

An Autonomy-Oriented System Design for Enhancement of Learner's Motivation in E-Learning

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Abstract. Many e-Learning practices don't care about learner's motivation. There are elements showing that this is an important factor in learner's success and that a lack of motivation produces a negative emotional impact. This work is aimed at establishing a survey of motivation literature and proposing a Motivation-Oriented System Design for e-Learning. Psychological theories underline the importance of giving control of his activities (i.e. providing autonomy) to a learner in order to enhance learner's self-beliefs, hence motivation. Coaching is also important to keep learners focused on an activity. ITS and Pedagogical Agents provide coaching whereas Open Environments offer autonomy to learners. The presented system is a hybrid solution taking motivational positive aspects of Open-Environments and Pedagogical Agents. It also uses role-playing practices in order to enhance constructivist learning.

Keywords: Achievement Motivation, Emotions, e-Learning, Intelligent Tutoring Systems, Pedagogical Agents, Agents Collaboration, Open-Environment, Role-Playing, Constructivist Learning.

1. Introduction

How to keep students interested in a learning activity? This question is one of teacher's major challenges. Eccles et al [6] cited Dewey to argue that "people will identify with, and be totally absorbed by, the materiel to be learned only if they are sufficiently interested in it". What is true in a classroom become tremendously important in e-Learning activities.

According to O'Regan's study [12], some actual e-Learning practices produce negative emotions on learners (frustration, fear, shame, anxiety and embarrassment) more frequently than positive ones (excitation, pride). It has been demonstrated that negative emotions, such as anxiety, are strongly linked to learner's motivation [9, 17]. Given O'Regan's outcomes, where is the problem in those e-Learning practices? What is missing in some e-Learning activities in order to procure interest to learners? What could be done to maintain and enhance learner's motivation for an e-Learning activity?

Achievement Motivation (AM) is the part of psychology dedicated to the study of motivation to succeed that a learner has and how this motivation can affect learner's results and behaviors. Many researches in AM demonstrated the importance of giving the belief to a learner that he has control on his activities and results (i.e. he has some autonomy). But other researches also underlined the necessity of monitoring and

sometime guiding and helping (i.e. coaching) students in order to keep them focused on learning activities [5, 6, 11]. In this paper, we will propose a system design in order to give autonomy and, at the same time, monitor/coach learners in an e-Learning system.

Contrary to O'Regan's outcomes, *non-controlling virtual environments* (for example Virtual Harlem [13]) have positive feedbacks from learners and appear to be very motivating. But those systems don't adapt to learners specificities. On their side, ITS provide organized knowledge and personalized help to learners but are very controlling systems. Thus, we propose a hybrid e-Learning system design using non-controlling virtual environment and agents inspired by pedagogical agents [8]. We demonstrate how this system can enhance learner's motivation.

In section two, we give an overview of some of the main AM theories and also present some of the motivation factors that have been defined in the AM field. In section three, we emphasize the importance of learner's autonomy in order to maintain a high level of motivation. We also focus on the necessity of finding balance between coaching and autonomy. In section four, we propose a virtual learning environment system for maintaining and enhancing motivation in an e-Learning activity. This environment will enhance learner's motivation by giving him more control on his learning activity, allowing him to explore solutions, to make hypothesis, to interact and play different roles.

2. Overview of Achievement Motivation

Petri [14] defines motivation as "the concept we use when we describe the forces acting on or within an organism to initiate and direct behavior". He also notices that motivation is used "to explain differences in the intensity of behavior" and "to indicate the direction of behavior. When we are hungry, we direct our behavior in ways to get food".

Study of motivation is a huge domain in psychology. AM is a sub-part of this domain where "theorists attempt to explain people's choice of achievement tasks, persistence on those tasks, vigor in carrying them out, and quality of task engagement" [5]. There are many different theories dealing with AM. Actual ones are mostly referring to a social-cognitive model of motivation proposed by Bandura [1], described by Eccles and her colleagues [5] as a postulate that "human achievement depends on interactions between one's behavior, personal factors (e.g. thoughts, beliefs) and environmental conditions". In the next part, we give a review of some of the main actual AM theories.

2.1. Theories of Achievement Motivation

The Attribution Theory is concerned with interpretations people have of their achievement outcomes and how it can determine future achievement strivings. Weiner [17] classified attribution using three dimensions: locus of control, stability and controllability. The locus of control (also called locus of causality: "attribution term" for sense of autonomy [15]) dimension can be internal or external depending if success is attributed to internal (depending of the learner) causes or not. The stability dimension determines if causes changes over time or not. The controllability

dimension makes a distinction between controllable attribution causes like skill/efficacy and uncontrollable ones like aptitude, mood.

Controls Theories [3, 16] are focused on beliefs people have on how they (and/or their environment) control their achievement.

Intrinsic Motivation Theories are focused on the distinction between intrinsic motivation (where people will do an activity “for their own sake”) and extrinsic motivation (people have an external interest in doing the activity, like receiving an award). As Eccles and al [6] noticed, the distinction between intrinsic and extrinsic motivation “is assumed to be fundamental throughout the motivation literature”. Deci and Ryan’s *self-determination theory* [15] is one of the major intrinsic motivation theories.

Theories of Self-Regulation study how people regulate their behaviors in order to succeed in a task or activity. Zimmerman [19] enumerated three processes in which self-regulated learners are engaged: self-observation (monitoring one’s activities), self-judgment (making an evaluation of one’s performances) and self-reaction (dealing with one’s reaction to its performance outcomes). Self-determination theory, seen in the precedent paragraph, also deals with self-regulation.

Theories Concerning Volition. According to Corno [2], Eccles et al [6] say that “the term volition refers to both the strength of will needed to complete a task and diligence of pursuit”. Kulh [9] enounces different volitional strategies (cognitive, emotional and motivational control strategies) to explain persistence when there are distractive elements.

Academic Help Seeking is focused on finding appropriate moments for help and is closely-linked to self-regulation and volition concepts. Providing help whereas the student never tried may result in a work-avoidant strategy. But, according to Newman [11], Eccles and her colleagues [6] pointed that “instrumental help seeking can foster motivation by keeping children engaged in an activity when they experience difficulties”.

In all those theories, many factors have been said to affect motivation. In the next part, we will go deeper in the explanation of those factors.

2.2. Factors of Achievement Motivation

Elements that can affect AM are numerous. In AM literature, those which appear most frequently are individual goals, social environment, emotions, intrinsic interest for an activity and self beliefs. It exist relations between all those factors so they must not be seen as being independent of the others.

Individual Goals. As explained by Eccles et al [6], researches show that a learner can develop ego-involved goals (if he wants to maximize the probability of a good evaluation of his competences and create a positive image of himself), task-involved goals (if he wants to master tasks and improve his competences) or also work-avoidant goals (if he wants to minimize the effort). In fact, goals are generally said to be oriented to performance (ego-involved) or mastery (task-involved).

The Social Environment. Because it affect self-belief, social environment is an important factor of individual’s motivation. Parents, peers, school, personal specificities (such as gender or ethnic group) and instructional contexts have a strong impact on learner’s motivation to succeed [5, 6]. Ego-involved goals are particularly linked with the social environment. If a learner has such goals, the importance of the

evaluation that his environment do on him will be increased. The objective of that kind of learner is to maintain a positive self-image and also to outperform other learners. For example, if in some case, failure seems likely, a learner may decide not to try in order to avoid to be judged by his peers. Those learners think that it is better their peers attribute the failure to a lack of effort instead of low ability. It is commonly called a “face saving tactic”.

Emotions. Inserting emotions in e-Learning is a growing practice that needs to be enhanced. O'Regan [12] emphasizes the fact that some actual e-Learning practices produce negative emotions on learners more frequently than positive ones. That means emotional control has to be enhanced in e-Learning. Many researches explain that emotions can act as motivators [14]. But motivation can also influence emotions [5, 6]. Eccles et al [6] say that, in Weiner's attribution theory [17], “the locus of control dimension was linked most strongly to affective reactions” and “attributing success to internal causes should enhance pride or self-esteem; attributing it to external causes should enhance gratitude; attributing failure to internal causes should produce shame; attributing it to external causes should induce anger”. In his volition theory, Kuhl [9] proposed volitional strategies to explain persistence when a learner is confronted to distraction or others possibilities. One of these strategies refers to emotional control and its goal is “to keep inhibiting emotional states such as anxiety or depression in check” [6]. What is interesting to notice is that, in O'Regan [12] experimentation, learners reported emotions discussed by Weiner [17] and Kuhl [9] as being linked to a lack of motivation.

The Intrinsic Interest for an Activity. An individual is intrinsically motivated by a learning activity when he decides to perform this activity without external needs, without trying to be rewarded. According to different researches, there are individual differences and orientations in intrinsic interest. Some learners will be attracted by hard and challenging tasks. For others, curiosity will be a major element of intrinsic interest. A third category of learners will look for activities that will enhance their competence and mastery. Furthermore, Eccles et al [6] cited Matsumoto and Sanders [10] to tell that “evidence suggests that high levels of traitlike intrinsic motivation facilitate positive emotional experience”. As we have seen before, learners using e-Learning often have a lack of positive emotions [12]. We suppose that is partly due to a lack of motivation.

Self-Beliefs. Many different self-beliefs can affect the AM of a learner. A learner can have outcome expectations before performing an activity. If the expected outcomes are low, the learner may decide not to try (see also part 2.2.1). A learner can also have efficacy expectations, which means he believes he can perform needed behaviors in order to succeed in the activity. Self-beliefs are also proposed in control [3, 16] and intrinsic motivation theories ([15], see also part 3.1) concerning the control a learner believes to have on a task and on his achievement. According to Eccles et al [6], many researches “confirmed the positive association between internal locus of control and academic achievement”. Connell and Wellborn [3] proposed that children who believe they control their achievement outcomes should feel more competent. They also made a link between control beliefs and competence needs and hypothesized that the fulfillment of needs was influenced by social environment characteristics (such as autonomy provided to the learner). In her AM model, Skinner

[16] described a control belief as an expectation a person has to be able to produce desired events.

In the next part, we show the interest for e-Learning of giving to the learner the belief that he has control (i.e. autonomy) on his activities and achievements.

3. Coaching Versus Autonomy in e-Learning: Finding Balance

3.1. Importance of Autonomy

Eccles et al [6] reported that many psychologists “have argued that intrinsic motivation is good for learning” and that “classroom environments that are overly controlling and do not provide adequate autonomy, undermine intrinsic motivation, mastery orientation, ability self-concepts and expectation and self-direction, and induce a learner helplessness response to difficult tasks”. Flink et al [7] made experimentation in this way. They created homogeneous groups of learners and asked different teachers to teach with either controlling methodology or by giving autonomy to the learner. All the sessions were videotaped. After that, they showed the tapes to a group of observers and asked them who the best teachers were. Observers answered that teachers having the controlling style were better (maybe because they seemed more active, directive and better organized [6]). In fact learners having more autonomy obtained results significantly better. Others researchers found similar results.

In Deci and Ryan’s Self-Determination Theory [15], a process called internalization is presented. As Eccles et al mentioned [6], “Internalization is the process of transferring the regulation of behavior from outside to inside the individual”. Ryan and Deci also proposed different regulatory styles which correspond to different level of autonomy. Figure 1 represents these different levels, their corresponding locus of control (i.e. “perceived locus of control”) and the relevant regulatory processes.

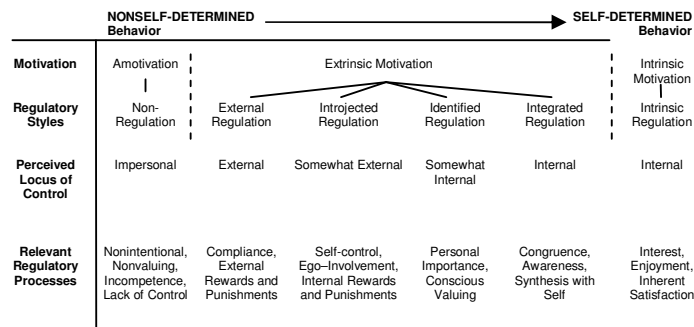


Fig. 1. A taxonomy of Human Motivation (as proposed by Ryan and Deci [15])

In this figure, we can see that the more internal the locus of control is, the better the regulatory processes. That means that, if a learner has intrinsic motivation for an activity, his regulation style will be intrinsic, his locus of control will be intern and he

will resent inherent satisfaction, enjoyment, and interest. Intrinsic motivation will only occur if the learner is highly interested in the activity. In many e-Learning activities, interest for the activity will be lower. And motivation will be somewhat extrinsic. So, in e-Learning, we have to focus on enhancing an learner's internal perception of locus of control.

3.2 Virtual Harlem: an Example of “Open Environment” for Autonomy in e-Learning

Some e-Learning systems already provide autonomy without being focused on it. Virtual Harlem [13] for example is a reconstruction of Harlem during the 1920s. The aim of this system is to provide a Distance Learning Classroom concerning African-American Literature of that period. Some didactic elements like sound or text can be inserted in the virtual world and the learner is able to retrieve those didactic elements.

Virtual Harlem is also a collaborative environment and learners can interact with other learners or teachers in order to share the experience they acquired in the virtual world. An interesting element in Virtual Harlem is that learners can add content to the world, expressing what they felt and making the virtual world richer (this is some kind of asynchronous help for future students). Virtual Harlem provides autonomy not because it is Virtual Reality but because this is an “open world”. By “open environment”, we mean that constraints in term of movements and actions are limited. Contrary to O'Regan's study, Virtual Harlem received positive feedbacks from learners who said there should be more exposure to technologies in classrooms.

But Virtual Harlem has also problems. The system itself has few pedagogical capabilities. There is no adaptation to learner specificities, which limits learning strategies. Asynchronous learning remains difficult because a huge part of the learning depends on the interaction with other human beings connected to the system.

3.3 Interest of Coaching

We have seen that autonomy is positive for learning. Many ITS systems are used to support e-Learning activities. They can be described as extremely controlling because they adopt a state-transition scheme (i.e. the learner does an activity, the ITS assesses the learner and, given the results ask the learner to do another activity). Locus of control is mainly external. Virtual reality pedagogical agents like STEVE [8] are also controlling. If STEVE decides to perform an activity, the learner will also have to do the activity if he wants to learn. He has limited way of learning by himself.

But ITS, of course, have positive aspects for e-Learning. Student model is an important module in an ITS architecture. A student model allows the system to adapt its teaching style and strategy to a learner. It can provide many different kinds of help. STEVE can be used asynchronously because each STEVE can be either human-controlled or AI-controlled. This means that if you are logged to the system, there can be ten STEVE interacting with you but you can be the only human being.

3.4 Enhancing Motivation in e-Learning Systems

We have seen that actual e-Learning Systems, which don't provide autonomy, provoke more negatives than positive emotions on learners and lower the interest for the learning activity [12]. We have shown that “open world” can deal with learners

autonomy needs. But actual systems like Virtual Harlem lack of pedagogical capabilities and adaptation to the learner. ITS provide that adaptation but are very controlling systems.

In the next part, we propose to define a motivation-oriented hybrid system. The aim of this system is to provide an environment where learning initiatives (i.e. autonomy) are encouraged in order to increase learner's intrinsic interest for the learning activity. This system is a multi-learner online system using role-playing practices. Thus, it has a constructivist learning approach [18]. As we pointed before, if they are used with parsimony, help and guidance are useful for learner's motivation and success. Our system monitors learner's behaviors and takes the initiative to propose help to the learner only when a problem is detected.

To go further Virtual Harlem and other systems, we propose to define motivational e-Learning systems.

4. A Description of MeLS: Motivational e-Learning System

4.1. Role-Playing in MeLS: Using Scenarios for Constructivist Learning

How do people learn with MeLS? As in Virtual Harlem, the objective of MeLS is to immerse learners in the domain to learn in order to enhance constructivist learning [18]. For example, in a MeLS activity concerning medicine we can imagine to model a 3D Hospital with rooms containing some surgery tools, radiographic devices... By clicking on an object, a learner can have information on its use, exercises, simulation. If the learner decides to visit the hospital, he can also meet and communicate with avatars representing doctors, nurses, patients. Patients can have different problems: fractures, burns, diseases... And the learner can try to determine the pathology of the patient with whom he communicates.

If it appears to MeLS that the learner is not actively learning by himself, the system can generate a scenario. For example, a doctor will come to tell the learner that there is a fire next to the hospital and that many injured persons (new patients) are coming. The doctor will then ask the learner to make diagnostic on those new patients and determine whose patients have to be cured first.

4.2 MeLS Elements

There are three types of entities that can communicate together in the system: the learner application, Motivational Pedagogical Agents (MPAs) and the Motivational Strategy Controller (MSC). Two other elements complete MeLS design: the Open Environment and the Curriculum Module. Figure 2 represents the global architecture of MeLS.

The Open Environment is a 3D environment. Some interactive objects can be added to the environment in order to ameliorate constructivist learning.

The Learner Application contains the student model of the learner and sensors to analyze the activity of the learner. If the learner is passive, MeLS will deduce that he needs to be motivated. Those sensors also help to maintain the student model of the learner. In the open environment, each learner is represented by an avatar.

An MPA is an extension of the pedagogical agent concept proposed by Johnson and his colleagues [8]. Each MPA is represented by an avatar and has particular

behavior, personality and knowledge given their assigned role (doctors and nurses don't know the same things about medicine) in the virtual environment. Given the behavior of the learner, an MPA can also decide to contact a learner (when he is passive) in order to propose him an activity. To compare with ITS and depending of the learning strategy used, MPAs can be seen as companion or tutor.

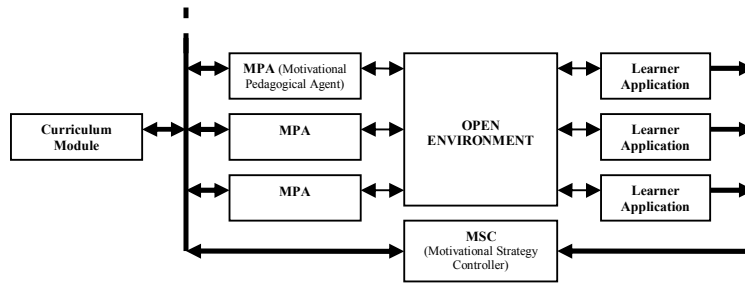


Fig. 2. Architecture of MeLS

The *MSC* has no physical representation in the open environment. Its meaning is to define a more global strategy for enhancing learners' motivation. The *MSC* is also in charge of proposing scenario (adapted from a bank of scenario template) and, for this purpose, he can generate new *MSC*. As we said before, there can be many learners on the system. The *MSC* can organize collaborative activities (collaboration enhances motivation [6]) within a scenario. *MSC* is in someway the equivalent of the planner in ITS.

The *Curriculum Module* has the same meaning than in an ITS. When we say that an *MPA* has certain knowledge, we mean they have the right to access to corresponding knowledge resources in the curriculum module. We decide to exteriorize knowledge of *MPAs* in order to facilitate the process of knowledge update (there will be only one module to update).

4.3 Discreet Monitoring Process

Discreet Monitoring Process (DMP) is a process of interaction between three modules of MeLS: the Learner Application, the *MSC* and *MPAs*. The aim of DMP is to produce an adapted reaction only when students really need it. In this case, as shown by Newman [11], providing help can stimulate motivation by keeping children focused on a difficult activity. Thus, the negative impact of controlling the learner is avoided. Figure 3 presents the DMP.

The process is the following:

- (a) Sensors of the learner application monitor the learner.
- (b) Data concerning the learner are transmitted to the analyzer of the learner application.
- (c) The analyzer detects that there is a problem and send information to the *MSC*.
- (d) *MSC* identifies the problem type with its diagnostic tool and refers it to a strategy engine

- (e) Given the diagnostic, MSC elaborates a strategy to resolve the problem (ex: fire scenario proposed in 4.1). Once a strategy is defined, one (or more in case of a collaborative strategy) MPA is initialized in order to carry out the strategy.
- (f) One of the initialized MPA contacts the learner and, if the learner accepts, integrates the learner in the strategy in order to correct the problem.

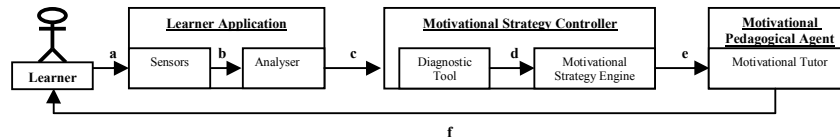


Fig. 3. The Discreet Monitoring Process

There are two kinds of learner's needs that the system can try to fulfill: academic help or motivation enhancement. In the first case (academic help need), DMP detects that a learner has academic problems (for example, he is always failing to achieve an activity). In the second case (motivation enhancement need) DMP detects that a learner is passive (some work on motivation diagnosis in ITS was done by De Vicente and Pain [4]). DMP deduce that this learner needs to be motivated. Once a problem is detected, a strategy (ex: a scenario) to resolve it will be elaborate by the MSC.

5. Conclusions & Future Works

In this paper, we made a survey of the "Achievement Motivation" field and underlined the importance of learner's motivation to succeed. From this work and from O'Regan's study [12] about emotions produced on learners by e-Learning, we deduced that enhancing autonomy in e-Learning will increase learners' intrinsic interest for e-Learning and, by the way, learners' success. But coaching can also be positive for learner's success.

In order to mix coaching and learner's autonomy in e-Learning systems, we defined an hybrid system design between open environments and ITS, called Motivational e-Learning System (MeLS). This system resolves problems of learner's autonomy that we described in ITS: it gives possibilities of self-learning to learners by interacting with the environment, which can be seen as a constructivist learning approach. The Discreet Monitoring Process (DMP) was proposed to foster learner's motivation. DMP can deal with academic or learner's passive behavior problems. DMP is able to generate strategies (such as scenarios) to correct learner's problems. Motivational Pedagogical Agents (MPAs), inspired by pedagogical agents like STEVE [8] and represented in the virtual world by avatars, are in charge of executing those strategies.

Next step will be to create a whole course using MeLS design. Motivational student model, strategies (local or global) have to be clarified. In this purpose, further readings on volition and intrinsic motivation concepts and on academic help seeking are planned.

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