AN EMPIRICAL STUDY ON THE IMPACT OF USING AN ADAPTIVE E-LEARNING ENVIRONMENT BASED ON LEARNER'S PERSONALITY AND EMOTION

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ABSTRACT

Emotions and personality are important parts of human characteristics and they play a significant role in parts of adaptive e-learning systems, it is essential to consider them in designing these systems. This paper presents an empirical study on the impact of using an adaptive e-learning environment based on learner's personality and emotion. This adaptive e-learning environment uses the Myers-Briggs Type Indicator (MBTI) model for personality and the Ortony, Clore & Collins (OCC) model for emotion modeling. The adaptive e-learning environment is compared with a simple e-learning environment. The results show that students deal with the adaptive e-learning environment (experimental group) expressed the adaptive e-learning environment is more attractive and close to their personality traits than others (control group). Moreover, the adaptive e-learning environment understand their emotional state better, has a suitable reaction to them, and improves their learning rate.

KEYWORDS

Adaptive e-learning, Personality, Emotion, MBTI

1. INTRODUCTION

Nowadays, the number of e-learning systems and online degree programs has noticeably increased (Allen & Seaman, 2007). Despite the increasing in using e-learning systems and their advantages such as access to different online resources, and self-directed learning, learning e-learning systems suffer from several problems. The most important problem of these systems is high dropout rate (Yukselturk, et al., 2014). A lot of learners are easily leaving e-learning systems without satisfaction (Carr, 2000; Inan et al., 2009; Kotsiantis et al., 2003; Lykourentzou et al., 2009; Willging & Johnson, 2004). Because this type of learning environment cannot interact with learners as well as traditional learning environments. Then, it is necessary to consider the human characteristics in the design and implementation of e-learning environments, aiming to make them more realistic and attractive (Niesler & Wydmuch, 2009).

Since emotions and personality are important parts of human characteristics and they play an important role in parts of adaptive systems such as implicit feedback, it is necessary in designing adaptive learning systems. Many adaptive e-learning systems have been developed to consider human characteristics but most of these systems just consider emotions, mood, learning styles, motivations, or personality alone (Trantafillou et al., 2002, Grigoriadou et al., 2001, Wolf, 2003, Bajraktarevic et al., 2003). There is a few research used combination some of the human characteristics together (Conati, & Zhou 2002; Chalfoun et al., 2006; Fatahi et al., 2009; Fatahi & Moradi, 2016). In addition, most of the research in adaptive e-learning system area do not pay attention to the experimental evaluation of impact these systems have had on learners. In this study, we have designed and implemented two versions of e-learning systems. One of them is a simple e-learning environment and the other one is an adaptive e-learning environment based on learner's personality and emotion. The goal of this paper is the evaluation of impact the adaptive e-learning environment which uses learner's personality and emotion to interact with the learner.

2. RELATED WORKS

Numerous studies have been carried out in adaptive e-learning systems area, in this section; the most important ones are listed. Kim et al. (2013) examined the relationship between a learner's personality dimensions and the influence of personality dimensions on learners' preferences. The findings of this research demonstrate individuals with different personality have different preferences and learning styles. Then, these differences should be considered in designing adaptive learning systems. The authors proposed design guidelines to provide appropriate material to learners based on their learning styles. Rani et al. (2015) proposed an ontology-driven system which is used to provide personalized learning materials for learners. To evaluate the system, a questionnaire which measures different dimensions such as learner, teacher, course, technology, and design is used. The results indicate that the average score that was calculated for all dimensions is reasonable. Garcia-Cabot et al. (2015) carried out an empirical study on an adaptive mobile system. The aim of this research was evaluating the learning performance and attitude of learners when they use an adaptive mobile system. The results illustrated that mobile learning adaptation had a limited effect on learning performance of practical skills when compared to an e-learning system. Bourkoukou et al. (2016) consider learner's personality to design a personalized e-learning system. The system works based on different learning scenario for each learner. It recommends suitable learning materials according to learner profile. Authors suggested an algorithm to recommend learning object to learners. After evaluating the proposed model, the results show that prediction accuracy of it is reasonable. Isaias et al. (2017) carried out an empirical study on a group of 79 students who used mobile and distance learning. The goal of this research was the influence of attitude toward empathic forums, used for mobile and distance learning. The results show that performance expectancy and effort expectancy had a positive influence on the students' attitudes towards empathic forums. Despite all these efforts, there is a lot of research in adaptive e-learning systems but there is no work on evaluating an adaptive e-learning system which considers personality and emotion of learner against a simple e-learning environment. In this paper, our aim is to compare an adaptive e-learning system which considers personality and emotion of learner and a simple learning environment.

3. METHODOLOGY

This study is based on an e-learning environment which includes many online courses. The course in this study is the "Introduction to computing systems and programming" (ICSP) which is taught to the first year students at the school of electrical and computer engineering at the University of Tehran in Iran. Figure 1 displays the overview page of the course.

Since this study focuses on personality and emotion of learner as important human characteristics, then in the first step, the participants are asked to fill out the online MBTI questionnaire to determine their personality. Therefore, in the first step, the personality of students based on MBTI are identified. Also, the goals of students are determined through a questionnaire is based on Ames's theory.

In the second step, we categorize students in experimental and control group. The experimental group who will work with an adaptive e-learning system based on personality and emotion and the control group who will work with another version of the system without adaptation. It should be mentioned that the experimental and control groups carry out exactly the same learning activities in the same amount of time.

In this study, one of the chapters of the ICSP syllabus, "Pointers and Arrays" is selected to teach the students. In the third step, the student logs in into the course page and has to participate in an online quiz consisting five questions about pointers and arrays which called Pre-quiz. This process helps us to measure the level of knowledge before learning materials and desirability level of him in associated with e-learning environment events. For each question of the quiz, the hint button is provided. If the student needs a hint to answer the question, use it easily. If the student clicks on hint button and uses it, the system asks him how much the hint was helpful (Figure 2). The student must give a rate on how much the hint was helpful. The rate is one to five, one means very low and five means very high.

پوینتر (یا اشاره‌گر) چیست؟

پوینر آدرسی از معوری است که در آن object (مانند متغیرها و ...) قرار دارد. با استفاده از پوینترها می‌توان به طور غیرمستقیم به این objectها دسترسی پیدا کرد. در زبان C آرگومان‌های توابع "passed by value" هستند یعنی کپی از مقدار هر یک از آرگومان ها با فراخوانی شدن تابع در run-time stack، push می‌شود. بنابراین هر تغییری که در حین اجرای تابع روی متغیرهای ورودی رخ دهد با بازگشت از تابع و پاک شدن بخش‌هایی از run-time stack که مربوط به تابع فراخوانده شده است از بین خواهد رفت. مثال از نحوه‌ی استفاده از پوینتر در زبان C:

```
int *ptr;
```

علامت "*" نشانه‌ی پوینتر است. در اینجا پوینتری به نام ptr از جنس int تعریف شده‌است.

نحوه‌ی مقداردهی پوینترها:

```
int *ptr;
int object;
ptr = &object;
```

قطعه کد زیر را در نظر میگیریم:

هدف این کد جابه جایی محتوای دو متغیر valueA و valueB است. اما چون در زبان c آرگومان های توابع by value به تابع پاس داده میشوند. پس از بازگشت از تابع مقادیر متغیر ها تغییر نیافته باقی میمانند.

```
void Swap (int firstVal, int secondVal);
int main()
{
    int valueA = 3;
    int valueB = 4;
    printf("Before Swap");
```

Figure 1. Overview page of the course

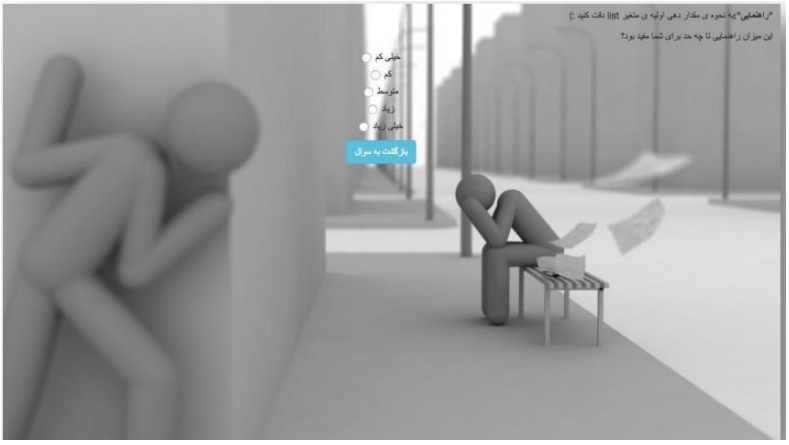

Figure 2. Determine the helpfulness of the hint

Later, the student can go back to submit his answer to the question. After answering a question, the effort level of student is asked (Figure 3). This question determines how much the student had the effort to answer a question. The student should give a rate between one to five, one means very low and five means very high for the effort level. It should be mentioned that the time to answer each question is three minutes and after that, the system automatically redirects the student to the effort level measuring page.

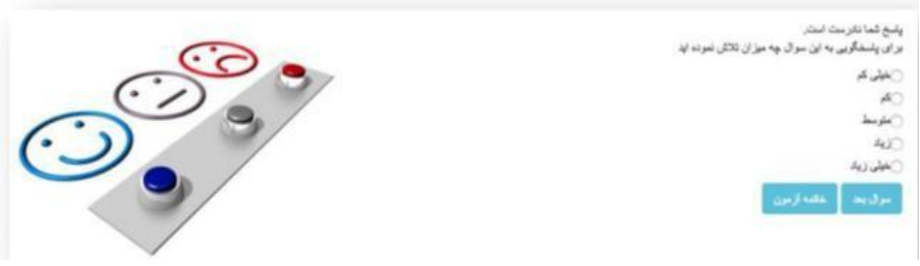

Figure 3. Determine the effort level

Finally, the desirability level will be asked and the student should answer how much he desirable or undesirable of this learning environment event (Figure 4). For example, it seems clear that the student could not answer questions has undesirable emotion.

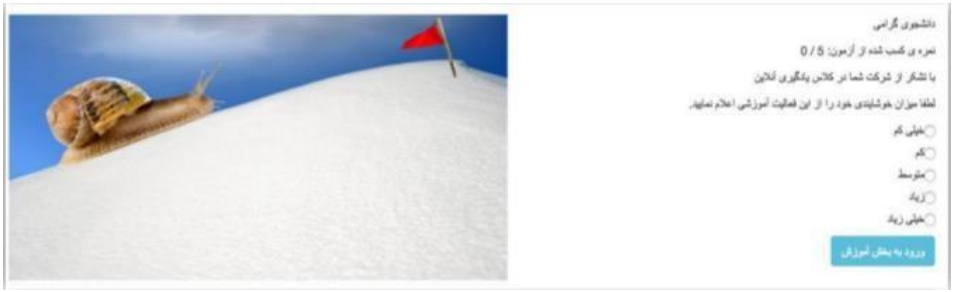

Figure 4. Determine the desirability level

After the student answers all questions or skips them in Pre-quiz step, a part of the lesson on the subject “Pointers and Arrays” is taught to the student, in the fourth step. It should be mentioned the designing e-learning environment for experimental and control group in teaching section is totally different (Figure 5 and Figure 6).

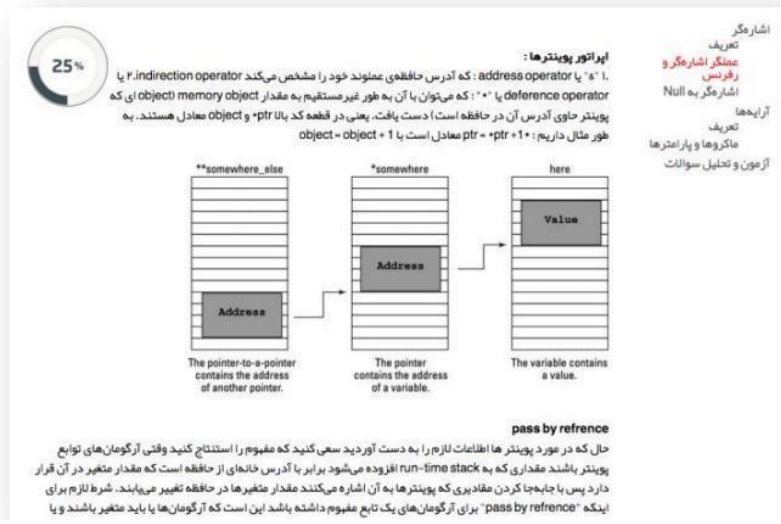

Figure 5. Adaptive e-learning Environment

Figure 6. Simple e-learning Environment

3.1 Adaptive e-learning Environment based on Personality

For ISTJ (Introversion, sensing, thinking and judging) individuals designing e-learning environment adapted to their personality dimensions and emotion. These people learn best from an orderly sequence of details, likes to know the "right way" to solve problems, interested to learn structured materials, choose to work alone, likes quiet space to work, works on one thing for a long time, dislikes interruptions, prefer to begin with the details and facts, and then move towards concepts: there is also more liking for step-by-step exposition, likes logic, facts, and objectivity, sets up "shoulds" and "oughts" and regularly judges self against these (Dewar & Whittington 2000). In designing adaptive e-learning system, we consider ISTJ individuals characteristics which are explained below: Since ISTJ people choose to work alone and like quiet space to work, the online and personalized learning environment is fit with their preferences. Also, we added a progress bar to each page of the lesson so that the student knows how much he had the progress in the lesson. In addition, we highlighted current outlines in each page of the lesson. These features would help the ISTJ individuals who set up "shoulds" and "oughts" and regularly judges self against these. Since ISTJ people likes fact and objective materials and they obtain information through their senses not their intuitions, we used some pictures instead of text only. Furthermore, we added a navigation bar which shows topics and subtopics. It helps that the student knows what section will be present in the future and the student may want to change the flow of the lesson or skip some sections. Also, ISTJ persons need to know the goals and sub-goals of their task. Finally, due to ISTJ individuals prefer to work on one thing for a long time and dislike interruptions, this online learning course designed for 45 minutes.

3.2 Adaptive e-learning Environment based on Emotion

As mentioned before, the OCC model is used in this study and we focus on desirability variable is one of the most important variables to calculate the first group of emotions. To calculate the desirability level, we used a computational model (Fatahi & Moradi, 2016) which is based on learner's personality, e-learning environmental events, and learner's goals. The results show this model can predict desirability level 76% accuracy. Then, we used this model to predict student's desirability level. It should be mentioned we ask the desirability level of the student but we use the actual value for comparing with predict value of the model for sure. After Pre-quiz and before starting the teaching, the desirability level of the student is determined. After that, we used some motivational strategies to encourage the student continue to work with the adaptive e-learning environment. These strategies are some encouraging message with energetic music, and animations.

In the fifth step, after studying the lesson, students are tested with an online quiz consisting five questions about pointers and arrays which called Post-quiz. The process in the Pre-quiz and Post-quiz is same.

In the final step, all students in experimental and control group fill out a questionnaire consisting five questions about the impact of adaptive learning environment on the learning (Table 1).

Table 1. Evaluation System Questionnaire

Questions	Very low	Low	Medium	High	Very high
1- How much this e-learning environment is interesting?					
2- How much this e-learning environment close to the features of your personality?					
3-Howmuchyour emotional state understand?					
4- How much well the e-learning environment reacted to you (with the consideration of your emotional state)?					
5- How much this e-learning environment can be improved learning rate?					

4. EXPERIMENT AND RESULTS

We collected data from 222 students who enrolled in the course. Only 181 of students participated in the online MBTI questioner. Eventually, 127 valid questioners were collected. Fig 8 shows the personality distribution of students in each dimension of MBTI and Fig 7 shows the distribution of personality types of the MBTI. As mentioned before, we consider two groups of students for experimental and control group. Based on the data collection phase, there are 27 students who have ISTJ personality type and just 16 of them participated in the online course and completed the course and answered the final questionnaire.

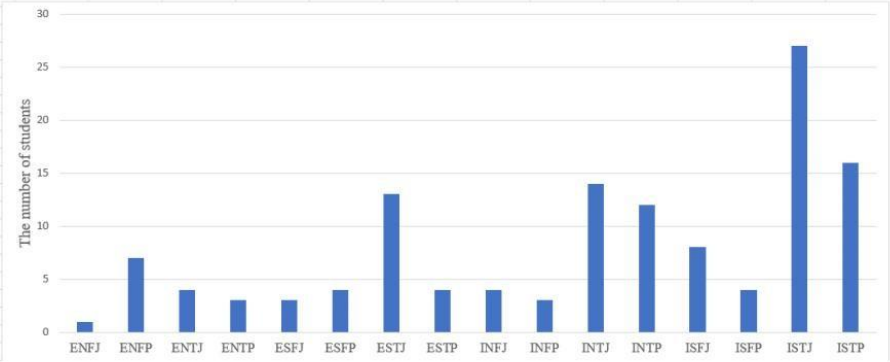

Figure 7. The Personality Type Distribution of Students in Each Type of MBTI

Also, the number of other students which participated in the course and have others personality types were 100. Only 34 of them finished the Pre-quiz, only 29 of 34 finished the Postquiz, and finally, 27 of them answered the final questioner. Therefore, there is 16 sample of ISTJ data (experimental group) and 27 of others personality type (control group). Since the number of data in the experimental and control group is not the same, we normalized the obtained results. The results reported in two steps which are Pre-Quiz and Post-Quiz. In the Pre-quiz step, the students log in into the web course while they have not been trained. In the Post-Quiz, the students have been trained a subject. Figure 8 shows the scores that the experimental and control group of student obtained in Pre-quiz and Post-quiz and Figure 9, the desirability level of students.

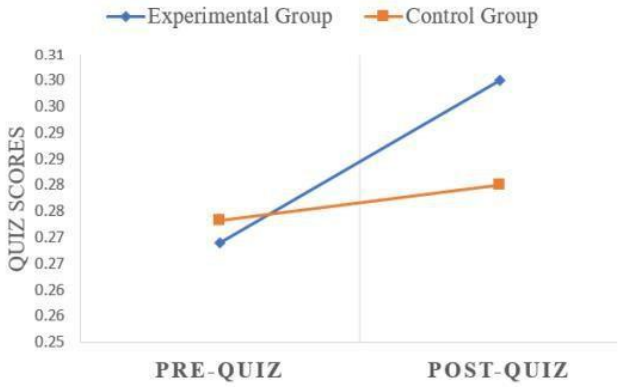

Figure 8. Quiz scores

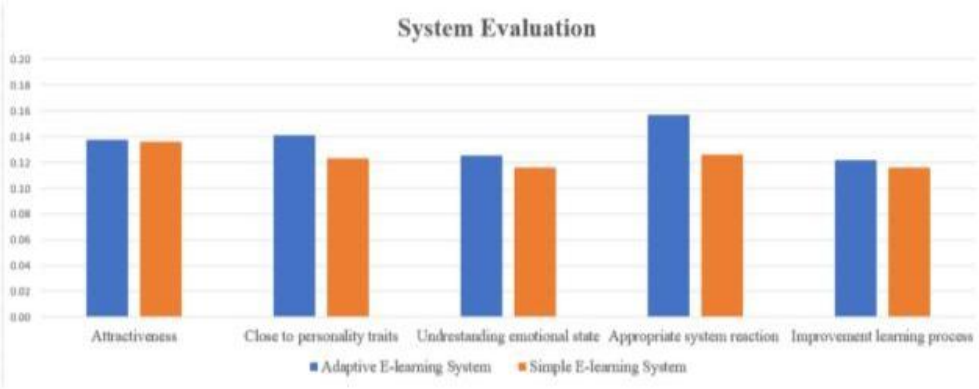

Figure 9. The evaluation questionnaire result

5. DISCUSSION

The goal of this study is comparing a simple e-learning environment and an adaptive e-learning environment based on learner's personality and emotion. The results show that there are differences between these environments. As Figure 8 shows, in the Pre-quiz, the control group gained higher scores to answering questions than experimental group. It implies the level of knowledge about pointers and arrays is better among the control group. After teaching, the experimental group in the adaptive e-learning environment based on their personality and emotion improved their performance significantly rather than the control group. The rate of progress in quiz score of the experimental group is almost 4.6 times more than the control group. Figure 9 shows the results of a questionnaire which filled out by two groups of students to compare two environments. As Figure 9 display the adaptive e-learning system has more scores in all measures. The higher score is related to the appreciate reaction of the system which means how much the system has a suitable reaction after understanding learners' status. Also, the students confirm the adaptive learning was designed very close to their personality types.

6. CONCLUSION AND FUTURE WORKS

In this paper, an adaptive e-learning system based on personality and emotion designed, implemented and evaluated. We used the MBTI model for personality module and OCC model for emotion module. The system tested in two versions for control and experimental group. The control group deals with a simple e-learning system while the experimental group interacts with an adaptive e-learning system based on personality and emotion. As the results have shown considering the human characteristics such as emotion and personality improves the learning process. The experimental group believed that the adaptive e-learning environment causes progress in their learning rate. Also, it can recognize their status in terms of emotional state and personality traits. Therefore, this system has fit strategies to interact with learners. This finding can be used in later research in order to customize the e-learning environment. One limitation of this study was the number of participants in the course. In the future work, we can collect more data and designed the adaptive system for all sixteen personality types of the MBTI.

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