E-Learning Content Development based on Emo-Inter Instructional Model for Design of Bridges according to LRFD Method

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Abstract

New technologies have created appropriate facilities for teaching and learning. In this paper, emotional and interactional (Emo-Inter) model for e-learning content development is proposed according to the human learning model. Based on this model, electronic educational content development process for the "Design of Concrete Bridge" course is presented according to the AASHTO LRFD method. These course main features contain the educational behavioral objectives at the beginning of each training component, using question and answer style by the first and second narrator to promote learners emotional level and using the parametric figures and exercises for interaction with learners and better understanding of design relations. According to the survey which was conducted on learning model in one semester, 79% of students evaluated the learning models very useful and effective and also 68% of students maintained that objectives were achieved.

Keywords: Emotional and Interactive Instructional Model, E-Learning of Engineering Courses, E-Content Development, Bridge Design Course, AASHTO LRFD.

1. INTRODUCTION

The development of information technology has revolutionized methods of education, a significantly important element in observing justice in a cooperative society, and it has relieved the restrictions of traditional education systems (Christodoulou, 2004). In this context, many efforts have been made to design teaching materials and packages by computers for engineering courses around the world (Aparicio & Ruiz-Teran 2007; McMullin et al. 2002) such as the Computer Aided Concrete Teaching (COMPACT 1999) for the Concrete Bridges course.
E-learning provides the possibility of teaching based on learning objects (Wiley, 2001). Learning objects are the smallest independent educational components which can be reused in e-content of different subjects and authors; thus it is more economical and time-saving in e-content development.

E-learning also has disadvantages. One of these disadvantages is the absence of face to face training, which leads to reduction of the student's excitation through learning. This reduction is so significant that students prefer the traditional education. According to Zaho et al (2009), the lack of emotion is very serious in E-Learning. Also Chuah et al. (2009) expressed "Many studies related to the use of virtual reality in education are focused on the cognitive aspects with little consideration given to the emotional domain"

Undoubtedly emotion has positive effect in learning. Shen,Wang and Shen (2009) used emotional data to improve learning in pervasive learning environment. They proposed a model and examined it, they cited

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"Experiments indicated the superiority of emotion aware over non-emotion-aware with a performance increase of 91%."

On the other hand, Astleintner et.al (2000) claim that existing instructional design approaches do not adequately address the question of how instructional technology should be designed to help learners learn in an emotionally sound manner.

Historical attention to emotional design of instruction method can be found in Keller's attempt, who proposed ARCS Model for improving motivation in instruction. His model contains four essential components: Attention, Relevance, Confidence, Satisfaction (Keller, 1987. Keller,1999). ARCS Model was used in e-learning environment (Keller and Suzuki, 2004).

The teaching method in e-learning has changed from being teacher-based to being student-based. Virtual environment can create pervasive and dynamic interaction through virtual simulation which will upgrade learning accompanied by hearing and seeing to practical learning and experiencing (Table 1)(Ataei & Najibi, 2010).

Interaction between learners, learner-content, learner-teacher is crucial for increasing emotion. According to three main learning theories, which are Behaviorism Learning Theory, Cognitive Learning Theory and Constructivism Learning Theory, *Interaction* is essential for emotion (Zaho et al 2009). For instance Hsu (2008) examined the effect of Collaborative Interactivity. The results of this study indicated that higher levels of collaborative interactivity create greater positive emotions, learning performance, and attitudes toward the learning subject in a web based learning environment.

Table 1. Educational methods

	Real	**Virtual**
Audio	Lecture	Book, Radio
Visual	Field Trip	Movies, Television
Experimental	Laboratory	Virtual simulation

So the main advantage and disadvantage of e-learning are:

- The disadvantage: decline in emotional levels because of the virtual environment.
- The advantage: User interaction by virtual simulation and the ability to reuse learning objects.

In this paper according to the main advantages and disadvantages of e-learning, emotional and interactive instructional model for e-learning objects design, based on operant model of human is used to design and develop e-learning content of Concrete Bridge Design course. This course is developed according to the load and resistance factor design (LRFD) method of AASHTO standard (AASHTO

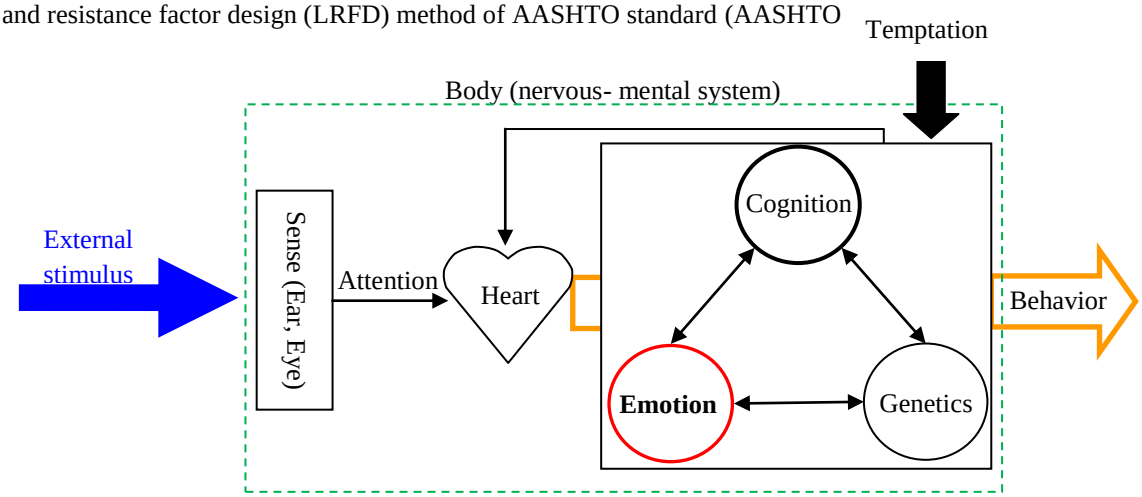

Figure 1. Respondent(passive) model of human (Ataei & Najibi, 2010)

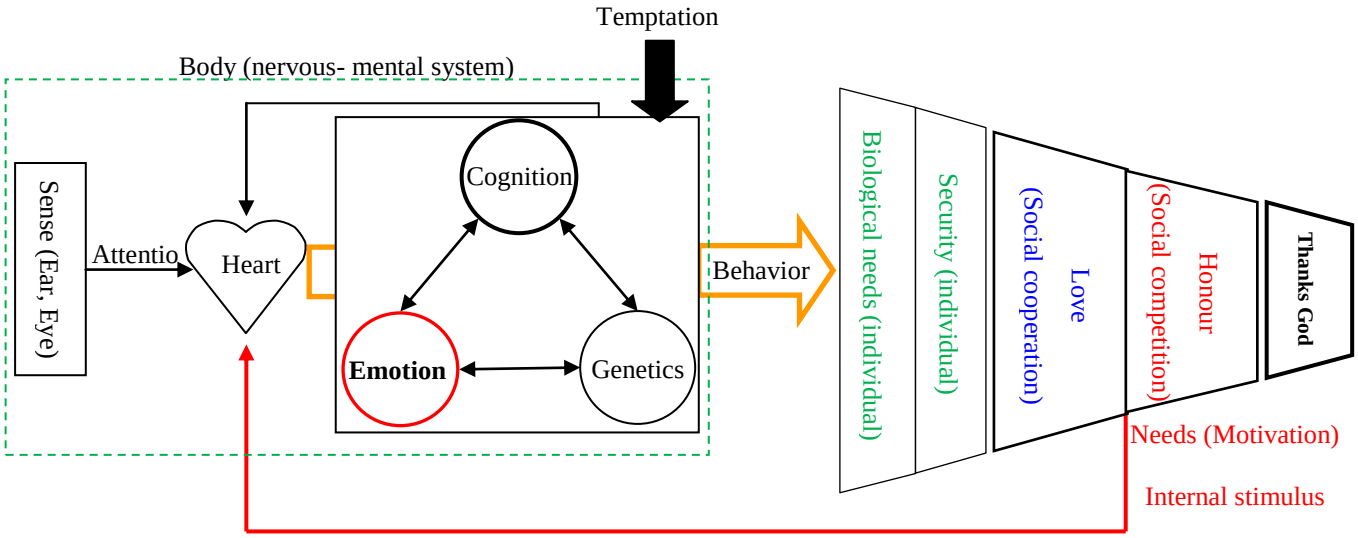

Figure 2. Operant (motivational, active) model of human (Ataei & Najibi, 2010)

2. EMOTIONAL AND INTERACTIVE INSTRUCTIONAL MODEL

To present an e-learning object design model, first of all, there should be a model for learning based on a simplified human model; then the advantages and disadvantages of e-learning should be considered and according to the pedagogical training rules (Govindasamy, 2002; Miller, 1997), an instructional model should be presented. In general, human behavior model could be respondent or passive (Fig. 1), it means it could be influenced by external environment stimuli (Fig.2) or it could be influenced by internal stimuli or a motivation caused by needs (Lefrancois, 2005).Since the true and complete learning is obtained by the students' operant and active practice, intended cognitive-emotional-behavioral model through student learning is according to operant model (Fig.2). By cognition we mean logical perception, by emotion we mean emotional feeling and by behavior we mean observable human action. Motivations or needs of human can be categorized in some levels (Maslow 1943). The lowest level of needs is biological and security needs which are individual needs. Human and plants have this need in common. The higher levels of needs are need for love and honor which are social needs. Need for love is a cooperative need and need for honor is a competitive need. Human society covers the need for love and honor. These two needs are shared by human and animals. The highest level of needs is the need for thanking God. This need is exclusive to human. Human indigenously thank the one who gives them blessings. According to Holy Quran, creation of the heaven and the earth, night and day and their durations, sun and moon, sending winds, rainfall, quickening the dead earth after rainfall, taking souls at the sleep or death, different languages and colors of human, creating duads, creating human from dust, expansion or restriction of provision, spreading all types of creatures on earth and marine transportation are reminded as signs of God (Holy Quran, *surah Al-Ra'd*); Human is reminded not to give the originality to the unstable living world and not to forget the everlasting hereafter life and he is asked to appreciate the countless blessings of God by remembering him and spending his property in favor of God (Holy Quran, *surah Al-Haj*).

Figure 3 shows a proposed learning model. In this model, at first, information turns into cognition then to emotion next to action or behavior and finally to belief. Belief reinforces the cognition, emotion and action; and it provides learning. It paves the way for permanent changes in spirit.

In the cognitive perception, human compresses the detailed information and finds the relations between them with the similarity or the subset hood criteria (Fig. 4). Associate relationship (symmetry relation) is extracted with similarity criteria and entailment relation is extracted with subset hood criteria; so the information is organized and the relations are identified. In this phase, human processes the information as a classifier by compressing and discovering the relationship which is a cognitively active procedure. In cognitive stage of learning, there must be a special focus on organizing material, extracting key words and ranking them based on hierarchy and importance (Ataei & Najibi, 2010).

In this model, emotion or feeling has a prominent effect on learning. First, emotion is associated with cognition, then it is turned to action, and finally it is turned to belief and a permanent change in human ego is formed. By emotion we mean lust, anger and affection. Human's emotional model encompasses a wide range of positive emotions such as joy, trust, love and surprise as well as negative emotions such as sadness, disgust, remorse, anger and fear. These human emotions can also be expressed actively or passively (Fig.5) (Goleman, 2006).

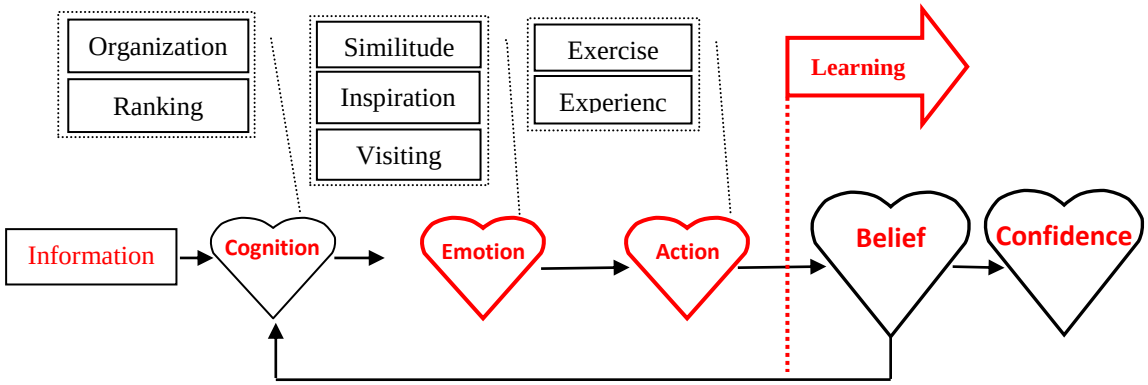

Fig. 3. Learning model (Ataei & Najibi, 2010)

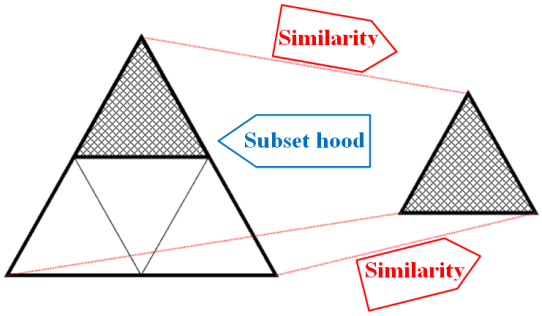

Figure 4. Knowledge extraction criteria from information; Similarity or subset hood (Ataei & Najibi, 2010)

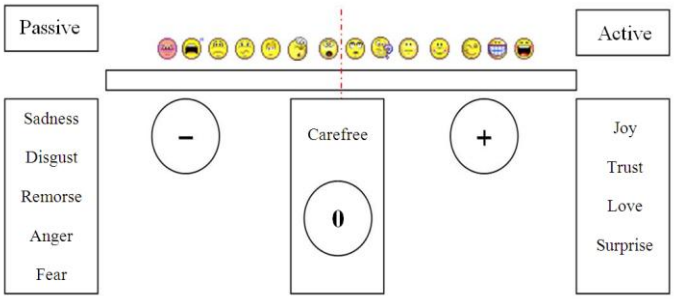

Figure 5. Emotional model (positive/negative, active/passive) (Ataei & Najibi, 2010)

In this model, the process of learning should be in accordance with the positive emotion spectrum and preferably in the form of active expression. Due to the remarkable effect of emotion on learning, special attention should be paid to emotion; especially in e-learning because of being distant and hence missing the face to face interaction. Educational e-content should be based on emotions. Structures and components used in the development an e-content should be designed to increase emotion and it should be considered a key criterion for virtual products assessment. To increase emotional association, similitude, examples and virtual experiences should be employed to create a mutual interaction with learners. Virtual or real visits of projects, explaining the application of theoretical subjects and creating a dynamic interaction by establishing groups, scientific associations and forums can increase the level of emotion in learning (Gupta, 2002). Presenting lessons along with questions and answers with two narrators can also establish an interactive communication and increase the emotion.

Any cognitive or emotional activity is controlled by a part of the nervous system in human body. The function of this nervous system is however determined by human genes. The brain cortex neurons and the brain limbic system are responsible for cognitive and emotional activities of human, respectively. Based on physiology of learning, the weight of synapses of brain neurons change by learning; thus in a comprehensive system of learning, synaptic weight should be updated in brain cortex neurons as well as brain limbic part.

The proposed model can be used in teaching engineering courses in general and specifically in e-content development. In this model, emphasis is on student operant model, the importance of emotion and motivation to thank God.

This learning model was applied in one semester for about 50 graduate and undergraduate students. According to the survey carried out on learning model, on average 79% of students evaluated the operant models of students, having motivation to thank God, and considering emotion very effective in learning (Table 2). Also some criteria are introduced to evaluate the success of the learning model in achieving its goals. "Not solely depending on the lecture and studying other references of the course" is considered as operant criteria, "amount of remembrance of GOD and expenditure for him" is considered as the criterion to assess the motivation to thank God, and "sense of mastery of course materials" is considered as the criterion for measuring the learning emotion. It was concluded that the average realization of learning model criteria according to the survey results were as follows: operant model of students goal: 76%; thanking GOD motivation goal: 59%; emotional learning goal: 69%; (Table 3). On the average, 68% of students maintained that objectives were achieved.

Table 2. The percentage of the students, who found the objectives considered for learning model beneficial

Students	Percentage of agreement with aim		
	Operant model	Thanking God motivation	Emotion of learning
Graduate	75	73	71
Undergraduate (senior)	81	88	88
Undergraduate (junior)	88	70	85
Mean of all	82	75	81
Standard deviation	24	35	29

Table 3. Percentage of students who believe the goals of the learning model were achieved according to the designed criteria

Students	Operant model	Thanking GOD motivation	Thanking GOD motivation	Emotion of learning
	Studying other references	Expenditure as an outcome of learning	Remembering God, who created relations	Sense of mastery of course materials
Graduate	76	66	37	71
Undergraduate (senior)	77	75	46	64
Undergraduate (junior)	75	71	59	70
Mean of all	76	70	48	69
Standard deviation	16	24	29	21

3. DESIGN MODEL OF LEARNING OBJECTS

For e-learning content development of concrete bridge superstructure design course, the following steps were taken (Fig. 6):

- Preparation of original educational object presentation according to the proposed model (Fig. 7).
- Preparation of the narration by the teacher (writing her/his speech with all details).
- Providing development scenario (Providing the manual of recording process, presenting charts, tables, Images, animations, parametric simulations, etc. by teacher, assistant, manager and e-content producer)
- Recording the course in studio by the first and second narrator.
- Educational object development by contractor.
- Reviewing and removing the bugs in the produced files (by teacher, assistant and manager).

According to the learning model (Fig. 3), fig. 7 offers emotional and interactive instructional model of learning object with emphasis on creating emotion and interaction with the user as follows:

- Inspiring training educational goals
    - Remembering the contents of the objects as signs of God, thus giving thanks to the Creator by remembering him and spending out in his way.
    - Expressing the behavioral training objectives
- Organizing the details and highlighting its interrelation with other components of the course.
- Providing educational object content.

- Presenting the lesson in form of question and answer by the first and second narrator.
- Minimal usage of texts and showing only the key expressions.
- Using pictures, graphs and animations to visualize concepts and relations.
- Using similitude and examples for emotional description of concepts and relations.
- Interacting with the user by parametric tables and images (Fig. 8).

- Assessment of learning.
- Presenting the summary of training object.

Interaction is any use of mouse or keyboard when user sees one object's component. User interaction can be facilitated through question in the form of multiple choices, yes/no, true/false, drag and drops, filling the blanks and parametric simulation. The interaction has been designed to mimic the real test as much as possible (Davey-Wilson, 1994). Presenting the course in questions and answers by two narrators and using similitude and examples for explanation of concepts and relations increase the emotion.

For instance, fig. 8 presents the parametric simulation of geometric properties of cracked reinforced concrete sections in development of the e-content of Chapter 2; the user can see the result by changing the parameters and experience learning through processing. Different kinds of exercises can be used to evaluate training processes. As an example, Fig. 9 presents a question about tension development length calculation of a straight bar and Fig. 10 presents periodic exercises at the end of Chapter 2.

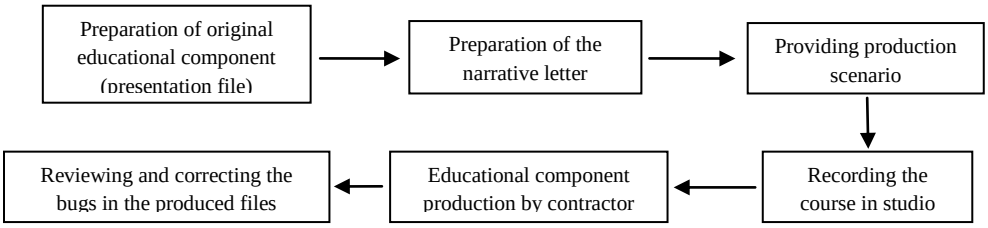

Figure 6. Development stages of each content objects

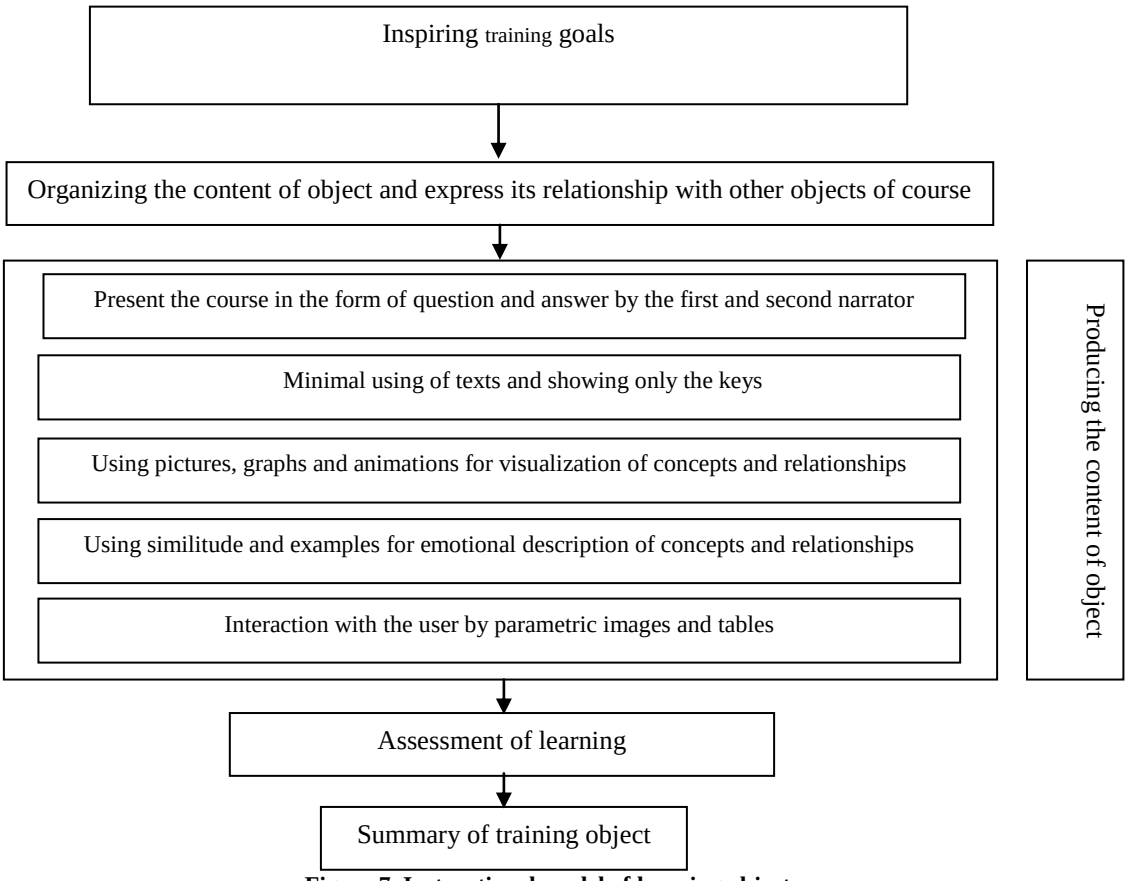

Figure 7. Instructional model of learning object

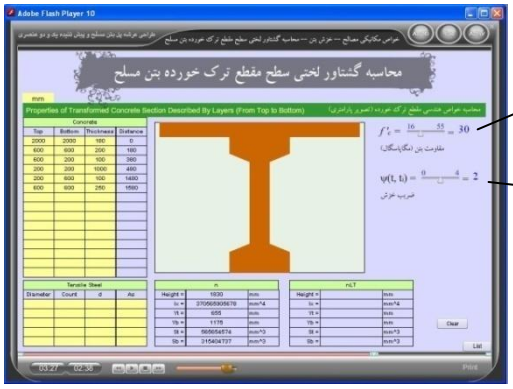

Figure 8. Parametric simulation of geometric properties of cracked reinforced concrete sections (Section is described by layers)

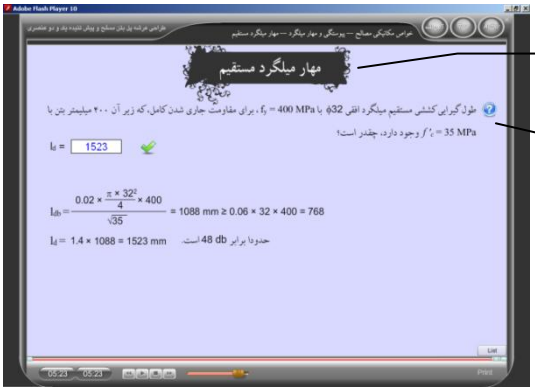

Figure 9. Question about tension development length calculation of straight bar (Chapter 2)

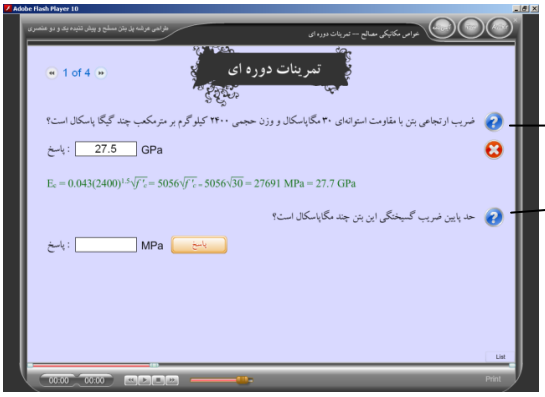

Figure 10. Periodic exercise of concrete mechanical properties (Chapter 2)

4. CONCLUSIONS

Briefly explaining, in this article, the following points have been thoroughly reviewed:

- Attention to emotional design of instruction can be found in Keller's attempt who proposed ARCS Model for improving motivation in instruction as can be seen in Emo-Inter Instructional Model.
- Student behavior was modeled according to operant model. In this model, heart is the center of decision making that acts under the influence of cognition, emotion and genetics. Emotion and motivation influence human behavior immensely in this model.
- According to the learning model, at first, information changes to cognition, next to emotion, then to action or behavior and finally it turns into belief; in this point it is possible to claim that complete learning, i.e. permanent changes have occurred. Raising emotion based on proposed training is one of the key stages in the learning process, which provides necessary motivation for action and finally achieving effective learning.

- The proposed model is used in teaching engineering courses in general and specially in e-content development for virtual courses.
- Considering operant model for student, having motivation to thank God for learning, and raising emotion during the training process are main elements in proposed learning model.
- According to three main learning theories, Behaviorism Learning Theory, Cognitive Learning Theory, Constructivism Learning Theory, *Interaction* is essential for emotion.
- The depression of emotional level is the major disadvantage of virtual learning.
- Interaction with the user by virtual simulation and the capability of reusing the learning objects are advantages of virtual learning.
- According to the survey which was done on learning model in one semester, on average 79% of students evaluated the learning models very useful and effective and 68% of students evaluated objectives were achieved during semester.
- In an overall view of e-learning content development, first of all the overall course objectives, course place, references and related softwares, practical applications, lesson chapters and its organization and SCOs' list (in accordance with the technical restrictions and independence in object's content) must be determined.
- Preparing the list of course's objects is the most important part of e-content development.
- For e-learning content development, the following steps should be taken:
    - Preparation of the original narration of presentations according to the proposed model.
    - Preparing the narration.
    - Providing development scenario.
    - Educational component development by the contractor.
    - Reviewing and revision of the object's content.
- According to emotional and interactive instructional model, following steps are proposed for learning object development:
    - Inspiring training goals
    - Organizing the object content
    - Presenting the lesson in questions and answers with two narrators
    - Minimal use of texts
    - Using pictures, graphs and animation to visualize the concepts and relations
    - Using similitude and examples for emotional description of concepts and relations
    - Interaction with the user through parametric tables and images.
    - Assessment of learning
    - Expressing summary
- The e-content development stages of the concrete bridge superstructure design course are presented through the proposed model.

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