Guidelines for Edutainment in E-learning Systems

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Abstract: This paper discusses the final conclusions and empirically derived guidelines for the incorporation of multimodal metaphors and entertainment elements in interface for e-learning applications. The study tested the benefits of integration of various modalities representing natural recorded speech, earcons, and virtual avatars within the e-learning framework through three experiments. This was conducted using usability parameters that include efficiency, effectiveness, and user satisfaction.

Key-Words: - Avatar, E-learning, Edutainment, Entertainment, Human-Human Interaction (HHI), Multimodal.

1 Introduction
Multimodality is the natural way to human to communicate unconsciously using all different information and using different channels every day. For example, human can speak, write, listen and move simultaneously [1-4]. On the other hand, the majority of the computer system developers concentrate on sight sense only to convey the information; therefore this may confuse the users and distract their retention [5] due to the overloading on the visual channel during the interaction [6]. These multimodal metaphors can enhance the interaction between human and machine by linking together more than one channel to convey different information [7] and this consequently decreases the working memory capacity [8, 9]. This flexible environment will enable the flexible use of input and output modes to interact with computers, depending on the setting: speech, gesture, gaze, pen, touch, movement [10].

Moreover the multimodal nature in human-human interaction (HHI) can help to make computer to human and human to environment interaction more natural [2, 11] and could get over the lack of face-to-face communication problem in computer user interfaces [12, 13], and avoid misunderstanding that occur sometimes to the lack for nonverbal feedback like in email communication [10].

Therefore the nonverbal activities like postures, gestures, facial expressions help to add richer meaning to human to human messages. Also, the multimodal interaction provides the facilitates for presenting the similar information using different channels [7], which give the users an alternative choice to interact with the computer application utilising the most appropriate type of interaction that fits to their abilities, preferences and needs [14].

This work presents the final conclusions and empirically derived guidelines for the incorporation of multimodal metaphors and entertainment elements in interface for e-learning applications. It starts with a brief review of the work that has been carried out in this research thesis, followed by a summary of the main conclusions and finally empirically derived guidelines.

2 Review of the Experimental Studies
The first experiment was a preliminary investigation into the role of edutainment in a multimodal e-learning context. It was an attempt to answer whether or not the incorporation of multimodal metaphors and entertainment elements in interface for e-learning applications. The experiment performed evaluated the usability features of two interfaces; one the edutainment interface using avatar (human like appearance) to convey some entertainment aspects, and the other non-edutainment (typical e-learning interface). Overall 44 volunteers took part in the study dependently; all users used both edutainment (condition E) and non-edutainment (condition NE). The usability of these two environments was analysed by one dependent group of users. User efficiency, effectiveness and satisfaction were assessed under a controlled environment.
The second experimental phase investigated and compared three new interfaces integrated with different entertainment attributes to identify further which entertainment activity was mostly preferred by users. These three interfaces include: Virtual classroom using avatars as representatives of teacher and students (VC), Game-based learning (GBL) and Storytelling (ST). In addition to textual and graphical communication modalities, natural and sometimes amusing recorded speech was used as common feature in the three platforms. Moreover earcon attribute was built into the game to measure its effect in enhancing the usability of the game and users performance. The three quantitative usability principles that included users’ time spent, correctness, and satisfaction were empirically measured. The circumstances for the experiment were controlled to guarantee its validity, either by the rotation method used or by the lesson distribution mechanism provided. The experimental dependent-variable measurements were managed in order to acquire accurate results, which were achieved through incorporating a fitted time design in all systems and a webcam was employed to capture user’s responses and record their expressions.

The third experimental work in this research programme presented the third set of experiments carried out to determine the most preferred multimodal attribute or set of attributes that learners required to create an excellent learning environment whether it was visual-only metaphors (text and graphics), audio-visual metaphors (speaking avatar with full body gestures), or auditory ones (earcons and auditory icons). This was accomplished using four different platforms swapped with four different lessons from geology science with the intention of exploring deeper the effect of entertainment in cumulative students’ enjoyment, and thus student performance. The four “edutainment” environments evaluated in this chapter are TSEA (The game with test, speech, earcons and avatars interface), TSE (The game with test, speech, earcons interface); TS (The game with test, speech interface) and finally TE (The game with test, earcons interface). One group of 46 users took part in the experiment where each user in the group had to answer 4 questions related to the presented learning content in order to measure the effectiveness of each interface as well as the learning gained by users from the presented material. These four interfaces and four lessons were randomly rotated dependently on one group of user. Data required measuring up users’ effectiveness; efficiency and satisfaction were collected through questionnaire and observation methods, and analysed. Moreover Likert five-point scale with 10-items were also analysed and reported. In addition, ANOVAs test was applied to the data and user interface preference and order were also statistically measured.

3 Main Outcomes of Experiments

The results of the first experiment showed improvement in user enjoyment and learning retention and a more satisfactory interface being created as well. The application of the analysis of variance between groups so defined further confirmed this supposition. Therefore it can be concluded that the tested multimodal metaphors in this experiment could significantly contribute in enhancing user learning performance and the usability of e-learning interfaces in terms of efficiency, effectiveness and user satisfaction.

The second experiments established that the Game-based learning interface outperformed all other interfaces. In other words the experiment provided empirical evidence that using multimodal features in addition to game combined with the learning material in the same interface constituent is more efficient, more effective and more satisfactory as opposed to the other two investigated e-learning interfaces.

The results of the third experiment demonstrated that the TSEA (the game with test, speech, earcons and avatars interface) interface outperformed all other interfaces in terms of the time users took to complete required tasks, frequency of incorrectness and users satisfaction. In addition TSEA interface was the platform with the highest number of users’ preference. Nevertheless, users’ interface preference order also shows support for the TSEA interface which had the highest mean. Furthermore ANOVA tests resulted in significant variance and supported the hypotheses shaped. A Wilcoxon test result also differentiates between platforms where the incorrectness and the time were significantly lower in condition TSEA than in the TSE, TE and TS conditions.

4 Empirically Derived Design Guidelines

4.1 Recorded Speech Usage Rules

The results of the experiments in this study demonstrated that using recorded speech in
delivering the learning topics, accompanied with entertainment messages and amusing messages, expressed by avatars, improved the users’ mood during the lesson and encouraged them to continue discovering other interesting facts and predicting more amusing elements.

4.2 **Use of Avatars with Entertained Facial Expressions**

The study showed that the users enjoyed not only from positive facial expressions of happiness and surprise, but also from negative ones such as angers or madness, disapproved, sadness and upset. Therefore whatever were the expressions, the focus should be on how to present the way to express these facial expressions and when.

4.3 **Use of Avatar’s Entertaining Body Gestures**

There are ranges of gestures or body movements that can use with a combination of other different facial expressions and recorded speech that provide altogether the required edutainment communication when they are used effectively and honestly. The thing that the designers should take in their mind is the culture issues, since some non-verbal gesture has different meaning for different people in different countries and this may confuse the user.

4.4 **Use of Non-speech Auditory Sounds**

The users’ preference to the results of each condition demonstrated that most of the users preferred to design interfaces using avatar, speech, earcons (Visual, Speech, Non-Speech metaphors). However, the results gave additional evidence of the effect of multimodal metaphors represented by non-speech sounds (earcons) on the GBL interface in enhancing further the usability and learning.

4.5 **Use of the Game with Avatars**

The results of experiments described which investigated the game design four times with different sets of multimodal elements demonstrated that the majority of users enjoyed all conditions due to the power of the game in conveying the learning materials; however users preferred TSEA condition for reason of the avatars, earcons and recorded speech that were incorporated to add the entertaining elements that improve the user’s mood and reduce the stress during play, and increase user satisfaction and enjoyment that assisted in achieving the users’ aspirations.

5 **Conclusion**

This study has investigated the usability aspects that employed multimodal interaction metaphors with edutainment fundamentals in the presentation of the learning content of e-learning interfaces. The multimodal features such as earcons, speech and particularly avatars investigated in this research programme helped in improving the usability as well as users’ learning performance when utilised to communicate the incorporated learning material; this can be considered as one of the various attributes providing substitution for lack of face to face contact with the teacher in e-learning interfaces. The experimental findings stated above derived empirically guidelines that could be used for the design of more usable e-learning applications while contributing towards enriching the research literature that are concerned with multimodal interaction, the e-learning and the edutainment fields as well.

**References:**


