

# An Emotional System for Effective and Collaborative e-Learning

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**Abstract:** Though e-learning is being debated to have some advantages over person to person teaching, the latter is considered to be superior with respect to the effectiveness of teaching. One of the reasons for this advantage of human expert tutors is their ability to deal with the emotional aspects of the learner. We introduce an emotion sensitive e-learning model which is sensitive to both emotional aspects as well as the learning ability of the learner. This is a major difference with the other similar attempts to make effective e-learning systems and the preliminary analyses indicate considerable promise. We hope this would complement the effectiveness of e-learning.

**Keywords** - e-learning; emotional systems; emotional e-learning

## I. INTRODUCTION

Nowadays, e-learning is becoming an increasingly popular paradigm of learning. This is very evident especially in the corporate training arena. And it is expected that this paradigm would eventually become mainstream channel of training which would add to a company's competitive advantage [6, 16].

The main goals of e-learning systems identified by different researchers are given below [24, 25].

- Focus on active learning
- Accommodate various learning styles
- Explicitly place the responsibility for learning with the students
- Develop written and oral communication skills
- Clarify the role of the teacher as facilitator and mentor
- Provide better coverage of material
- Develop a sense of self-confidence and independence in students
- Include a teamwork experience
- Encourage peer review
- Develop interpersonal communication skills when students are geographically spread

- Support entire educational process when students are spread both geographically and temporally
- Learn to handle time management including the meeting of deadlines

Many of the above goals themselves explain the advantages of e-learning systems over traditional learning approaches. Another advantage of e-learning systems is that they are scalable. The number of learners that an e-learning system can handle with individual attention is much more than that can be accommodated in a classroom.

However, they have some disadvantages as well. During person-to-person communication, more than 65% of the information exchange happens through nonverbal communication [11]. These include facial expressions, body posture, tone of voice etc. So, the learner gets less information through e-learning system than through person – to – person interaction.

Personality and emotion has a role to play in learning. The learning styles that can be more effective for a learner may be different according to these aspects [7]. Emotions can influence a person's cognitive organization and thought process. Positive emotions play a crucial role in these aspects of one's intelligence. They are also instrumental in improving creativity and flexibility in problem solving. At the same time, negative emotions can produce the opposite effect on one's thought process [3].

Expert human tutors judge these factors and teach accordingly. This is a major difference in the style of learning with traditional e-learning systems and that with human expert tutors. Human expert tutors focus on the emotional component of learning also, whereas the traditional e-learning systems focus on learning targets alone [12]. This makes the human expert tutors more effective. But, it would be impossible for a human tutor to give attention to every student, if he is handling a large number of them.

This motivates us to think about incorporating emotional aspects of teaching in e-learning systems to make it more intelligent. An intelligent e-learning system should be able to adapt to the knowledge, learning abilities and needs of each learner [26]. This would give them a feel of individual care which would help them in the learning process.

Incorporating emotions in e-learning systems is not a very new idea. “affective e-learning systems” had been found in the literature since the book ‘Affective Computing’ which was published in 1997 [15]. Many e-learning systems have been introduced with affective agents and different types of emotion sensing techniques [2, 4, 14, 17, 20, 22, 26]. The emotion sensing techniques used in such models include facial expression analysis [13, 26, 27], voice analysis [5, 8, 26, 27], text analysis [18, 26], analyzing the physiological data and behavior [10, 19, 22], etc. Some of them require costly equipments for effective functioning. This is an overhead over the learner.

The current trends in e-learning are personal learning environments [9, 23], self directed learning [21], networked learning [1], etc. But these approaches may not be appropriate in case of a small duration – high content learning as observed in corporate trainings.

In this paper, we introduce the design of an emotion sensitive e-learning system that gives emphasis to the complete learning process and that is very cost effective. This model is made as configurable as possible to make it suitable for a wide range of learners and to give them a feel of individual attention. This is the major advantage of this model over the others.

## II. ARCHITECTURE

In this section we will discuss the architecture of the emotion sensitive e-learning system. Fig. 1 shows the architecture of the e-Learning system. This system mainly consists of three major units namely the *Course Delivery Unit*, the *Assessment Unit* and the *Report Unit*. There are two more additional components called the *Emotion Modulators* and the *Focus Analyzer* which play a vital role in the system. The individual units will be discussed in the subsequent sections.

### A. System Roles

The various identified system roles, which have a very unique role to play in the system, are: System Admin, Learner and Course Owner.

#### 1) System Admin

The System Admin is responsible for managing the entire system. He has several responsibilities which include configuring the emotion assessment, emotion modulators, parameters for the report and time for which the learner can indulge in any of the emotion modulators. He is also responsible for choosing the number of questions for emotion detection and technical analysis.

#### 2) Learner

Learner is the individual who takes up the eLearning by registering himself to the e-Learning system. The Learner can choose any of the courses provided by the System. The Learner is assumed to be responsible enough to make the best use of the system. So, the learner is provided with the flexibility to configure the system to a certain extent which includes the following:

He has the freedom to override the system’s suggestion and choosing the course delivery style of his/her choice.

He also has the flexibility to choose the emotion modulators; the time is however fixed by the System Admin.

He can skip to the next granule after completing the current questionnaire.

He is as well free to turn off the emotion modulators.

#### 3) Course Owner

Every individual course will be designed and developed by the respective Course Owner who is responsible for configuring the system. His responsibilities includes providing the different granules as per the different styles, deciding the format of each granule, providing with a Technical Question bank and also the necessary emotional plugins

#### B. Course Delivery Unit

This unit comprises of several course offerings in different learning styles. The course offering focuses mainly on two learning aspects namely: Emotional State, Technical Understanding and Grasping Power.

The *Emotional Plugins* are designed to tune the learning style to the current emotional state of the learner. The system concentrates on broadly three emotional states of the learner which are judged by the Emotion Sensing module of the Assessment Unit: Happy, Neutral, and Sad.

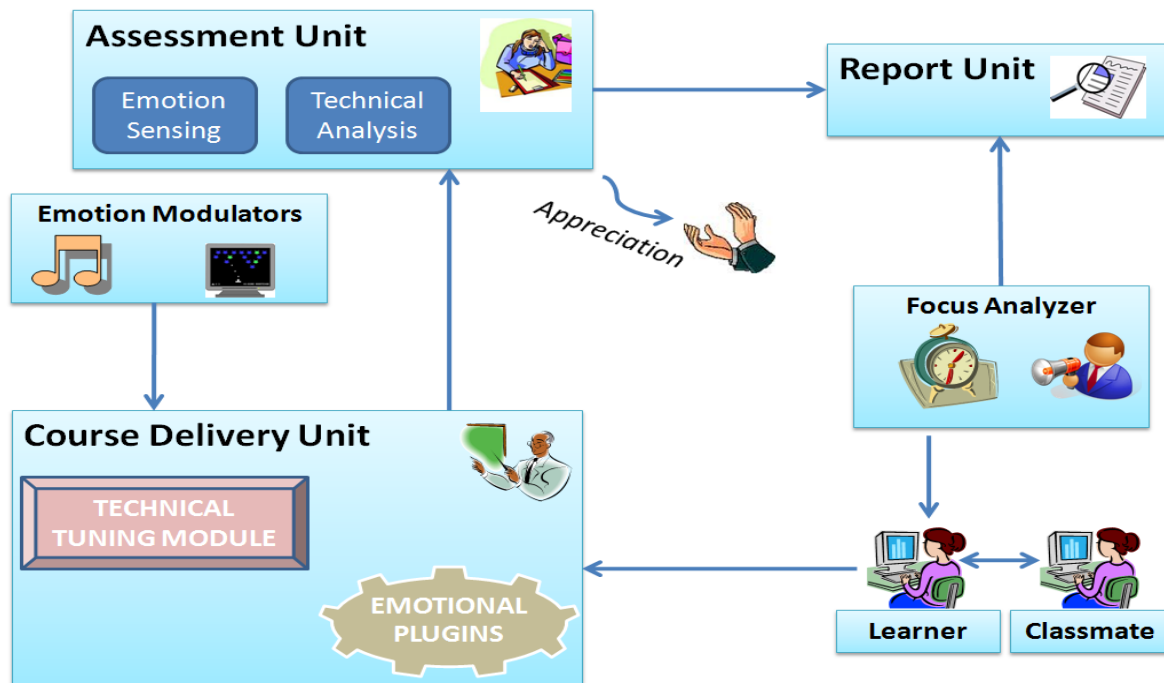


Figure 1. The architecture

The *Technical Tuning* module focuses on the technical understanding and the grasping power of the learner. The same is evaluated by the Technical Analysis module of the Assessment unit which is categorized into the following: Slow, Medium, and Fast.

Every learner is provided with a different style of course delivery which is specially tuned to his/her technical understanding and emotional state as described above. The learning style for a course is categorized into the following Emotional and technical modes:

*a. Emotional Modes*

We have three emotional modes that are categorized namely Emotional Mode 1, Emotional Mode 2 and Emotional Mode 3. Emotional Mode 1 is for a happy and excited listener, Emotional Mode 2 is for a listener with a neutral state of mind and Emotional Mode 3 is for a listener who is in a sad state of mind.

To explain the impact of these emotional modes on the learner, let us discuss each of these modes one at a time.

Let us consider the learner to be in emotional Mode 1(happy and excited state). In this case, the reason behind the happiness and excitement of the learner could be the learning satisfaction. At the same time, the reason could

also be something totally external that has no relevance from the current learning that he is undergoing. The former reason will definitely be conducive for learning; however the latter will be a distraction.

To confirm the same, after every granule, the learner score is examined. If the learner is scoring less and if his emotion is detected to be “happy”, in that case, the system concludes that the learner is distracted. Suitable emotional plugins and Emotion modulators are inserted which will aim at getting the learner’s emotion to “neutral”. Emotional Plugins and modulators are explained in the further sections.

On the contrary, if he scores well, we conclude that he is happy about the learning process and not distracted.

Similarly, when the learner is in Emotional Mode 3(sad state), he is again not in a favorable mode to learn since sadness may distract him and reduce his learnability. Appropriate emotional plugins and emotion modulators are provided again to get him back to neutral state of mind.

Hence, the system considers Emotional Mode 2 as the most encouraging mode for learning, since here the

learner is neither happy nor sad. There will not be distractions for learning from the emotional point of view.

*b. Technical Modes*

We have three technical modes that are categorized namely Technical Mode 1, Technical Mode 2 and Technical Mode 3. Technical Mode 1 is slow and encouraging paced flow of the course delivery, Technical Mode 2 is medium paced flow of the course delivery and Technical Mode 3 is fast and challenging paced flow of the course delivery.

Any learning style provided to a learner will be a blend of the above mentioned emotional and technical modes resulting in a 3 X 3 combination. The *Course Delivery Unit* is externally assisted by an additional *Emotion modulator (apart from the Emotional Plugins)* at regular intervals which helps the learner in better focusing at regular intervals.

*1) Emotional Plugins*

The emotional plugins are a set of objects which the system suggests to be plugged-in to the technical tuning module depending on the emotional state of the learner. These plugins help in modulating the mood of the learner enhancing the effectiveness of the learning process, to name a few of these plugins; we have Animation and graphics, Cartoons, Pictures and others.

The distinctive feature of the system is that it suggests the preferred configuration of the emotional plugins but however it provides the optimum flexibility to the learner to turn-on or turn-off or tune any of the plugins of his/her choice. Each of these plugins is suggested at regular intervals by the system, as per the current emotional state. For an instance, a learner with a sad state will be suggested with more of animations, pictures etc. The appearance of the system could also be changed to generate a better look and feel by providing different themes to the learner. Similarly other plugins can also be tuned accordingly.

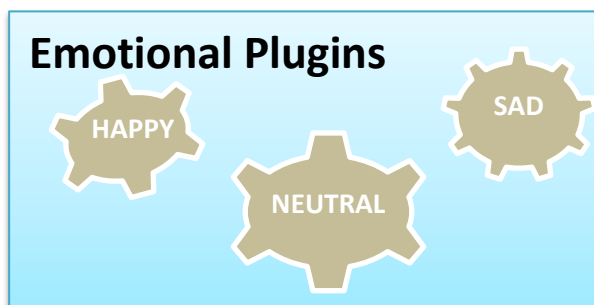


Figure 2. Emotional plugins

*2) Technical Tuning Module*

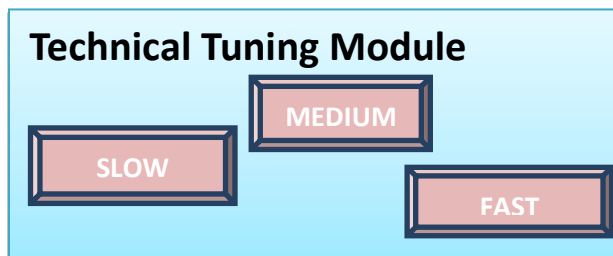


Figure 3. Technical tuning module

Technical Tuning module concentrates on the actual course delivery. In order to enhance the effectiveness of the learning process, every course is dealt at a granular level. A granule is the smallest unit within which the mode switching is possible. To support the different technical modes (as discussed in 2.1), the tutor provides 3 different offerings for each granule corresponding to the 3 different technical modes which could be in any of the desired formats like a video/audio recording, a text-write up etc.

The system enables the learner to repeat the granule any number of times. The learner is not allowed to skip to the next granule without completing the questionnaire for that granule. This is to ensure that the learner gets a better clarity on each of the granules.

The first granule of the course begins with a medium paced course offering. After each granule, the assessment unit interacts with the learner and assesses the level of the learner’s grasping power. Based on its outcome the system gives a suggestion to the learner to opt to a more suitable technical mode. Here again the system provides the flexibility to the user to continue/switch the same/different mode of his/her choice. As described in Section 2.1.1, the emotional plugins are interleaved with the granule offering to cater to his emotional needs as well.

The technical tuning for every granule is realized in terms of the various technical illustrations, demos, assignments, hands-on, depth of the each concept dealt etc. In case of slow paced mode the learner is supplied with elaborate illustrations, more demos and given more time on solving the assignments. On the contrary less emphasis is given on illustrations, assignments and the like in the fast paced mode.

*C. Assessment Unit*

The assessment Unit comprises of the following modules: Emotion Sensing Module and Technical Analysis Module

The emotion Sensing and technical Analysis modules gauge the learning capabilities and emotional state of the learner. Though these function as two separate modules internally, they are interleaved together into a single unit.

This unit presents a questionnaire comprising of questions that are intended to analyze the technical as well as the emotional state of the learner. This exercise is repeated at the end of every granule. The outcome of this process is fed into the Course Delivery Unit which suggests the style of the next granule. At the same time the result is forwarded to the Reporting Unit (Explained in the subsequent sections).

1) *Technical Analysis Module*

This module chooses the technical part of the questionnaire from a repository. The questions are categorized on the basis of their complexity into the following three types: Simple, Medium and Complex.

The system fires a medium complexity question to the learner. The complexity of the next question is dependent on the answer provided by the learner. The system gives a complex question if the medium complexity question is answered right while it throws a simple question if the learner answers it wrong. This cycle continues until a definite number of questions are posed to the learner. At the end of this exercise the system suggests the technical mode that the learner could choose in order to have an effective learning. This is done by analyzing which category (simple, medium or complex) of questions did the learner answer the most number of times.

The system gives appreciation to the learner based on the outcome of the technical questionnaire. It also appreciates the learner whenever he/she outsmarts the virtual classmate (virtual class mate is explained in the subsequent sections).

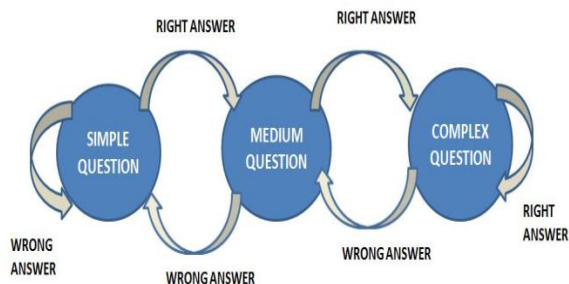


Figure 4. Selection of questions in technical analysis module

2) *Emotion Sensing Module*

This module is responsible for choosing the part of the questionnaire from a repository for detecting the current emotional state of the learner. The system categorizes a learner’s emotional state into the following: Happy, Neutral, and Sad.

The questionnaire to categorize the emotional state of the learner depends on many factors like the learner’s culture, ethnicity, the languages that he is comfortable with, the education level of his parents etc. Verified and cross verified questionnaires are made that would help us to categorize the emotional state of different types of learners to happy, neutral or sad. This is done with the help of a psychologist. Most of the times this questionnaire would be an indirect way of asking the learner what emotional state is he in. The details are obtained from the learner when he registers to the system. Based on this data, the questions are selected from the suitable repository and merged with the technical questions selected by the technical analysis module.

The current emotional state of the learner is predicted based on the outcome of these questions.

D. *Reporting Unit*

The Reporting unit is responsible for providing the final report to the learner. This report consists of the following parameters which are configurable by the System Admin. The System Admin can choose to turn on/off any of the following parameters based on the requirement: The latest score of every granule, the time taken to solve the questionnaire, the duration the learner invests on the Emotion Modulators, the outcome of the Focus Analyzer component (which is discussed later), the number of times and the granules in which the learner has out merited the classmate.

E. *Emotion Modulators*

This component is designed with an intention of responding and reacting to the learner emotionally. It comprises of various constructive entertainment fragments. These modulators could be chosen by the learner at the end of every granule. The System Admin should configure the time for which these modulators can be played by the learner.

The idea behind the emotion modulators is to give assistance to the learners in achieving a continued focus on the learning process. They are basically intended to bring back the learner to a mood which is conducive for

learning. These are to be seen as a help for the learner to bring back his emotional state to the desired one. However these modulators need not necessarily assure the change in the emotional state of the learner.

The emotion modulator unit reads the emotion that is detected from the Emotion Assessment Unit. This helps the emotion modulator unit to understand whether the current emotion of the learner corresponds to happy, sad or neutral.

The emotion modulators are categorized based on the current emotion of the learner. The categories include Focus Emotion modulators and Cheerful Emotion modulators. The former ones are intended for learners with a happy emotion and are yet not performing well in the technical modules and the latter ones are aimed at learners whose current emotion is "sad".

The emotion modulators supported by the system are: Music, games, videos and write ups. A list of these modulators is maintained in the database and the collection is shown to the user. The user may select the one of his choice and soon after the selection the selected modulator is played. However, the time for which the modulator is played, is restricted.

The Learner is however free to turn off the emotion modulators if he/she is not interested.

Also, providing these different emotion modulators is not an overhead on the course author since it is taken care by the system.

#### F. Focus Analyzer

This component periodically examines the presence and the focus of the learner towards learning. This ensures both the physical and mental presence of the learner. This is achieved in an effortless fashion by sending frequent alert messages to the learner. Alert messages could be in the form of simple technical/informal questions. An explicit response from the learner's end ensures his/her presence.

The time at which these alert messages have to be sent out is configured by the System Admin suitably. The outcome of this whole process is recorded regularly by the Reporting Unit.

#### G. Virtual Classmates

This is to build a *collaborative* environment for the learner for an effective learning. This is intended to motivate the learner. The learner is always provided with a feel of virtual classmate to get a typical classroom feeling. The scores of the learner after individual granules are compared with the virtual classmate and the learner will be suitably appreciated if he/she excels. The system is also configurable to arrange for a quiz with the classmate and the winner will be decided based on the time taken to respond. The System Admin can configure the number of classmates and also has a hold on turning on/off the whole of this feature.

### III. CONCLUSION

In this paper, we have described an emotion sensitive e-learning model which is sensitive to both emotional aspects as well as the learning ability of the learner. The model is designed to be configurable to a good extent in order to make it suitable for a wide range of users. In future this model can be extended by adding more emotion sensing methods like facial expression analysis, click stream analysis, voice analysis etc to confirm the emotion sensed through the survey method. There are many more challenges in this area like customizing the course delivery according to the personality of the learner, reducing the overhead on the course owner in course preparation, more dynamism in mode switching etc.

### IV. ACKNOWLEDGEMENT

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