Using edutainment in e-learning application: an empirical study

Dimitrios Rigas, Khaled Ayad

***Abstract*—** Philosophers and psychologists' arguments in the area of effective learning and HCI demonstrated that humour or entertainment is one of many important factors that help in developing improved learning. Accordingly students' performance increases in learning environment combined with amusement features. This work investigates the role of edutainment using avatars as tool to represent the entertainment attributes in an e-learning framework. The empirical investigation aimed at measuring usability of two experimental interfaces: typical e-learning and multimodal e-learning system. The usability of these two environments was analysed by one dependent group of users. The results presented here confirmed that edutainment interface as learning medium persuaded users more than the typical version.

***Keywords*—** Avatar, Edutainment, E-learning, Human Computer Interface (HCI), Multi-modal, Non-edutainment, Virtual reality (VR).

I. INTRODUCTION

Philosophers and psychologists' arguments in the area of effective learning and HCI demonstrated that humour or entertainment is one of many important factors that help in developing improved learning [1], [2], [3], [4], [5], [6], [7], [8]. And when students enjoyed more in the class, learning outcome increases. Nevertheless humour is part of various aspects of our life, and it's without doubt necessary for many of us. Therefore humour should be an issue of future multimodal interfaces, especially in the area education [5]-[10], [11]. In this way elearning as new learning medium can engage students in individualized environment where they can explore and learn concept and content to meet their specific needs [9], [10], [12], [13], [14].

The result is the invention of new interfaces utilized in any circumstances and situations when required [15]. In this direction of integration, edutainment appeared as an area which is adapting multimedia interaction methods to produce educational learning materials in some kind of entertaining forms. Savidis [10] described edutainment as "pleasure or positive experiences that a learner hopefully desire. The pleasure can result not only from the entertaining and interesting content itself, but also from the satisfaction of getting problems solved especially in games". As edutainment is a combination of entertainment and education, this integration is mainly to create a motivating and successful environment for learning. Edutainment is a game used to teach particular knowledge. Edutainment had been also implemented in games software including all type of electronic games like computer games, console games, portable and handheld games. Many programs on TV that submits effective educational subjects via entertainment means for children as Sesame Street could be classified as edutainment [11]. Examples of websites that educate and entertain in the same time are Learn2.com, Serious Game, Simulearn, Games2train, MBA Games, and HowStuffWorks.com [12].

In this study users entertained mainly with human like avatars conveying knowledge with multimodal metaphors in an interesting and entertainment way.

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II. PREVIOUS WORK

Although, studies that specifically examine E-learning and entertainment are few. A number of studies have been carried out with significant results [16], [17], [20], [19], [20] to measure the user's amusement and their involvement within E-learning systems.

One particular study [17] demonstrates the use of streaming multimedia narratives in web entertainment. The idea is to make users stop or navigate through hot links that lead to extra information, whilst watching entertaining and engaging cultural tours which stream continuously for several minutes. By quantifying the number of mouse clicks, the results showed that the users who clicked more times reported less entertainment and engagement. That is what the author called the "less clicking more watching" design approach. The research also recommended that the maximum time that the users can watch is around 5 minutes. The study summarized that web entertainment can be passive and the approach suggested somewhat benefits the users and it can be a design guideline for at least one domain [17].

Digital storytelling used in academic teaching within the computer science department still work in progress [18], employed hypermedia and virtual reality topics as base for background research. The objective of this study was to investigate the role of storytelling activity within the context of a Hypermedia Novel (HyMN) as edutainment self conducted learning compared to traditional lecture and practice courses. The HyMN approach incorporates different user tasks like receptor, author, and publisher in one medium; enabling personalized as well as distributed story reception and

storytelling. Participants, with a number of 16 test subjects and a single course over one term with 8 hours per week, stated their opinion regarding traditional and digital storytelling. The study concluded that the digital storytelling approach can be supplement traditional academic teaching approaches or in other words it works similar to traditional academic teaching, in terms of user's motivation and achievement [18].

Further work [19] has been conducted on bio-edutainment VR-enhanced bio-molecular education using a gaming model. 3D visualized environment, 3D audio, protein music, and 3D gaming interface integrated to form 3D edutainment VR game for bio-molecular learning. This gaming environment enables the player to discover important protein structure. With the game devices incorporated, players can have better interaction with virtual bio-molecular world during their learning process. Students can repeatedly play the game as many times as they wish. The developed tool can be used to handle all bio-molecules in Protein Data Bank (PDB) with their structure determined by X-ray crystallography. Moreover, playing X games allow all age levels of students to learn bio-molecular structure and also it helps to understand complex structure of bio-molecules (Proteins). Experiences accumulated by users during playing this type of games, helps to develop their curiosity and skills to explore the complex world of science [19].

Seeing that, there is no doubt that edutainment is the field of today technology assembling to enhance interactivity and stimulate creative thinking. Also the pedagogical aspects cannot be ignored as a result of educational features included in the edutainment programs. In spite of that, the area requires further research, more investigations and extra verifications, since the field is too large and open to all scientific and non scientific disciplines.

III. Experiments and Method

Two interfaces have been designed and developed. The first multi-modal E-learning platform encompassed edutainment elements. The second interface was non-edutainment interface. Everything in both interfaces is similar in terms of content and number of tasks but differs in the means of presenting the information or material. Please refer to Table 1 shows the features incorporated in both interfaces.

Each platform contains two chapters (Case 1, Case 2) in which difficulty gradually increases from Case 1 to Case 2. To avoid any familiarity with the topic and the interface sampling in the experiment, random rotation technique was applied between platforms and also in terms of chapters (Cases). As seen in Table 2, the user may starts from Case 1 in edutainment interface and finishes in Case 2 in non-edutainment interface, and the opposite is true. Tasks were divided into 2 groups, the first recognition questions and the second recall. Again tasks increased in term of difficulty (easy - moderate - hard). Table 3 summarised the tasks executed by users'.

The user must use both interfaces and they have to decide which interface is better and enjoyable through a feedback. The study targeted high level educational students (Master & PhD Students), and the subject matter examined as E-learning content was Human Computer Interaction (HCI).

Considering that, HCI as a subject matter is mainly theoretical. Learners need something to watch and listen to improve their imagination and engagement. This can be done by entertaining users with the learning materials. To achieve this goal, an idea employed was to adapt Avatar (sound and human like expressions) as an assistance tool to convey the message to the student by incorporating amusing elements such as jokes, facial expression and body gesture.

The word avatar comes from the Sanskrit language [20] and can be translated as God's Incarnation on Earth. In the virtual reality community, avatars are 3D humanoid characters inhabiting virtual space, with varying degrees of animation and behavioral abilities. Avatars typically represent humans who visit the space virtually. Each visitor controls their avatar and is aware of other visitors' avatars and their actions. The avatar moves and gestures in the mirror as the experimental subject moves and gestures in the physical room [20], [21]. Furthermore interesting possibilities can be offered by avatar world for online learning, collaboration, discovering new environments and attracting learners to keep progressing. Both educator and students can also build their own virtual worlds. This creates a sense of realism that is often absent from distance learning, which has been considered a benefit of educational three dimensional virtual worlds [22].

IV. Experimental Platforms Design

The main modality used in the platform to introduce the edutainment aspects is avatar. Text presented as an additional modality was displayed simultaneously on the screen. Integration of various elements has been implemented by educational software called Authorware 6.5, which is a Macromedia product. The plan is to employ the avatar to read to the user the subject matter and to entertain the learner by jokes, gesture, facial expressions, Fig. 1.a. The screen was divided into two parts; left part is for avatar display with optional button to stop the avatar at any time; the right part is for text display which is organized with font size 18 for the title and 14 for body text. At the bottom of the page there are two types of buttons; one type is for navigation forward and backward between cases. The other type which is under the blackboard is for navigation between lessons in one particular case. Additional button has been allocated to direct the students' attention to exercises. After the user has finished the training parts within the specific case, they are then examined to test how much they have memorised. Fig. 1.b shows a snapshot for multiple questions type. In this type of exercises the questions are represented by 4 labeled boxes. First box usually is for questions labeled (Q1, Q2, Q3….), the rest are for answers labeled (A1, A2, A3….). As soon as the user goes into to the exercise section, he/she will see nothing but labeled boxes. To see the avatar, read text and listen to voice of represented question, the action the user must take is to move the mouse over the first box.

As a result to check the correct answers the user must rollover the mouse over the remaining boxes or answers. Nevertheless, the design strategy here lets the user listen and

read one answer at a time. In other words when the user chooses to move the mouse over, for example A1, the A2 and A3 are kept hidden. In this case the students have to keep in mind answer 1 to compare with answer 2, until the student reaches the correct answer.

Once the user clicked chosen answer, an entertaining short message appears as positive or negative feedback. This response was represented by some kind of amusing avatar gesture accompanied with short text and sound message as seen in Fig. 1.c.

Another technique of exercises, is shown in Fig. 1.d where the user has to move or drag the colored word (term) in the middle of the screen to the correct position or corresponding shape. The right shape accepts the word and immediately the positive response as in the first type of exercise appears Fig. 1.e otherwise rejects the word and comes back to the original position with a negative response.

In addition the system is designed to jump to the next question automatically in case of correct answer, if not, after three attempts for each question, the system allows the user to go to the next question, considering the result incorrect.

When the student provides no action for several seconds (approximately 30 seconds), the program launches an immediate humorous prompt as shown in Fig. 1.f, reminding the user by his/her slow act in taking a decision, which is in turn to motivate the client to take faster action.

Earcons has been incorporated to make user to navigate more easily with and without the need to see to the pointers position with his eyes. In addition, the system has been designed with understandable buttons, popup menus and clear choices, descriptive and clear instructions.

V. RESULTS AND ANALYSIS

Overall 44 volunteers took part in this study. All users used both edutainment (condition E) and non-edutainment (condition NE). The condition (E and NE) was distributed randomly but was the same within each user.

VI. USERS PROFILES

Users were 97.7% males. The average age was 36 years. Users were generally high educated level, Doctoral degree was 31.81%, and Masters was 59.09%, whereas Undergraduates was 9.09%. In terms of area of study, 50.00% of users were from computing and informatics department, 14.00% were from engineering in general; the remaining users were from different schools and department. Around 90.00% of users use more than 10 hours per week. Whereas 86.36% using Internet more than 10 hours per week. Only 18.18% of users had excellent knowledge about HCI, 34.09% were good, 20.45% limited, and 27.27% had no knowledge at all. Users whom had knowledge about E-learning were 43.18%. Concerning avatar, 56.81% had no knowledge, 22.72% limited, 15.90% were good, 4.54% were excellent.

VII. EXPERIMENTAL SESSIONS

Sessions ended between 20 and 35 minutes with an average time of 27.50 minutes (standard deviation 10.60), including pre- and post-questionnaire. The time was distributed as follow: Users started with pre-session questionnaire for average 3 minutes, and then read the tasks for average 4 minutes, straight begun platform 1 experiment for average 10 minutes, followed by first platform feedback questionnaire for average 4 minutes, continued by platform 2 for average 10 minutes, ended by post-questionnaire about 4 minutes.

VIII. COMPLETIONS

The number of users completed all tasks in condition (E) was 61.36% compared with 50% on condition (NE), Fig. 2. In term of independent task as shown in Fig. 2 in condition (E) 93.18 % completed tasks 1, 2, and 3. Whereas 100% for task 4. 81% was for task 5 and 13.63% was for task 6. Overall, users performed slight better in the first 3 tasks. It was slightly lower in condition (NE), 88.63% completed task 1. Tasks 2, 3 were 93.2%, whereas 81.81% for task 4. Users completed tasks 5, 6, were 79.54 %.

Regarding completed tasks for condition (E) case 1 and 2 was 68.18% and 50%. Condition (NE) case 1 and 2 was 63.63% and 36.36%. Fig. 2 shows that case 2 in both platforms was harder to complete than the first case. In the main time, as shown in Fig. 2, in condition (E) the recognition questions completed percentage was 81.81%, recall type was 68.18%. Whereas in condition (NE) recognition tasks 81.81%, recall was 63.63%.

IX. EFFECTIVENESS

Fig. 3 shows the mean correct answers for condition (E) was higher than the average of condition (NE), 63.63% and 43.56% respectively. On the task level, users whom answered tasks correctly given in condition (E) were 22.73%. In contrast, condition (NE) was 13.64%. Regarding each task by its own it was obvious that the correct answers decreases gradually in direction of recall tasks for both conditions. These results illustrated in Fig. 3 summarizing users' numbers and percentage of correct answers for all tasks for both platforms.

Variation between users performance for both conditions (E & NE) in terms of cases regardless of task type are noticed during the experiment session. Taken average of correct answers for case 1 (case 1 for both conditions E & NE), compared with case 2 (case 2 for both conditions E & NE) is illustrated in Fig. 3. The average for case 1 was 61.74% and case 2 was 50.88. This gives us indication that case 2 is more difficult than the first case.

Fig. 3 depicts the percentage of correct answers by users for recognition and recall questions in both conditions, the average for condition (E) for recognition type was 71.76%, whereas in condition (NE) was 61.36%. In contrast, recall category was significantly low, it observed in condition (E) 53.78%, and condition (NE) 35.60%.

X. SATISFACTION

The questionnaire was based on five-point scale with 10-items as general feedback [23]. It asked users to express their opinion to statements provided. The scoring system followed here is by taking the average score for each statement, since

some statements formulated in this scale is not the standard statements. This generally results a positive affect where users liked condition (E) more than condition (NE) as shown in Fig. 4. The average score was 4.1 for edutainment platform. In contrast it was less valuable in text oriented platform, it gained only 3.55. Additional in depth analyses has been made for every statement. Noticeable high ranks outcome reported about users satisfactory of condition (E), can be observed especially in statements such as: "The interface of this system is pleasant", 4.2 was the average in condition (E), and 3.3 in condition (NE). In the statement shaped concerning avatar "I enjoyed the exercises because of Avatar", condition (E) average was 4.1, and in condition (NE) was 3.5. Another significant score average obtained from the statement "This system is boring", in condition (E) was 1.5, and 3.6 in condition (NE). Looking at the other 6 remaining general statements, still edutainment interface ranks is greater. This means that users' enjoyment and satisfaction is significantly improved in condition (E) in comparison with text version.

XI. Memorability

Expressions identification (Memorability) of the post-experiment questionnaire was conducted. Users were given 2 expressions (Avatars facial expression), then asked them to select the correct expression that have been experienced in the experiment session. For example if the avatar in the questionnaire expressed the positive action, the user should choose happy mode which the avatar has taken when users responded right. The feedback depicted that 70% of users recognized the expression easily, whereas 22% answered wrong and only 8% refused to answer.

XII. Interface Preference

The study provided by direct question requested from the users in the end of post-questionnaire to articulate the preferred platform experience. The final statistics demonstrated that 80% of users preferred condition (E).

XIII. T-Test Results

Since the sample was dependent, variations between conditions were compared when tested for the individual factors, using a T-Test: Paired Two Sample for Means with $p<0.05$ P (T<=t) one-tail. In terms of correct answers between platforms, significance results were found, T-Test derives $t = 2.25$, 43df, $p = 0.14$. Moreover T-Test conducted on correct answers for each task separately, T-Test found $t = 3$, 5df, $p = 0.15$, given that $p < .05$, thus significant results between platforms and in terms of each individual task were noted, therefore rejecting the null hypotheses.

XIV. DISCUSSION OF Results

The average of correct answers in general was satisfied, although 18% had excellent knowledge about HCI, Results demonstrated that variation between conditions as well as tasks are significant, condition (E) was 63.63%, and condition (NE) was 43.56%. On the level of tasks condition (E) were 22.73%, condition (NE) was 13.64%. Additionally, a T-Test confirmed that the difference was statistically significant ($p<0.05$). These indications supported with satisfaction score where users gained more than 4 in majority of statements analysed excluding boring score in condition (E). These significant statistics are maintaining users' excellent performance in condition (E). This promises that edutainment increasing user attention and performance.

Decreasing user's effectiveness outcomes were interpreted as increasing of difficulty level of cases and tasks that had prepared not by chance to involve user in some kind of challenged environment. Bearing in mind, the average for case 1 was 61.74% and chapter 2 was 50.88. Nevertheless, the average for condition (E) for recognition type was 71.76%, in condition (NE) was 61.36%.

In contrast, recall category was relatively low; it was for condition (E) 53.78%, and condition (NE) was 35.60%. It is obvious that the results acquired in both question type's and also in terms of level of difficulty (easy-moderate-hard) were higher in condition (E), compared with condition (NE). Though enhancement is observed in condition (E) were students' preserved the knowledge given longer period of time, which can be referred to entertainment practice experienced.

Concerning the platforms as whole, supplementary results indicated generally that 70% of users recognized easily the facial expression provided by avatar, whereas 22% answered wrong and only 8% refused to comment. Although 56.81% of participants had no knowledge about avatar expressions, an amazing observation was, users easily distinguished between happy and sad expressions when introduced after right and wrong answers. Consequently the outcome determined that the avatar conveyed to the users emotional expressions effectively.

Finally 80% of users preferred the condition (E) when asked about their opinion for the two conditions regardless of subject matter and if they responded correctly or not.

XV. Conclusion

This paper concluded the first an experiment result. The main objective was to see the influence of entertainment in e-learning interfaces. Particularly the study applied avatar as main modality representing human like facial and gesture expression. Users showed improvement in their enjoyment and learning retention.

Moreover the application of the analysis of variance between groups thus confirmed this supposition. Additionally, this work also anticipated in building improved interfaces in order to contribute in developing user usability and learnability measurements. Further experimentation will be conducted through sequences of tests to improve usability problems within edutainment interfaces.

Table 1 Platforms features, E = Edutainment, NE = Non-edutainment

Conditions	Features									
	Sound	Text	Graphics	Avatar	Earcons	Gesture	Facial expression	Jokes	Normal Feedback	Funny feedback
E	√	√	√	√	√	√	√	√	√	√
NE	√	√	√						√	

Table 2 Tasks rotations

Users	Edutainment	Non- Edutainment
10	Case 1 : T1, T2, T3, T4, T5, T6	Case 1 : T1, T2, T3, T4, T5, T6
10	Case 2 : T1, T2, T3, T4, T5, T6	Case 1 : T1, T2, T3, T4, T5, T6
	Non-Edutainment	**Edutainment**
10	Case 1 : T1, T2, T3, T4, T5, T6	Case 2 : T1, T2, T3, T4, T5, T6
10	Case 2 : T1, T2, T3, T4, T5, T6	Case 1 : T1, T2, T3, T4, T5, T6

Table 3 Both questions types tasks for both platforms (E&N).

Task 1	**Multiple instructions tasks** 1. Move the mouse cursor over the button labeled "Q1" and click to read and listen to the question. 2. Move the mouse cursor over the remaining buttons in the page to read and listen to the answers. 3. Click on correct answer. 4. In case of correct answer, the program will jump to the next question. **Drag the term instructons tasks** 1. Drag the colored word (Term) in the middle of the page to the right position. 2. Do the same operation if you have answered wrong. 3. In case of correct answer, the program will jump to the next question.
Task 2	Repeat the same steps in task 1.
Task 3	Repeat the same steps in task 1
Task 4	Here you will find short answer question, and all you have to do, is to write down the proper word (s) in the space shown and click on the Record Answer Button.
Task 5	Click on the next button to go to the next question, repeat the same steps in task4.
Task 6	Repeat the same steps in tasks 4, 5.

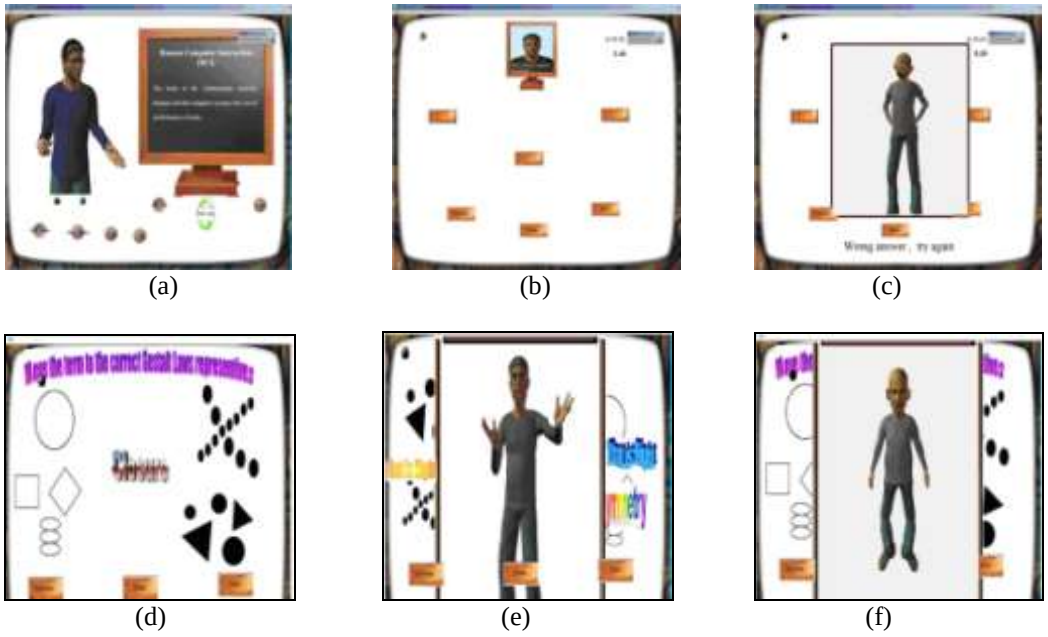


Fig.1 Snapshots of experimental tool for edutainment platform (a) Avatar as teacher reading the materials to the student (b) Example of exercise were the avatar reading the question with text display. (c) Example of negative feedback. (d) Example of second type of exercise before any actions from user. (e) Example of positive feedback. (f) snapshot of reminder when the user have taken slow action.

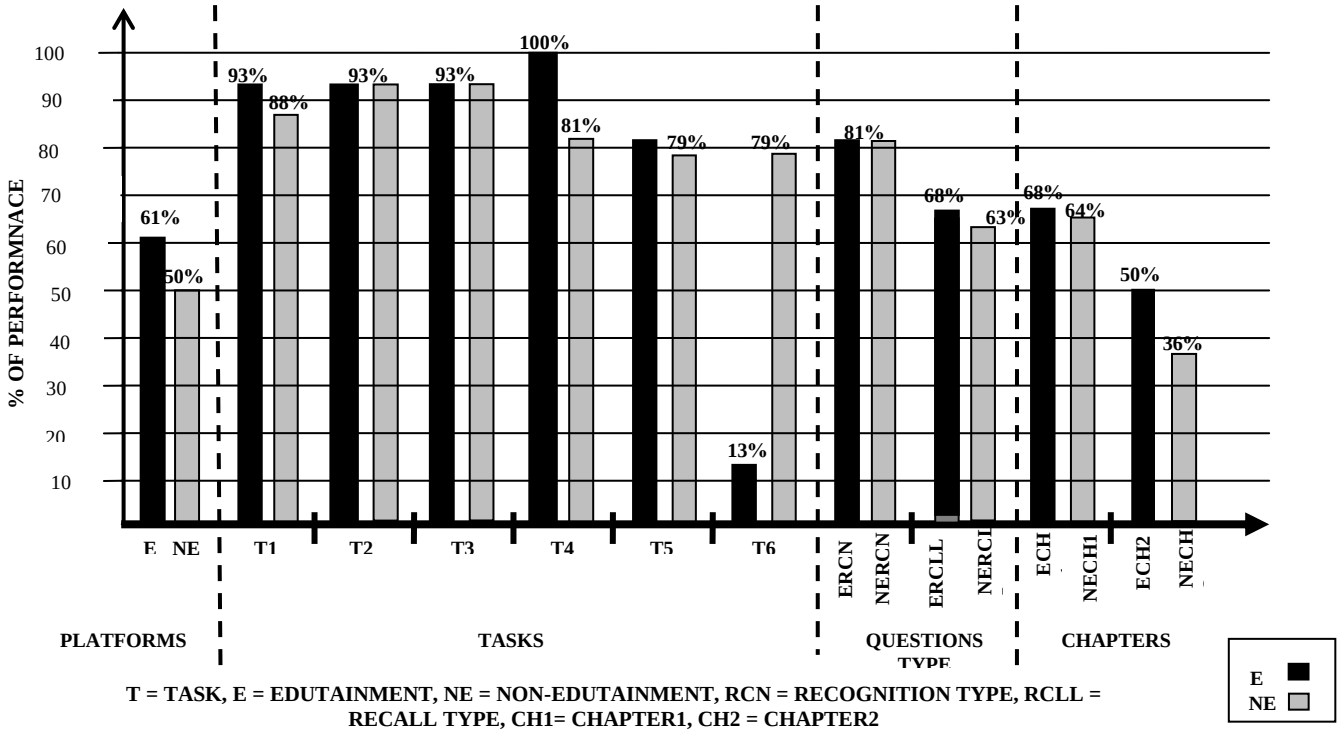


Fig. 2 Percentage of completions for tasks, questions and case conditions.

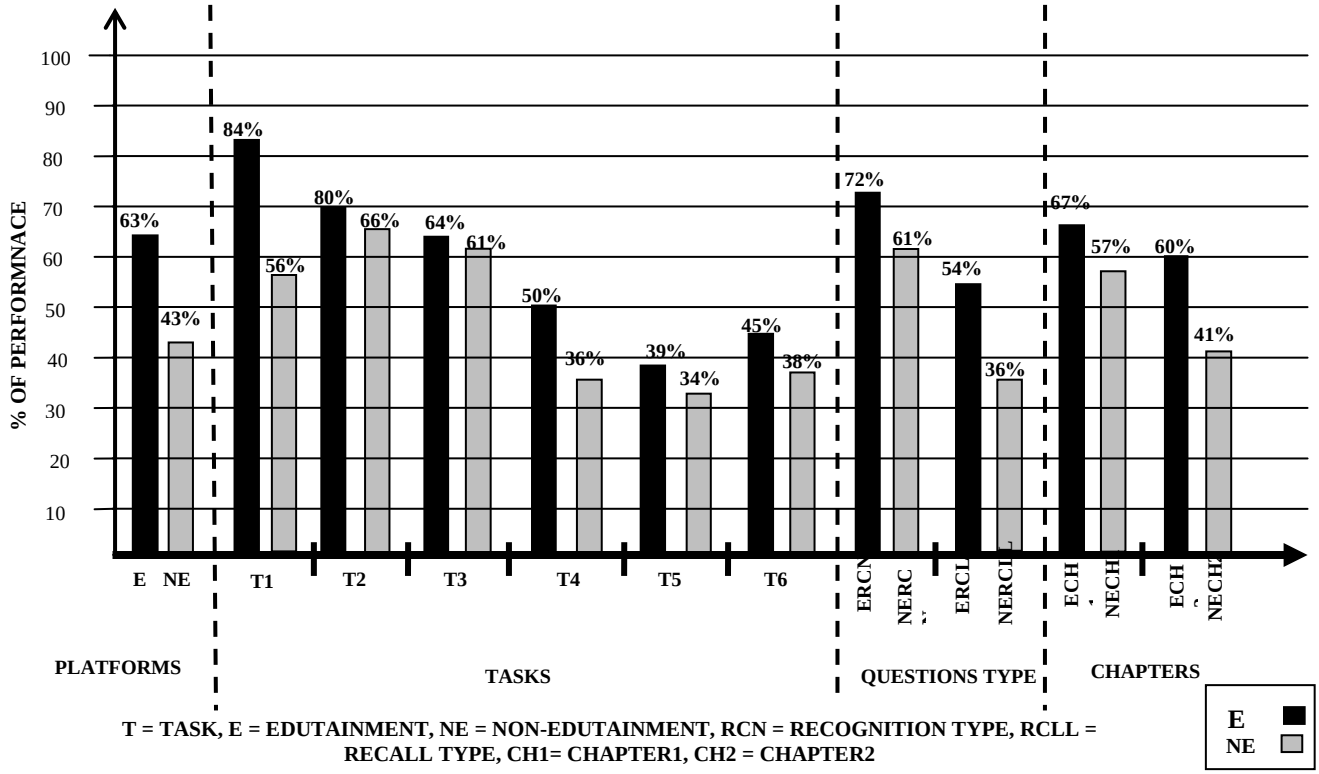
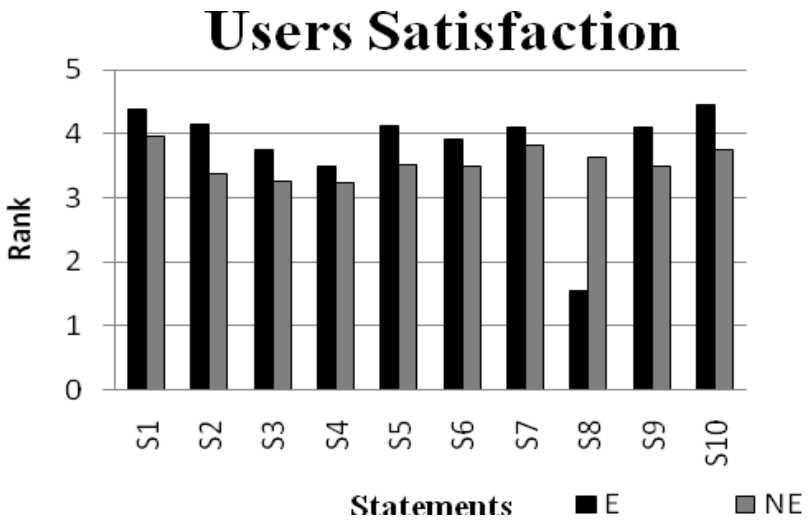


Fig. 3 Percentage of correct answer for tasks, questions, case conditions.



S1= I think the interface was easy to use.
S2= The interface of this system is pleasant.
S3= It was easy to answer the exercises.
S4= There have been times while interacting with the system where I felt challenging.
S5= I enjoyed the exercises because of Avatar
S6= The challenge forces me to continue.
S7= People will learn the use of this tool quickly.
S8= This system is boring.
S9= I would recommend this system to my colleagues
S10= Overall, I am satisfied with this system.

Fig. 4 Average users satisfactions in both conditions

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