Character Education Using Pedagogical Agents and Socratic Voice

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Abstract

Promoting ethical, responsible, and caring young people is a perennial aim of education. Schools are invited to include moral teaching in every possible curriculum, such as the core subjects and sports teams and clubs. Efforts have been done to find other teaching ways other than traditional ones such as games or role play or engaging students in moral dilemmas. Computer games have been always found as one of the most engaging learning platforms. This paper introduces AEINS, a learning environment that is designed and implemented based on the learning theories such as: Bloom's Taxonomy, Keller's ARCS model and Gagné's Nine Principles. The learning environment allows the students to interact with different moral dilemmas and see the effect of their choices on themselves and others. AEINS makes use of the Socratic Method as its predominant teaching pedagogy and employs pedagogical agents to supply the educational process. AEINS evaluation results indicated development of moral reasoning and transfer of moral virtues to its users.

Introduction

Phenomena such as violence, shoplifting, drug abuse, and racism raise the need to develop child and adolescent awareness of social and moral responsibilities, so-called, character education. Character education holds the widely shared, pivotally important, core ethical values, such as caring, honesty, fairness, responsibility, and respect for self and others, along with supportive performance values that form the basis of good character, such as diligence, a strong work ethic, and perseverance (Lickona et al., 2007). Character education aims to establish moral values for the new generation in order to promote ethical, responsible, and caring young people. These values (virtues) are defined in terms of behaviors that can be observed in the life of the school.
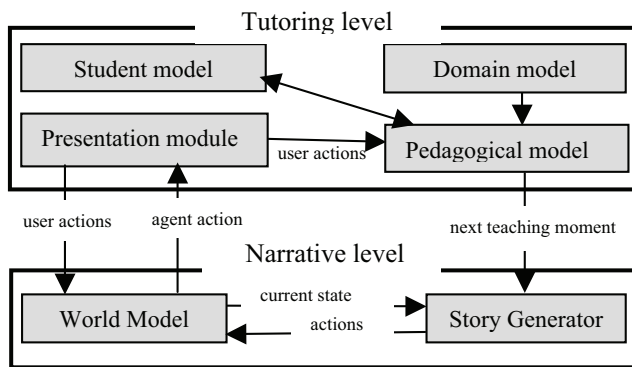
We argue that the development of virtues requires practicing the same way other skills such as reading or writing does. Children need to practice enough independent thinking by being in different situations and to act according to their beliefs. Presenting the effect of these actions on themselves and others as consequences can help them to eventually begin to formulate their own conceptions of rights, values and principles. In addition, it is possible that some 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 presents AEINS, a learning environment that allows the student to practice various character education virtues. It involves the learners in interactive moral dilemmas that focus on virtues and moral exemplars; the learners are involved in independent thinking processes that help them to identify what is good and bad. The paper discusses how learning theories such as: Bloom's Taxonomy (Bloom and Krathwohl, 1956), Keller's ARCS model (Keller, 1987) and Gagné's Principles (Gagné et al., 2005) 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 semi-autonomous agents in supplying the educational process. AEINS promotes the acquisition of skills and knowledge in a pleasant interactive way, as shown by our evaluation.

AEINS

The main idea of the proposed work is to integrate interactive narrative, evolving characters, and intelligent tutoring in a learning environment in order to teach basic moral virtues to young learners. 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.

Figure 1 shows: Tutoring level — Student model, Domain model, Presentation module, Pedagogical model (user actions); Narrative level — World Model, Story Generator, with labels "user actions", "agent action", "next teaching moment", "current state", "actions".

The AEINS architecture shown in Figure 1 is an adapted version of that presented by Hodhod et al. (2009), where the presentation module is now interacting with the pedagogical model instead of the student model. In doing so, the pedagogical model would be solely responsible of updating and making use of the student information. AEINS is an adaptive educational game that aims to help in character education. AEINS is a problem solving environment that helps 8-12 year old children to be engaged effectively in interactive moral dilemmas in order to practice moral virtues. AEINS main aim is to allow students 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 models to serve the educational targets and two models for generating the story and storing information about the story world. AEINS starts by generating a story that the student can act within and affect how the story unfolds. Based on the learner's actions the world is changing and the effects of these changes are presented to the learner through the presentation module. To initialize the student model, the learner is presented by four agents, with personalities, inhabiting the world and has to choose whom he liked to be their friends.

Based on the current student model together with the domain model, the pedagogical model decides on the next moral dilemma (teaching moment) to present the learner with. 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 learner would start interacting with it immediately. 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 (logically and coherently interleaved). The pedagogical model tracks and assesses the learner's actions and updates the student model accordingly.

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. Actually, it can be considered as the bottle neck in the system development phases.

The continuous story generated aims to tie the teaching moments together in one dramatic arc from the start to the end taking advantage of the evolving agents as the actors in the generated story and also as pedagogical facilitators within the teaching moments.

The Socratic Method as the Teaching Pedagogy

Students of all ages use questions in their learning of topics; 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. This method requires a delicate balance between letting the students make decisions, and it promotes a method for demonstrating the limits in their reasoning. Finally, ``raising the ante", which is defined as raising the stakes and introducing consequences, is a tactic followed if a student sticks with the unethical choice. For example, if we would like learners 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 has been shown that when learners faced with evidence that what they believe to be true is, in fact, false and a misconception, learners often are interested in resolving the discrepancy (Bergin, 1999). AEINS also words the question from the perspective of the learner 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 learners 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 learner 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 learner performs a wrong choice, a text dialogue starts between the moral agent and the learner 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 ante 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 (Giraffa and Viccari, 1998). They can have a set of normative teaching goals and plans for achieving these goals (e.g., teaching strategies), 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 have been used to observe the students actions and assess them, in addition to providing feedback, explanations and demonstrations to the learner (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 allows them to be 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 learner 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: Keller's ARCS Motivational Model, Gagne's Events of Instruction, and Bloom's Taxonomy.

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 learner 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 that inspired this work is Keller 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 learner'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, learners 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 learner 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 learner 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 learners 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] Learners 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.

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.

In designing this study, it was determined that 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 learner's friends, to raise the moral conflict, pushes the learner to think harder to solve the discrepancy inherent in these situations. For example, from P11's log file, it has been found that the learner 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 learner 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 learner 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 learners in different mental and emotional states. Moreover this allows the learner 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 learners 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.

In summary, we think that considering the learning theories in the design and the implementation phases of AEINS helped to build the learning tasks according to the right 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. and Sawamura, H. 2009. *Developing an Argument Learning Environment Using Agent-Based ITS (ALES)*. EDM09: proceedings of The Second International Conference on Educational Data Mining. Cordoba, Spain.

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.

Bergin, D. A. (1999). *Influences on Classroom Interest*. Educational Psychologist Journal, 34(2), 87-98.

Bloom, B. S. and 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, 1956.

Crain, W. (1985). *Theories of Development. Kohlberg's Stages of Moral Development*. Prentice Hall International, 118-136.

Gagné, R.M., Wager, W.W., Golas, K.G. and Keller, J.M. (2005). *Principles of Instructional Design*. Toronto, ON: Thomson Wadsworth.

Gee, J. P. (2004). *What Video Games Have to Teach us About learning and Literacy*. Palgrave Macmillan.

Giraffa, L. and Viccari,R. *The Use of Agents Techniques on Intelligent Tutoring Systems*. sccc, pp.76, XVIII International Conference of the Chilean Computer Science Society, 1998

Hodhod, R. & Kudenko, D. and Cairns, P. (2009, April). *Serious Games to Teach Ethics*. In proceedings of AISB'09: Artificial and Ambient Intelligence. Edinburgh, Scotland, UK.

Hospers, M., Kroezen, E., Nijholt, A., op den Akker, R. and Heylen,D. 2003. *Developing a Generic Agent-Based Intelligent Tutoring System*. icalt, pp.443, 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.

Kuhn, D. (1993). *Science as Argument: Implications for Teaching and Learning Scientific Thinking*. Science Education Journal, 77(3), 319-337.

Lester, J., S. Converse, B. Stone, S. Kahler, and T. Barlow. (1997). *Animated Pedagogical Agents and Problem-Solving Effectiveness: A Large-Scale Empirical Evaluation*. Proc. of the 8th World Conference on Artificial Intelligence in Education, Kobe, Japan.

Lickona, T., Schaps, E. and Lewis, C. (2007). *Eleven Principles of Effective Character Education*, Character Education Partnership.

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 a workshop held during ITS-2008. The 9th international Conference on Intelligent Tutoring Systems. Montreal, Canada.

Maragos K. and Grigoriadou M. (2005). *Towards the Design of Intelligent Educational Gaming Systems*. AIED workshop5, 12th International Conference on Artificial Intelligence in education, Amsterdam

Neji, M., Ben Ammar , M.,   Alimi, A.M. and Gouardères, G. 2008. *Agent-Based Framework for Affective Intelligent Tutoring Systems*. Woolf et al. (Eds.): ITS 2008, LNCS 5091, pp. 665 667.

Nkambou, R. 2006. *Towards Affective Intelligent Tutoring System, Workshop on Motivational and Affective Issues in ITS*. 8th International Conference on ITS 2006, pp. 5 12.

Rebolledo-Mendez, Genaro; Freitas, Sara de; Gaona, Alma Rosa Garcia. (2009). *A Model of Motivation Based on Empathy for AI-Driven Avatars in Virtual Worlds*. Conference in Games and Virtual Worlds for Serious Applications, 2009. VS-GAMES'09, 23-24 March 2009 Page(s):5 - 11 Digital Object Identifier   10.1109/VS-GAMES.2009.33

Sklar, Elizabeth. 2003. *Agents for education: when too much intelligence is a bad thing*. AAMAS '03: Proceedings of the second international joint conference on Autonomous agents and Multiagent systems, ACM, New York, NY, USA, pp. 1118-1119, Melbourne, Australia. http://doi.acm.org/10.1145/860575.860824

Thalmann, D., Noser, H. and Huang,Z. (1997), A*utonomous Virtual Actors Based on Virtual Sensors*. In: Creating Personalities for Synthetic Actors: towards autonomous personality agents. Trappl,R.; Petta,P. (Eds.). Berlin: Springer Verlag

Yang, F., Kim, J. H., Glass, M. and Evens, M. W. (2000). *Turn Planning in CIRCSIM-Tutor*. FLAIRS Conference, 60-64.