conference on Artificial Intelligence in Education (AIED09)*.
Nkambou, R. 2006. Towards affective intelligent tutoring system, Workshop on Motivational and Affective Issues in ITS. *In proceedings of the 8th International Conference on Intelligent Tutoring Systems (ITS 2006),* 5–12.
Nucci, L. (2008). An Overview of Moral Development and Moral Education. Retrieved from: http://tigger.uic.edu/~lnucci/MoralEd/overview.html
Shaffer, D. W. (2005). Multisubculturalism: Computers and the end of progressive education. under review by Teachers College Record. Retrieved from: http://coweb.wcer.wisc.edu/cv/papers/multisubculturalism-draft1.pdf
Shaffer, D. W. (2006). Epistemic frames for epistemic games. *Computers and Education Journal*, Elsevier Science Ltd. (pub.), 46(3), 223-234 Retrieved from: http://dx.doi.org/10.1016/j.compedu.2005.11.003
Shin, N. & McGee S. (2003). Designers Should Enhance learners' Ill-Structured Problem-Solving Skills Retrieved from: http://vdc.cet.edu/entries/illps.htm
Simpson, D. E. (1998). Dilemmas in palliative care education, *Palliative Medicine Journal*, 12.
Sklar, E. (2003). Agents for education: when too much intelligence is a bad thing. *In Proceedings of the second international joint conference on Autonomous agents and Multiagent systems (AAMAS '03)*, ACM, New York, NY, USA, pp. 1118-1119, Melbourne, Australia.
Tan, J., Beers, C., Gupta, R., &Biswas, G. (2005). Computer Games as Intelligent Learning Environments: A River Ecosystem Adventure. *Artificial Intelligence in Education*, C. K. Looi et al. (Eds.), IOS Press.
Thalmann, D., Noser, H., & Huang, Z. (1997), Autonomous Virtual Actors Based on Virtual Sensors. In Trappl, R. & Petta, P. (Eds.). Creating Personalities for Synthetic Actors: towards autonomous personality agents. Berlin: Springer Verlag.
Thomas, J. M. & Young, M. (2007). Becoming Scientists: Employing Adaptive Interactive Narrative to Guide Discovery Learning. *AIED-07 Workshop on Narrative Learning Environments*, Marina Del Rey, California, USA.
Troup, P. (n.d.). Understanding Student Development Theories as Multicultural. Retrieved from: http://www1.umn.edu/ohr/prod/groups/ohr/@pub/@ohr/documents/asset/ohr_68497.pdf
Willard, C. A., Woods, J., Van Eemeren, F. H., Walton, D. N. and Zarefsky, D. (1996). Fundamentals of argumentation theory: A handbook of historical backgrounds and contemporary developments, Mahwah, NJ: Lawrence Erlbaum Associates.
Yang, F., Kim, J. H., Glass, M., & Evens, M. W. (2000). Turn Planning in CIRCSIM-Tutor. In proceedings of the FLAIRS 2000 Conference, 60-64.