Learning with Edutainment: A Multi-Platform Approach

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Abstract: This paper describes a multi platform investigation, that evaluated three "edutainment" environments using three different platforms in order to explore usability aspects of edutainment in e-learning. These three platforms were virtual classroom, game-based and storytelling. Speech, earcons, avatars with graphics and game activity was combined in these three different platforms. A dependent group was used to measure users' performance in terms of user achievement and satisfaction. The empirical results collected indicated that the game-based approach was the best in terms of users' achievement as well as satisfaction with the interface and overall learning experience.

Key-Words: - Avatar, E-learning, Edutainment, Multi-modal, Human-Computer Interface.

1 Introduction

E-learning is not only an educational issue but also a complex experience that involves various domains such as social, emotional, psychological, and other related areas [1]. Many e-learning systems still present insufficient information, forcing students to navigate too quickly to less text-based and more interactive sites [2, 3].

Online learners today require more than mere information; they need to fill the gap missing in e-learning systems, an environment similar to that experienced in traditional learning, to interact with someone who could represent their teacher, to feel that they are in a classroom learning from other students, experiencing enjoyment during their learning, emotionally involved with the lesson and the instructor and learning from the teacher's facial expressions, gestures, hand movements and other activities that can convey the message [4, 5].

Considering the problem of E-learning, many researchers [5-9] are investigating the role of entertainment in improving learning through e-learning systems. As a result, modern students should be entertained and educated to achieve a better performance[3].

The intention of this study is to design edutainment platforms that can be used for the empirical evaluation of entertainment; with this as the focus; tools were required to demonstrate the amount of entertainment experienced by participating users. The motivation was to measure effectiveness, efficiency and user satisfaction and to evaluate how memorable and educationally valuable were certain aspects of edutainment. The results obtained from the experimental studies were compared and discussed in order to produce empirically derived conclusions as to which platform is preferable as a standard for e-learning applications.

2 Related studies

A number of studies have been conducted to investigate the role of entertainment and positive emotions to enhance learning [5, 10-16]. In this study a selected number of important related work is presented in the next section.

In research carried out by Nummenmaa [5], a total of 266 undergraduate students from different university courses participated in four independent studies. This research examined emotions in a Web-Based Text-Learning Environment (WBLE) that compared emotional reactions in face-to-face collaboration. Student behaviour in a WBLE was divided into three related classes: collaborative visible activities; non-collaborative invisible activities; and lurking. The results indicated that online learning was more effective when compared with learning in a face-to-face situation. Moreover, emotion during online learning was derived mostly from social communication rather than from the system itself.

Consequently this increase in the level of emotional reaction might decrease the students'

level of performance, especially in difficult learning duties. The author's interpretation of this result was attributed to the lack of ways in which emotional interaction with others increases affectivity in the web-based learning groups.

The study also recommends that future studies should focus on the potential to express emotion in a text-based web environment, ensuring better communication emotionally, and decreasing the level of affectivity.

In another study [11], the target was to explore the influence of tutorial and edutainment design of educational software programs that present the topic of ''cell division'' on student achievements, misconceptions and attitudes. The cell-division achievement test (CAT), cell-division concept test (CCT) and biology attitude scale (BAS) were applied at the beginning and at the end of the research. A total of 72 students took part in the study (age range 14-15 years). The users were distributed randomly in three groups within three ninth-grade classes of a public secondary school. Two were experimental groups and one was the control group. Each group had 24 students. Users in all groups had were computer users, but no experience of learning with CAI. The control group used a traditional teaching method, while the experimental groups were educated through computer-based learning.

The study showed that users in experimental groups performed better. Students understood the general functions of mitosis and meiosis easily as instructional software programs were obvious and effective. In addition, the study discovered that misconception in the experimental groups is not entirely eliminated even after the treatment. Nevertheless the study confirmed that the edutainment software program noticeably alters students' attitudes towards biology materials.

3 Hypothesis and methodology

The Null hypostasis H0 stated in this study was "Multimodal E-learning and Edutainment Systems will be the same (does not enhance students memory)" . To verify the proposed hypothesis, three interfaces were designed and built, the first one being virtual class, presenting the information in way similar to being in a classroom with a teacher and a students' discussion blackboard with amusing questions and answers that make the environment more interactive. The second interface presented the subject in a game-based learning interface. Storytelling was the third interface used in this experiment to present information.

Forty eight users evaluated these three interfaces (dependent group) and select the interface that they thought was the most enjoyable.

Three different geology lessons were rotated between the three platforms. Each lesson had similar volume of information.

4 Experimental tasks

Each user was provided with six tasks (questions) to perform in each platform. Tasks were moderate in terms of difficulty. Nevertheless, the system provided users with three attempts for every task with a built-in clock. Each user was allowed to take up to 60 seconds to complete the task.

5 Experiment

5.1 Virtual classroom

Avatars representing the teacher and students were put forward to read to the user the subject matter. At the same time learners were entertained by jokes, facial expressions, gestures and short messages as feedback from the teacher and sometimes as questions or comments from avatars representing students. Text as an additional modal was also displayed simultaneously on the screen. (See Fig. 1 (a), (b) and (c)).

Speech was included to enhance the system with necessary learning elements. Nevertheless, the system switched between teacher and student in a rotational manner. The avatar dressed in a dark colour, such as blue or dark grey against a light brown colour for the board. Under the avatar was a clock counting down to show the user the time remaining for the avatar to complete the task and a button to stop the avatar when the user chose not to continue. There was also another button, disambiguated with different colour and shape, that allowed the user to enter to quiz section. When the user completed listening and reading, the page automatically navigated to the next page until the lesson was completed.

To test the knowledge retained by the learners, users were asked six questions per lesson. These were built into the system, each question considered as one task, and each user had a maximum of 60 seconds to answer each question. Users had to click on their chosen answer and a response in the form of sounds and text was generated by the system. When users answered correctly, they had to click on the next button to go to the second question (task). In the same manner, users had to complete all the remaining tasks.

(a) (b) (c)

Fig.1 (a) Virtual class condition (teacher); (b) Virtual class condition (students); (c) Virtual class condition (female student).

5.2 Game-based learning

The method used in this platform was completely different from the previous interface. Users had to read and listen to a specific lesson and go directly to tasks (questions) designed to be answered as part of a game. This game was implemented using Authorware.

In the early phase, the game appeared as six squares (boxes), with the main box (rectangular), in the top middle of the screen, allocated for the question.

The question appeared only when the user shifted the mouse over the box. As users read the question, they had to move the pointer over the remaining boxes (six squares) to find the correct answer which was distributed randomly in the boxes.

Besides the text-based answer, the game provided earcons to help user to answer the questions. The tone used in these earcons was developed using Visual Music. By dividing short tones into portions, in a way which the first half was allocated to the question and the second half to the answer. Therefore, to find the correct tone, the user must click on any of the tone buttons allocated to each square or answer. The system automatically jumped to the next question if the user's answer was correct and the box disappeared. Conversely, the number of boxes rose to seven if the user's answer was wrong. The number of boxes would continue to increase if the answer remained incorrect, with nine boxes as a maximum, prompting the user to go to the next question and the game started over.

This made the probability of finding the correct answer low, forcing the user to find the correct answers during the first few attempts.

5.3 Storytelling

Storytelling, as a means of conveying information to people, is considered one of the most effective ways, in the edutainment aspect of the learning medium, of teaching students different subjects. The idea adopted from some researches, such as [44, 45], and tested here as an edutainment interface, presented the science information (geology) in an interactive way. The system articulates the information vocally with the text as an extra channel, associated with pictures, graphs, dynamic diagrams and movies that mimic and disclose the information offered. Certain circumstances determine the attractiveness of the means of conveying the information. For example, the presenter should stop for a while after every part of information, or raise or change his voice at times when the information is more important.

In this platform each lesson divided into pages, and each page containing some information as speech, text and graphs.

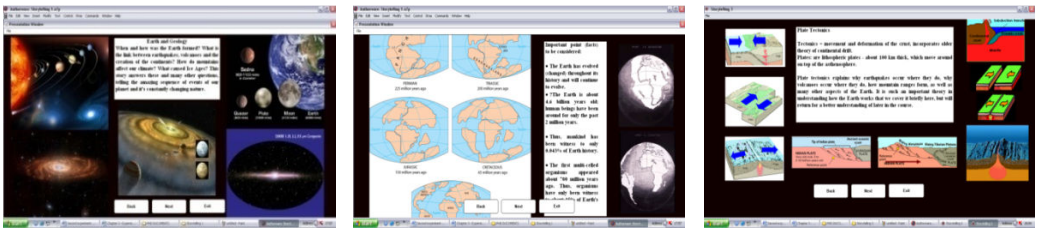
The user must press the next button to navigate to the next portion of information. Additionally the learner is provided with the facility of playing, stopping and going back to a specific point at any time. Fig. 2 (a), (b) and (c), demonstrates a snapshot of this interface. As in the procedure employed in the Virtual class interface, the same timing rules for tasks were usedto this platform.

6 Results and analysis

Overall, 48 users took part in the study, for over four weeks. All users utilised the three lessons and three edutainment conditions. Conditions and lessons were matched randomly for each user.

6.1 Users profile and personality

Users were aged 18-54; the average age was 36 with a standard deviation of 25.26. A total of 95.83% of users were male. Users were generally highly educated. A total of 43.75% had a doctoral degree while 56.25% had a Masters, whereas 2.08% were undergraduates. In terms of the area of study, 43.75% were from computing and informatics and 12.9% were from engineering. The remaining users had other specialisations. A total of 99.75% used computers for more than 10 hours per week, whereas 91.67% used the Internet more than 10 hours per week.



(a) (b) (c)

Fig.2 (a) The storytelling interface (example 1); (b) The storytelling interface (example 2); (c) The storytelling interface (example 3).

Only 2.08% of users had an advanced knowledge of geology, 25% had some knowledge, 54.17% a very limited knowledge and 18.75% no knowledge at all. A total of 33.33% of users had knowledge of e-learning.

6.2 Experimental sessions

Experimental sessions took 30-45 minutes with an average time of 37.5 minutes (standard deviation 10.60 minutes), including pre- and post-questionnaire. The time was distributed as follows: participants started with the pre-session questionnaire for an average of three minutes and then read the tasks for an average of four minutes, performed the experiment for an average of eight minutes, followed by the feedback questionnaire for an average of two minutes. This time distribution was similar for the other platforms.

6.3 Tasks achievement

Fig. 3 shows that the mean user achievement for game-based was higher in comparison to virtual class and storytelling platforms. Respectively, the figures are 79.86%, 97.9% and 85.76%. The proportion of users who completed their tasks without any mistakes was as follows: virtual class 77.08%; game-based 89.6%; and storytelling 45.80%. In general, as depicted in Fig. 3, better user performance observed in game-based condition.

In terms of each task on its own, as shown in Fig. 3, the mean percentage of students who completed tasks one, two, three and four were 94.81 in virtual class condition and slightly less in tasks five and six.

Overall, participants performed slightly better in the first four questions in all conditions compared with tasks four and five. But figures were slightly lower in condition three where the average was 79.17% for tasks four, five and six, as seen in Fig. 3.

6.4 Satisfaction

Uses satisfactions was measured using a questionnaire. The questionnaire used Likert five-point scale with 10-items [17]. Users were asked to express their agreement with specific statements. The average score for conditions respectively was 75.26%, 73.4%, 64.48. In addition to the standard condition, the Likert five-point scale was enriched by an extra five statements that also expressed user opinion scored as a normal average. In virtual class, the average user score was 3.37, in game-based it was 3.75 and in storytelling it was 3.17.

6.5 Interface preference

It is a good idea to support and enrich the documented results by including responses to a single statement at the end of the questionnaire allowing users to choose the best interface experienced. Game-based had the platform chosen the most, followed by virtual class and storytelling.

6.6 Interface preference order

Users were required to order interfaces according to their preference, by placing numbers one, two or three in the box provided in the questionnaire, where number one represented the best interface the user experienced and numbers two and three their second and third preferences.

The results show that game-based interface had the highest average of users' choices, at 58.33%. A total of 25% of users chose virtual class and 16.67% preferred storytelling.

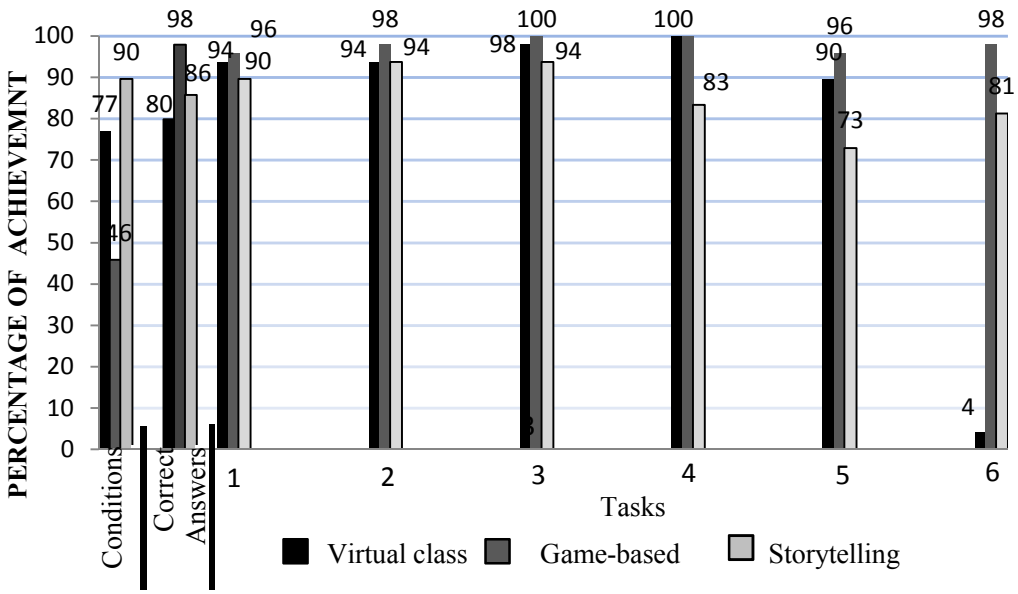


Fig. 3 Achievement for all conditions, achievement for users who completed all tasks in all conditions, achievement for all conditions for each task separately.

7 Discussion

In general, better user performance is noticeable in game-based, but in virtual class the result was less but still acceptable. It can be reasoned that this positive achievement of users in the game-based quiz was due to earcons enhanced that helped users to retain information over longer period of time.

An SUS-score [17] comparison shows that this was higher in virtual class than in the other conditions. The average score for virtual class was 75.26%, for game-based was 73.39% and for storytelling was 64.47%. On the other hand the additional statements provided showed that user satisfaction was higher 3.75 in game-based, then 3.37 in virtual class and 3.17 in storytelling. On overall, the users' satisfaction was almost as high in both Virtual-class and Game interfaces, but considerably less in storytelling interface.

As far as users' preferences are concerned, game-based was the platform with the highest number of users' preference, followed by virtual class and storytelling. Nevertheless, users' interface-preference order also shows supports for the game-based which had the highest average (58.33%) of users' options. In comparison, 25% of users chose virtual class and 16.67% preferred storytelling.

As a result of the data analysis, there is no doubt that condition two (Game interface) was the best platform compared with the Virtual class and Storytelling. Although the Virtual class came second, users preferred game-based approach rather than listening passively to the lessons. This also emphasises the power of the game in conveying learning materials, as many other researchers have suggested.

8 Conclusion

The focus of this experiment was to investigate users' achievement and satisfaction, where exposed to an edutainment in a multimodal e-learning environment through three different platforms in order to explore deeper the affect of entertainment in cumulative students' enjoyment.

The three "edutainment" environments evaluated here were Virtual classroom, Game-based learning and Storytelling. These three interfaces are randomly rotated between dependent groups of users. Users' achievement results were collected and analysed and Likert five-point scale with 10-items table were also analysed and reported.

The experimental results showed that the game-based learning interface outperformed all other interfaces in terms of users' achievement and satisfaction. In addition game-based learning was the platform with the highest number of users' preference, followed by Virtual class and Storytelling. Nevertheless, users' interface preference order also shows supports for the game-based which had the highest average. The use of game as an educational channel proved to be

valuable to learning. Besides teaching people in traditional approach, the game approach increased user satisfaction and enjoyment that assisted in achieving the users' aspirations.

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