Applying Affective Tactics for a Better Learning

Patricia Augustin Jaques and **Rosa Maria Vicari** [1] and **Sylvie Pesty** and **Jean-François Bonneville** [2]

Abstract. This paper describes the Mediating Agent, an animated pedagogical agent inserted in a computational system for distance learning, which has the goal of motivating the student to learn as well as promoting a positive mood in the student, which is more appropriate to learning. In order to accomplish its function, the agent should recognize the student's emotions to respond appropriately. Thus, it catches some information from observing the student's behaviour in the interface of the educational system, which allows it to infer the student's affective states according to the cognitive approach of emotion. This information is stored in an affective model and it is used so that the agent may choose an affective pedagogical tactic to be applied.

1 INTRODUCTION

Many educational systems have been implemented as animated pedagogical agents [3] [11] [12] [19] due to their motivational potential. The animated pedagogical agents are tutoring agents that use multimedia resources to provide the student with a lifelike character that has characteristics similar to those of intelligent alive creatures. These characteristics, such as facial expressions, gestures and understanding of human emotions, with a good dialogue interface with the user, turn the agents more attractive to the students since they explore more lifelike modes of interaction. Animated pedagogical agents offer great promise to increase the communication capacity of educational systems [11], to amuse the student [3] and to increase these systems' ability of engaging and motivating the students [13].

On the other hand, psychologists and pedagogues have pointed out the way that emotions affect learning [9] [20] [24]. According to Piaget [20], it is incontestable that the affectivity has an accelerating or perturbing role in learning. A good part of the students that are weak in mathematics, fails due to an affective blockage. Coles [5] suggests that negative emotions can impair learning; and positive emotions can contribute to learning achievement.

This way, some educational systems have given attention to generation of emotion in pedagogical environments (emotion expression and emotion synthesis) [13] [14] [19] and to the student's emotion recognition [6] [7] [15], pointing out the richness presented in affective interaction between student and tutor.

In this paper we present our proposal to handle student's emotions[3] in a educational system: a cognitive animated pedagogical agent, the Mediating Agent, which has the goal of motivating as well as promoting a positive mood in the student which is more appropriate to learning. We believe that the student can experience a more positive feeling through the exposure to emotional behaviour and encouragement messages sent by the Mediating Agent. In order to accomplish its function, the agent should recognise the student's emotions to respond appropriately. Thus, it catches some elements from the observation of the student's behaviour at the system's interface and then infers her/his affective state according to the cognitive approach of emotion, more precisely the OCC model [18]. This information is stored in an affective model and the agent uses it to choose a pedagogical tactic to be applied. We call this pedagogical tactic an affective tactic (for instance, increasing the student's effort, congratulating), because it adapts the system to the student's emotions. As we decided to express the affective tactics in 2 modalities (speech and behaviour - that we call emotive behaviour), we chose to represent the Mediating Agent as a lifelike character that interacts with the student through messages, speeches and emotive animations.

This work finds its place in the branch of Affective Computing area that studies the affectivity in Human Computer Interaction in which researchers are mainly interested in adapting the system to the user's affectivity. The systems that are part of this branch have the capacity of recognizing user's emotions [6] [7] [15] and expressing emotions [13] [14] [19] (by text and speeches, and gestures of lifelike characters). This is the case of the Mediating Agent since it identifies the student's emotions (recognize) in order to adapt the learning to the student's affectivity by presenting emotive gestures and messages (emotion's expression).

Although some systems have already integrated emotions into animated pedagogical agents [7] [13] [14] [19], the main goal was to turn these agents more believable[4] with the capacity of expressing emotions. In our system, we intend that the agent's emotions be used as affective tactics that aims at motivating and encouraging the student, and promoting a positive mood in the student which is more appropriate to learning (see section 2). And in order to know the appropriate moment to act and which tactics to apply, Mediating Agent also recognise the student's emotions.

In the next section we describe the role of the emotions in learning. In the following sections we describe how the Mediating Agent recognises the student's emotions and the affective tactics applied by it. Finally, we present the conclusion and perspectives for future works.

2 EMOTIONS AND LEARNING

Psychologists and pedagogues' investigations show that positive emotions have a positive effect on learning. Coles [5] points out some links between learning and emotions. For example, poor learning can

[1] Instituto de Informatica - Federal University of Rio Grande do Sul (UFRGS) Porto Alegre - Brazil. E-mail: {pjaques, rosa}@inf.ufrgs.br

[2] Laboratoire Leibniz - IMAG - Grenoble - France. E-mail: {Sylvie.Pesty, Jean-Francois.Bonneville}@imag.fr

[3] Although we use the terms "emotion" and "affective state" when we refer to the student's affectivity, affective state is more wide-ranging and it comprises the emotions and other states such as moods and sentiments [8]. Thus, it is not incorrect to use the term affective state to also denote the emotions, although it is not so accurate.

[4] It provides the illusion of life and then allows the suspicion of disbelief [4].

produce negative emotions; negative emotions can impair learning; and positive emotions can contribute to learning achievement and vice versa. Izard's works [10] show that induced negative emotions cause performance problems on cognitive tasks, and positive emotions have an opposite effect. Besides, Coles [5] considers that as a teacher can contribute for development of student's cognitive abilities, s/he can also assist the emotional development of the child through guidance and support. As Coles points out: "Fear of failure may be changed to feelings of self-confidence; motivation may change from low to high; intellectual insecurity may become confidence in one's intelligence. These transformations can occur through a teacher's scaffolding and guidance in the formation of new emotional states a learner can achieve and sustain by her/him- or herself" [5, p. 4]. We believe that this role of an affective tutor which cares about student's progress in learning, and chooses the appropriate affective tactics in order to promote positive emotions in the student which are better for learning can be performed by the Mediating Agent.

3 THE STUDENT'S EMOTIONS RECOGNITION

In order to accomplish its function, the Mediating Agent must recognise the student's emotional states to respond appropriately. For example, when the student is disappointed with her/his performance, s/he will probably give up the task. The agent needs to know when the student is disappointed in order to encourage her/him to keep on studying and accomplishing the task.

The Mediating Agent catches the student's emotions by her/his observable behaviour, i. e., the student's actions in the system's interface. Some examples of observable behaviour are: the success or failure in the execution of an exercise and ask for help. We chose this method because it seems the most natural way for the student to interact with the educational system. The student's emotion recognition by her/his observable behaviour has been adopted by other researchers, as shows the Martinho's work [15] for an educational game.

We model the student's *satisfaction* and *disappointment* emotions according to the OCC model [18], which is based on the cognitive theory of emotion, and may be implemented computationally. The OCC model provides information about the cognitive evaluation (called appraisal) that a person does and which elicits each one of the 22 emotions cited in [18]. This way, if we know students' appraisal, we can determine their emotions. This approach was also used by [6] and [15] for educational games.

According to the OCC model, emotions of satisfaction and disappointment are elicited when events of the world that already happened are evaluated (appraised) according to their desirability with respect to the user's goals [18]. The *satisfaction* emotion arises when one is pleased about the confirmation of a desirable event and disappointment when one is displeased about the disconfirmation of the prospect of a desirable event. Figure 1 presents a scheme that illustrates the appraisal for the satisfaction and disappointment emotions. So, what we want to do is verify when an event of the educational environment is desirable for the student (according to her/his goals) and when the student is pleased because this desirable event happened or displeased because it did not happen. This way, we need to define the events that can happen in the educational system, the user's goal (to know if the event is desirable or not) and how we are going to classify an event as pleasant or not.

First, we defined the events that can arise in the educational system. Some examples of events are: the student did not accomplish the task; the student provided a wrong answer for the exercise; and the student asked for help (due to space limitation, we just cite some examples of events).

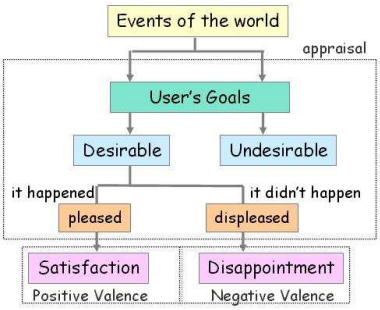

Figure 1. Scheme representing appraisal for satisfaction and disappointment emotions

Second, we need to determine the student's goals in order to verify the desirability of the events (see Figure 1). According to Ames [2], in an educational situation, students can have *mastery* or *performance goals*, which are the reasons for students to engage in learning. Students who have a *learning/mastery goal* are oriented towards developing new skills and abilities, trying to understand their work, improving their level of competence, and learning new things. When students have a *performance goal* they believe that performance is important and they want to demonstrate that they have abilities [2]. They feel successful when they please the teacher or do better than other students, rather than when they understand something new. In order to identify the student's goal orientation we use the Motivated Strategies for Learning Questionnaire (MSLQ) [21], that is a self-report instrument. It is based on a cognitive view of motivation and learning.

Third, once we know the events that can arise in our educational system and the student's goal, we can determine the desirability of the events and also when the student is pleased/displeased with an event. This process is necessary to infer the student's appraisal. This way, we classified the student's pleasure/displeasure for each one of the events according to what we know about students who have mastery or performance goals. With this information, we can determine the student's emotion in our system.

Our work differs from others that infer student's emotions in educational games [6] [15] because we propose a methodology to infer student's emotions (which are also determined by their goals according to the OCC model) in an educational environment that is domain-independent (it was built for teaching any domain of subject). So, differently, the events that can happen and the student's goals are not so well defined as in an educational game.

Once the agent knows the student's emotion, it chooses the affective tactics to be applied. The affective tactics promote actions that aim at adapting the system to the student's emotions. These tactics can be: (1) emotive behaviour presented by animations of the life-like character; and (2) domain-based tactics (for example, the agent can decide to present an easier exercise when the student is having difficulties in order to increase the student's confidence and to show her/him that s/he is able to resolve the problem). Based on studies about affectivity and learning [5] [16], we defined the tactics that are applied by the Mediating Agent. In the next section, we address these affective tactics.

4 THE AFFECTIVE PEDAGOGICAL TACTICS

The pedagogical tactics employed by the system are divided in affective tactics and tactics for performance and competence. The tactics for performance and competence promote actions that give support to the student in the learning of concepts and of the domain. These tactics are decided by the Diagnostic Agent, another agent of the educational system. The affective tactics are chosen by the Mediating Agent. In some cases, a conflict between the affective tactic (proposed by the Mediating Agent) and the tactic for performance and competence (decided by the Diagnostic Agent) can happen. In this case, the Mediating Agent carries out a new reasoning in a way that it reaches an affective pedagogical tactic that doesn't conflicts with the tactic for performance and competence. If it verifies that the tactic for performance and competence is not adapted to the actual affective state of the student, it will communicate with the diagnostic agent in order to propose an effective pedagogical tactic in the intellectual and affective point of view.

What we propose in this work is to improve the communication of the user and agent by considering student's affectivity and by applying affective tactics which aims at engaging and developing in the student a positive mood more propitious to learning, as a teacher does in a real class. We believe that the Mediating Agent can do it by presenting positive emotional behaviour and encouragement messages to the student, besides positive feedback to student's performance in the course.

As the student's emotions are also determined by her/his achievement goals (mastery or performance), we opted for applying affective tactics that consider the student's goal orientation, besides student's emotions. For example, students who have performance goals usually do not make many effort, they think that they have low ability when they fail and enjoy receive rewards. For these students, the agent seeks to encourage them to make more efforts and to show that they have ability when they fail, and praise them when they have success. The students who have mastery goal are more oriented towards learning subjects in which they are interested. For these students the agent seeks to arouse their curiosity for learning a subject and fulfilling exercises. Table 1 shows examples of affective tactics for one event (in the current version of Mediating Agent's prototype, there are tactics for 14 events). The student can feel disappointment, or satisfaction emotions, or neither, that is represented by NE. Each affective tactic is composed by a verbal (message) and a physical (action) behavior, which are respectively represented by VB and PB in the table. When the student who has **mastery goal** feels disappointed because s/he **did not accomplish correctly the task** (***Scenario 1***), the agent presents an empathic face gesture showing that it understands the difficulties that the student is experiencing. As a mastery-oriented student usually does great efforts, the agent just offers a specific help to the student to help her/him to accomplish the exercise. The student who has **performance goal** feels disappointed because s/he think that s/he is not able to accomplish the task when s/he fails (***Scenario 2***). And s/he usually does not do greater effort when s/he has difficulties, because s/he thinks that it means lack of ability [16]. This way, the agent presents a message for increasing student's beliefs about her/his self-ability and says to the student that s/he is able to carry out the task with a little more effort.

When the **mastery goal oriented student** is satisfied because s/he **accomplished a task with success** (***Scenario 3***), the agent shows to her/him the new ability s/he acquired, since the student is motivated to learn new things, to improve. If the event is indifferent to her/him ***(Scenario 4)***, the agent shows the new abilities the student acquired to foster her/his motivation and congratulate the student in order to her/him notice the new ability s/he acquired. The student who has **performance goal** is always satisfied with success in tasks ***(Scenario 5)***, because it means a proof of ability to her/him. In these cases, the agent congratulates strongly her/his performance to maintain her/his motivation since these students need tutor's appreciation.

Table 1. Examples of Affective Tactics

Event	Intrinsic Motivation	Extrinsic Motivation
Not correct task answer	*SCENARIO 1* **Disappointment**: 1) *Recognize-student-effort* *VB*: Recognize-student-effort; *PB*: Empathic 2) *Offer-help* *VB*: Offer-help; *PB*: speak	*SCENARIO 2* **Disappointment**: 1) *Increase-self-ability* *VB*: Increase-self-ability; *PB*: Encouragement; 2) *Increase-student-effort* *VB*: Increase-student-effort; *PB*: Speak 3) *Offer-help* *VB*: Offers-help, *PB*: Speak
Correct task answer	*SCENARIO 3* **Satisfaction**: 1) *Show-New-Skills* *VB*: New-skill; *PB*: New-skill	*SCENARIO 5* **Satisfaction**: 1) *Congratulate-Student* *VB*: Congratulation; *PB*: Congratulation;
	SCENARIO 4 **NE**: 1) *Congratulate-Student* *VB*: Congratulation; *PB*: Congratulation; 2) *Show-New-Skills* *VB*: New-skill; *PB*: New-skill	

In our system, we use a mentalist approach to implement the affective student model and the affective diagnosis. The proposed agent is implemented as a BDI (Belief, Desire and Intention) agent. The BDI [22] approach is based on describing the internal processing of the agent through mental attitudes - belief, desire and intention, which represent information, motivational and deliberative state of the agent. For the implementation of the cognitive agent, we will use the modelling and developing system of BDI agents, named X-BDI [17] that makes possible to implement the cognitive structure of a BDI agent, called "cognitive kernel". In our work, the X-BDI was used as tool for implementation of the agent's kernel cognitive because it turns easier the developer's work since it allows to specify the behavior of the agent in a high level of abstraction. But we believe that other approaches could also be used as, for example, rules [23].

For example, let us see how the X-BDI cognitive kernel selects the affective tactics for the **Scenario 2**, previously presented in Table 1. The student has performance goal (extrinsic motivation) and he is disappointed because he provided a incorrect response to the exercise. The *cognitive kernel* receives the following information from the agent's sensors:

```
current_time(2),sense(student_goal(performance),1).
current_time(3),sense(event(not_correct_answer),2).
```

So, the agent activates the desire "apply_tactics". As it is the only available desire, it is elected to the agent's intention.

```
/* The Mediating Agent desires to apply a determined
   tactic if it chose a tactic. */
des(agent,apply_tactics(Tactic),Tf,[0.6])
```

```
   if bel(agent,choose_tactics(Tactic)).

/* the cognitive kernel sends the chosen tactic to
   the Body module, which will apply the tactic */
act(agent,send_tactic(Tactic)) causes
   bel(agent,apply_tactics(Tactic))
   if bel(agent,choose_tactics(Tactic)).
```

The Mediating Agent infers the student's emotion through the following believes:

```
bel(agent,
  event_pleasantness(not_correct_answer,displeased))
  if bel(agent,student_goal(performance)),
     bel(agent,event(not_correct_answer)).

bel(agent,student_emotion(disappointment))
  if bel(agent,
              event_pleasantness(Event,displeased)).
```

The student's emotion is disappointed because the performance oriented student is displeased since it provided a *not correct answer to the exercise*.

Finally, the agent chooses the tactics to be applied through the believes showed below. Once it chose the affective tactic, it can accomplish the action of sending the tactic to the Body module. As this action is the restriction for the elected intention to be satisfied, the agent's intention of applying an affective tactic is realized.

```
bel(agent,
   choose_tactics(increase_student_self_ability))
    if bel(agent,student_emotion(disappointment)),
       bel(agent,event(not_correct_answer)),
       bel(agent,student_goal(performance)).

bel(agent, choose_tactics(increase_student_effort))
  if bel(agent,student_emotion(disappointment)),
     bel(agent,event(not_correct_answer)),
     bel(agent,student_goal(performance)).

bel(agent, choose_tactics(offer_help)) if
    bel(agent,student_emotion(disappointment)),
    bel(agent,event(not_correct_answer)),
    bel(agent,student_goal(performance)).
```

Each affective tactic is presented by an agent's physical and verbal behaviour. These kinds of behaviours are presented in the next section.

5 THE CHOICE OF EMOTIVE AND ANIMATED BEHAVIOUR AND SPEECHES

In our system, the animated behaviours of the character are stored in a database of speeches and behaviours. The agent chooses a behaviour, that can be verbal or physical or both, to be presented from this database. This implementation is very similar to the Space of Behaviours" used for the generation of animated behaviour in the Cosmo Agent [12]. As in Cosmo, the animated behaviour of the agent is not generated dynamically by 3D graphical algorithms (like Steve [11]), but it is selected from a database of behaviour.

The Mediating Agent's Architecture is basically composed by 2 modules: (1) *Mind*: responsible for the affective recognition and diagnosis; and (2) *Body*: which is composed by the Communication Module (responsible for the communication with other agents of the society), and Module for Presentation of Behaviour (responsible for presenting the physical and verbal behaviour - that are the affective tactics).

The Mind Module sends a message that contains the type of behaviour to be presented to the Body Module. For example, the Mind Module desires to present a behaviour of offer help". It must inform the action's type (verbal or physic) and the behavior's type (salutation, tutoring, help, etc).

First, the message is received by the "Module for Presentation of the Behaviours and Speeches". It randomly chooses a behaviour of the required type (generally, the mind module sends a physical and verbal behaviour together). In order to choose the behaviours arbitrarily, the agent stores in the database the time that each behaviour was accessed for the last time. So, if the behaviour chosen was one of the last ones presented, the agent chooses another. For each tactic the agent has more than one behaviour to be presented. This is important to the agent be believable [4], i. e., more realist and less monotonous.

After the agent has chosen a behaviour, it will compose the JavaScript code that will make the Microsoft Agent [1] move the agent.

The Microsoft Agent has already some characters to be used like Merlin and others. After a study with psychologists, we opted for designing our own character, since we did not find a character that matched the specified characteristics. The animated character, called PAT (Pedagogical and Affective Tutor), is a female with entire body. It has brown eyes and long hair, it wears jeans pants and a coloured shirt and it is approximately 30 years old, because the goal is to represent a young, extrovert and informal character. For the agent's speeches we use the Microsoft Speech API as voice synthesiser. Although the Microsoft technologies used in the character's implementation depends on the operational system, we opted for this software, because it offers a package for developing animated agents easy to implement and with good aspects of interface. It is out of the scope of this work to present the graphical implementation of the animated character. But the system supports the character implementation in other implementation languages. For characters that work in a similar way the Microsoft Agent, it is only necessary to replace the JavaScript on the Optional Field of the Database by the code of the language used. For characters in 3D environments (like Steve), it is necessary to create a component of communication between the Mediating Agent's Action Module and the environment responsible for generating the movements of the character.

It generates an HTML page with the JavaScript code for the agent's movements and present it in the student's browser. The browser reads the HTML page and sends the code to the Microsoft Agent (installed in the user's machine) that will present the behaviour determined in the code.

For example, suppose that for the tactics cited in Table 1, the Module for Presentation of Behaviour chooses the following character's actions:

For the **Scenario 1** cited in Table 1 - The student that has mastery goal is disappointed because s/he accomplished incorrectly an exercise: The agent recognises student's effort so that it shows the behaviour in Figure 2. After, it offers help to the student. An example of behaviour of offer help is showed in Figure 3.

Suppose now the **Scenario 2** cited in Table 1 - the student is disappointed because s/he accomplished incorrectly an exercise, but s/he is performance-goal oriented. Then the agent says, "You're a winner! Remember all yours previous success!" (as a message for increasing the student's self ability) and after says, "I know that you can strike your troubles! Keep trying!" and shows the agent fighting boxing (see Figure 4). Afterwards, the agent offers help to the student.

In the **Scenario 3** in Table 1, the agent congratulates the performance-oriented student because s/he is satisfied by the success in the task. The behaviour of Figure 5, which represents the agent winning a race and being applauded, is showed.

Figure 2. Examples of behaviours for the tactic *"Recognize student's effort"*

Figure 3. Examples of behaviours for the tactic *"Offer help"*

Figure 4. Examples of behaviours for the tactic *"Increase student's effort"*

Figure 5. Examples of behaviours for the tactic *"Congratulate student"*

We cited above some examples of behaviours that the agent can show to the student as an affective tactic. By the moment, we have 60 verbal and physical behaviours. So, for the same scenarios presented in this section, the agent can choose other different behaviours in order to be believable.

6 CONCLUSION

In this paper we presented a pedagogical agent responsible for inferring the student's emotions and presenting to the student emotive behaviours that aim at promoting a positive mood in the student, more suitable to learning. Our group is interdisciplinary and we had the support of psychologists in decisions related to student's emotions recognition and to the choice of the affective tactics.

The Mediating Agent is already implemented and we already designed by the moment 60 physical and verbal behaviours that compose the affective tactics. The database of behaviours is yet in expansion. In this article we presented some examples of these affective tactics and the behaviours that compose them.

As the educational system where the Mediating Agent is inserted is not yet implemented, we made a partial validation of the Mediating Agent and its affective tactics. In this validation we presented some scenarios and the respective affective tactics to pedagogues and psychologists expert in education. With this partial validation we reached our goal that was to demonstrate that the affective tactics are appropriate according to these psychologists' and pedagogues' point of view. When the educational system is completely implemented, we intend to accomplish another validation with a virtual class of undergraduate students.

ACKNOWLEDGEMENTS

This project is granted by Brazilian research agencies: CAPES - PhD stage scholarship, CNPq - PhD scholarship, and CAPES - PAPED program.

REFERENCES

[1] Microsoft agent. http://www.microsoft.com, 2002.
[2] C. Ames, 'Motivation: What teachers should know', *Teachers Colege Record 91*, **3**, (1990).
[3] E. Andre et al., 'Employing AI methods to control the behavior of animated interface agents', *Applied Artificial Intelligence*, **13**, 415–448, (1999).
[4] J. Bates, 'The role of emotion in believable agents', *Communication of ACM*, **37**(7), 122–125, (1994).
[5] G. Coles, *Reading Lessons: The Debate over Literacy*, Hill & Wang, New York, 1998.
[6] C. Conati and X. Zhou, 'Modelling students's emotions from cogntive appraisal in educational games', in *International Conference on ITS*, (2002).
[7] C. Elliot et al., *Lifelike pedagogical agents and Affective Computing*, 195–212, LN in Artificial Intelligence, Springer-Verlag, Berlin, 1999.
[8] N. Fridja, *Varietes of affect*, 59–67, Lectures Notes in Artificial Intelligence, Oxford University Press, 1994.
[9] D. Goleman, *Emotional Intelligence*, Bantam Books, New York, 1995.
[10] C. E. Izard, *Emotion Cognition relationships and human development*, 59–67, Emotions, cognition and behavior, Oxford University Press, 1984.
[11] L. Johnson et al., 'Animated pedagogical agents: Face-to-face interaction in interactive learning environments', *International Journal of Artificial Intelligence in Education*, **11**, 47–78, (2000).
[12] J. Lester et al., 'A life-like animated pedagogical agent with deictic believability', *IJCAI'97 Workshop on Animated Pedagogical Agents*, 61–69, (1997).
[13] J. Lester et al., 'The persona effect: affective impact of animated pedagogical agents', in *SIGCHI Conference on Human factors in Computing Systems*, pp. 359–366. ACM Press, (1997).
[14] J. Lester et al., 'Achieving affective impact: Visual emotive communication in lifelike pedagogical agents', *International Journal of Artificial Intelligence in Education*, **10**(34), 8278–291, (1999).
[15] C. Martinho et al., *A Cognitive Approach to Affective User Modeling*, volume 1814, 64–75, Lecture Note in Computer Science, Springer, 2000.
[16] J. Meece and W. McColskey. Improving student motivation. SERVE:, 2001.
[17] M. C. Mora et al., 'Bdi models and systems: reducing the gap.', in *Workshop on Intelligent Agents (ATAL-98)*, Paris, (1998).
[18] A. Ortony, G. L. Clore, and A. Collins, *The Cognitive Structure of Emotions*, Cambridge Press, UK, 1988.
[19] A. Paiva et al., 'Enriching pedagogical agents with emotional behavior: the case of vincent', in *AIED Life-like Pedagogical Agents*, Le Mans, (1999).
[20] J. Piaget, *Les relations entre l'intelligence et l'affectivit dans le dveloppement de l'enfant*, 75–95, Les Emotions, Paris, 1989.
[21] P. Pintrich et al., 'A manual for the use of the motivated strategies for learning questionnaire', Technical Report 91-B-004, (1991).
[22] A. Rao and M. Georgeff, 'Bdi agents: from theory to practice', Technical Report Technical Note 56, Melbourne, Australia, (1995).
[23] S. Russel and P. Norvig, *Artificial Intelligence - A modern approch*, Prentice-Hall, Englewood Cliffs, 1995.
[24] L. S. Vygotsky, *The Problem of the Environment*, 338–354, The Vygotsky Reader, Blackwell, Cambridge, 1994.