

Contextual Teaching and Learning Using a Card Game Interface

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Abstract

With bases well established in the constructivism of Vygotsky, Piaget and Dewey, Contextual Teaching and Learning is about to help students not only to memorize contents but also to construct the relation between subjects in order to define their meaning. Contextual Teaching and Learning represents an important field of study and analysis that can be widely applied to classrooms and new media but lack of information and research, especially in Video Games and virtual technologies. This paper proposes a Card Game based User Interface that reduces the player's learning curve of the gameplay and help the game content to be assimilated during the player's progress. Such interface can be applied to educational and non-educational Video Games always providing context, i.e. meaningful content, through text card's design. For research purposes, a contextual card deck based on Art History was developed and tested against the same theme of traditional game interface with buttons derived from Massively Multiplayer Online Games abilities. The provided results shows that Card Games as Video Game's interface can help to simplify user's interaction while giving the player subjective information and content. By playing a prototype with the proposed interfaces, users were presented with questions about Art History, which answers were in the game's interface. User and community driven design method was used in the prototype development. As Virtual Contextual Teaching and Learning is a concept yet to be well explored and defined, the present research aims to contribute with the notion of human's cognition development in simulated environments.

Keywords: Card Games, Video Games, Contextual Learning, Education.

1 Introduction

Today's world is a complex mix of realities. While the society is changing into a more connected global community, educators around the world discuss how the school and education can follow such lightning speed evolution.

The research here described proposes a combination of *Trading Card Games* and *Contextual Teaching and Learning* (CTL) principles to develop a better game interface, i.e. a better interaction between the system and the user, more fit to transmit information and promote education. It was based on the hypothesis that Playing Cards can carry much more information than buttons and icons and are more visual appealing.

In order to test the hypothesis, two game interfaces were created and tested: a Trading Card-based Interface and an Icon-based Interface. These interfaces were applied in a prototype specifically developed for testing purposes. Commercial Trading Card Games and Massively Multiplayer Online Games (MMOG) were analyzed for the design and development process of each type of interface.

For the prototype, user and community directed design method came in hand to create and develop the game context, essential in CTL process. 10 cards based on Art History were created and a similar interface was designed just with icons, as user test control element. 20 Brazilian users from two active online communities tested the prototype during 3 days. Each group of 10 people tested one of the proposed interfaces.

2 About Card Games

To better understand the developed interfaces, the Card Games will be here briefly described. Despite its obscure origin, it is possible to trace the European early card game from the fourteenth century onwards, probably coming from the East. Theories vary from Asian tablets and discs coming from chess to the further introduction into Europe by the Saracens through Spain. Benham [1] suggests however, that the European Playing Cards are distinct and original in its conception and as the timeline of Oriental games is doubtful, there's a good chance of these games' been created at same time in different cultures.

Independent of the origin, Playing Cards became very popular in a short period of time and many different games and decks have emerged since. The early Tarot and the well spread four-suit European pack have inspired different types of Playing Cards in the late 20th Century, mixing strategic gameplay with collecting activity. The Trading Card Games were created. Trading Cards appeared a century earlier as cigarette and baseball cards.

The World War II and its consequent lack of paper has stopped the culture of Trading Cards temporary and ended the cigarettes cards for good. Sometime later, however, the Trading Cards went back as Tea Cards and Chewing Gum Cards. Until then, they were just Trading Cards. By adding game rules to them, the Trading Card Games were created. *Magic: The Gathering* is considered the conceptual father of all Trading Card Games [2, 3].

Besides *Magic: The Gathering* (M:TG), *Yu-Gi-Oh* cards were used as source for product analysis. Differently from M:TG, *Yu-Gi-Oh* is an example of media mix product similar to other Japanese famous card games as *Pokémon* and *Digimon* [4].

Following the path of many other media, the Trading Card Games were inserted into the virtual world, especially on the Internet. The number of online card games is beyond count; many of them are available in Social Network Services and mobile devices as well. Even M:TG and *Yu-Gi-Oh* have their virtual versions.

Unfortunately, just a few games had ever used cards to communicate their functions to players and receive input from them. Most of these games are from past two or three game console generations and have no glory to boast about. Still, some were good enough to be mentioned as *Lost Kingdom* series, *Kingdom Hearts: Chains of Memories*, *Phantasy Star Online Episode III: C.A.R.D Revolution* and *Baten Kaitos I* and II; and more recently *Metal Gear Acid* series.

Two types of gameplay could be identified amongst these games: *real-time battle system* and *strategic turn-based tactics*. In the case of *Baten Kaitos* series, the strategic element is not present leaving just the turn-based battle system. *Lost Kingdom* games have real-time gameplay, i.e. the character can move around make actions while the fight takes place giving more freedom to the player. By the other hand, *Phantasy Star Online Episode III: C.A.R.D Revolution* gameplay relies in a complex strategic combat involving many characters at same time. *Metal Gear Acid* series follows the same pattern and even the character movements are card-controlled.

3 About Contextual Teaching and Learning

As the hypothesis assumes that the proposed interfaces can promote education by context, the CTL concept will be explained from this point in parallel with education theory in Video Games.

Games, as a ludic activity, have a lot in common to CTL. The very nature of play is directly related to the learning process [5]. The learning process comes embedded in Video Games even though game designers don't have the intention to author an educational content [6].

Its built-in learning feature however, it is not enough to state Video Games as CTL valid tools. A comparison between Video Games' characteristics and CTL principles may enlighten the question. According to Sato [7], there are seven principles in context education approach: Purpose, Building, Application, Problem Solving, Teamwork, Discovery and Connection. Also, Crawford [8], states a set of five procedures called REACT: Relating, Experiencing, Applying, Cooperating and Transferring.

Starting from the Sato's list, *purpose* is about the meaning of doing something. The act of play is defined by Huizinga [5] as a "significant function". Games are meaningful and the meaning of play is of contextual nature, for the play act is not only about the game itself but the sum of players' experiences [9]. That is what Crawford calls *relating* in the second list above, i.e. "learning in context of one's life experiences or

preexisting knowledge". The meaning and knowledge carried by an individual are therefore, outcome of one's own experiences. Without experiences the individual is empty. Experiencing can be considered the most important part of the process of learning by context because it involves the prime principle of learning by doing [10]. Therefore and furthermore, without experience or prior knowledge, CTL approach is not possible [8].

Teamwork and *discovery* from Sato's list represents what Crawford pointed as *experiencing*. It is not only the main concept to be part of CTL, but is also the core concept behind Video Games. Everything an individual does in life is experience of course, but interactive experiences are of more value to the learning matter [11].

Video Games are all about experiencing and immersion. The very act of play implies interactivity [9]. It contains the problem solving aspect of it [12] and is full of exploration, discovery and invention.

Applying can be found in both lists, and is subsequent action of *experiencing*. Crawford defines it as "learning by putting the concepts to use" [8]. In a very simple way, applying is experience again but now knowing what to do. The success of application can be motivating or frustrating. It cannot be too easy or too difficult to accomplish.

Next there is the *cooperating* aspect of Crawford's REACT. It can be also related with *teamwork* and *connection* in Sato's approach. In fact, the cooperating or sharing is a present point in the experiencing and applying when it comes with work in groups. It's true that some Video Games have no cooperation, but especially after the Internet, almost every game has the capability to share the user's experience.

When it comes to cooperation, many games offer the multiplayer option online and offline. In that sense it may be that the MMOG represent the most cooperative of games, with its thousand of players sharing the same simulacrum and experiences in a synchronous and persistent environment [12]. In order to advance in a MMOG, the player must engage in a collaborative learning process. It means socialize and cooperate in order to learn [12]. Lone gamers can have a hard experience by trying to advance in a MMOG. Most of times players must form small groups to overcome challenging dungeons or bigger ones to accomplish difficult raids or even more organized associations as guilds which members can better cooperate and share [13].

Collaborative learning also comprehends *knowledge transfer*, the last element of Crawford's list. Among the four ways of knowledge conversion proposed by Nonaka in *A Dynamic Theory of Organizational Knowledge Creation* [12], *externalization* is the most suitable in the sense of what Crawford suggests. According to the authors, the experienced players tend to share their knowledge with beginners, and that is what externalization means and also what *transferring* is about in CTL context. Thus, MMOG offer the best environment to apply the CTL concepts and promote a technology-mediated collaborative learning.

It is now possible to convert the found CTL principles and the Trading Card Games concepts into a Game User Interface that can be tested with users.

4 Interface Development

A simple method involving design needs and requirements [14, 15] was applied in the card development and heuristic evaluation [16, 17, 18] for the prototyping process. If something Playing Cards are complex information holders full of signs and playful content. In that sense, a user-centered approach based on cognitive and communicative aspect of interaction [19, 20] was used to fulfill the product requirements in combination with a community-centered design approach [21].

Trading Card Games are very social activities. Video Games in general are becoming more social nowadays. As discussed above, MMOG can be turned into a great tool for CTL just because its social features. Considering all these social factors, a community-centered design approach was really useful. Furthermore, it helped to define the target audience. By choosing a community in the first place, its users naturally composed the test group that the interface was designed towards.

Following that direction, two Brazilian communities with common interest were chosen. They are organized in the Social Network Service *Facebook* under the names *Nerd Power* and *SkyNerd* with 3.660 and 1157 users respectively in the time of writing.

The communities were chosen not only for its size, but also for the social learning element found in it. As the names suggests, they share common interest on *nerd* content, what varies from pop culture to quantum physics. The nerd community around the world has been bound to a negative stereotype for a long time [22], but the past two decades the nerds and geeks, or the *Third Culture* [23], has become popular and important to the media and industry.

Nerd communities usually share and discuss their subjects with great enthusiasm. It carries many constructivist elements associated with some relevant content, what promotes CTL. The communities here observed use different kinds of media to share and discuss content, including podcasts and video casts.

As mentioned, a game prototype was developed in a community-centered design. The game itself is part of a bigger research about CTL and Video Games. It is a Massively Multiplayer Online Game which narrative comes from many distinct community's resources. A Video Game needs an interface as any other tool, and in this particular case, the Trading Card Game proposition was applied and evaluated.

The game called temporarily *Skynerd Protocol* [24] is set in a apocalyptic Earth, when natural resources are scarce and knowledge of the human race of late is lost but for some artifacts to found during the game progress, artifacts that represent human History, Science and Art. The game's context is also well placed over environmental issues, as climate changes and preservation of natural resources. On top of all that, social, politic and economic discussions are contextualized in a world that has suffered with war and must now survive an atomic winter.

The context the game is based on can give room to many and more contextual learning. In fact, the game is been developed to be a collaborative platform for the *Nerd Power* community

and educators alike. That is no matter for the research however, but all that contextualization may be well used alongside with a proper interface.

For the proposed experiment, a simple game mechanics was designed following the *real-time battle system* observed in some games earlier during the research. The game's goal is to find five hidden chests in which famous original paintings are stored. To open each chest the player needs to use a card corresponding to the painting artist. A deck of 10 cards was created (Fig. 1) and 4 cards are drawn each time for the player to choose.



Figure 1 Card Deck of Famous Artists

The cards hold information about the artists as year of birth and death (if applicable), brief bio and a quote, designed accordingly with the Card Games previously analyzed. Because the target audience is Brazilian, the information is written in Portuguese. Following the community-based approach, the cards were designed based on comic books, a common media among the target community.

The second interface was based on the traditional MMOG, such as *World of Warcraft* and *Star Wars: The Old Republic*. Those games make use of common icons to represent character abilities or items and labels which bear the necessary info to be viewed when the user roll the mouse over it. Again, the interface comes with the artists shown in the last figure and the info only appears in the mouse over state of the icon. The button or icon-based interface does not require the same gameplay as the Trading Cards; therefore, all icons are visible and available for the user all the time as seen in the Figure 2. The Figure 3 shows the Trading Card version of the interface.



Figure 2 Icon-based Interface



Figure 3 Trading Card-based Interface

Once inside the game, the user must answer 5 questions about Art History regarding the paintings and artists in the game. After completing the game the user is prompted with the same questionnaire again. The difference between the answers may give some directions on which interface is better for CTL and if the learning process is in fact occurring.

5 Results

The game prototype was tested with 20 volunteers from the mentioned communities, 17 male, 18 students, all Brazilian from 10 different cities and 9 states during the period between 7th and 9th of January of 2014. The prototype was programmed to run just once and guide the user through the first set of questions about Art History just after filling a form with personal data. To the user was given plenty of time to explore the simulated environment and find 5 pieces of lost famous paintings. Half the players used the Trading Card Interface and the other half the common MMOG abilities buttons. At the end of the game, the users were prompted with the same questions already answered but with a new question in place of the last one.

Also, the level of gaming experience was questioned with most of participants stated as regular (55%) or advanced players (40%). Just 5% have said they're beginners. It was important to establish whether the game mechanics or the interface complexity could interfere in the final results. Despite of a well balanced distribution, 80% of the players affirmed to play more than two hours per week, 60% more than 5 hours. It was considered enough for the simple game mechanics presented and to follow the interface instructions. The game playtime feedback (Figure 5) also provided at the end of the test showed that Card UI players finished the game in an average time of 6'18" against 38'52" of Icon UI users.

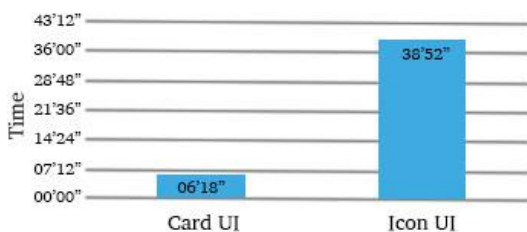


Figure 5 Total Playtime

The result demonstrates that Card-based UI promotes a better comprehension of the game mechanics and help players to end tasks quicker, also confirmed by applying a t-Test method.

The difference between the five questions presented before the gameplay and the five showed at the end are represented in the Figure 6. Although 40% of the players showed no evolution, in general, the after game questionnaire proved to have the best performance, including the only time when users got the top score. Besides, the second score was never lower than the first, been equal or higher. The average test score for Card UI players was 2.5 and 3 for before and after respectively. The same result for Icon UI users was 1.9 and 2.9. We can see here that Card Game Interface held better results in both questionnaires, but it does not mean it is the best for the learning process, at least in regard of the first test. Also, the learning curve was better for the Icon UI players.

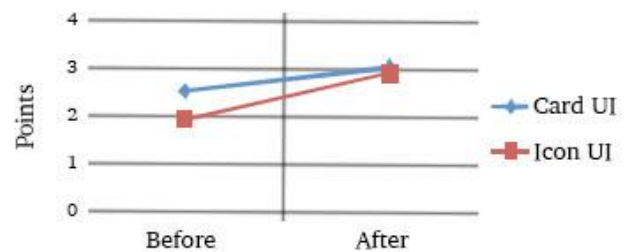


Figure 6 Game Score Comparison

Regarding the game total score, the graphic in the Figure 7 demonstrates a better performance for users using the Card Game UI. For each correct button or card used, 100 points were given to the player. Each wrong choice resulted in minus 50 points. The average score for them was 155 points against 100 for Icon users. Cards UI players were not only faster but got a better general score in the game too, also confirmed by applying a t-Test method.

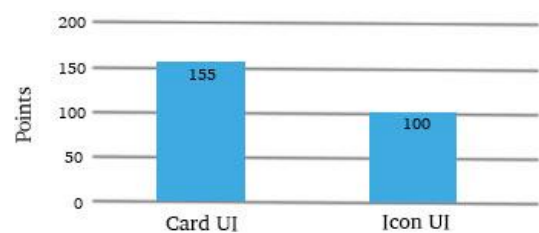


Figure 7 Game Interface Comparison

6 Conclusions

Of course there is more to do than what was done in this brief research. The direction is however defined. It is possible to state that Card-based Interfaces are helpful and can be used to build a faster and simple gameplay with a good learning process alongside. It's a better solution for CTL games.

Why exactly the cards offer a better choice to CTL is still unclear. Supposedly the cards carry more information visible to the player in real-time while buttons show only icons and numbers, with the need of a mouse-over to access the details.

The hypothesis can only be confirmed with users evaluation in future works.

The approach of two questionnaires, before and after game, showed a flaw. It was observed that most players tried to repeat the answers from one test to another. The observation was possible by adding a slightly different question in the second test. A better approach is to apply the tests with players and non-players and compare the results. It should be done with an expanded prototype that will have an improved gameplay, promoting user's collaboration, what lacked in the current application, preventing to prove Sato's [7] principles of Teamwork and Connection and Crawford's [5] Cooperating and Transferring.

About CTL's principles, the current prototype was developed to have all of them but the multiplayer factor, not available for technical reasons. It will be included in the next, more detailed, research.

The present work is relevant to point such directions. Learning and cognition process associated with Video Games are very complex and require a step-by-step approach. The results here presented are just the first step towards a complete interface proposition. The card-based interface here used and proposed worked well, but there is always room for improvement. In fact, is possible to conclude that the room is wide. User tests can help to build a proper card interface for CTL, although the one applied here was a good start indeed.

The complexity of information and educational content can also be improved. The quality of information and evaluation methodology will be pursued in order to allow more accurate and better results to analyze.

Despite those questions, some answers were also found. First of all, Cards UI promoted a better, faster and intuitive gameplay what resulted in good game scores and information absorption. Icon UI proved to be less clear and complicated to use, even though it is the most common interface in MMOG and most players were advanced game users.

Icon UI players, however, learned more during the process. While is known that it is not related to the interface because the before-game test was not influenced by UI, it's matter that needs attention in the future tests. The answer can help build better card elements and improve the learning curve for card-based interfaces as well.

Card Game-based Interfaces can be used in CTL games, but its format is yet to be improved.

7 Next Steps for the Research

This is a work in progress as any other research and moreover, just half of the interface development for all that is known about UI design. Much and more are yet to be done, starting with the user tests and interaction evaluation and most important, user socialization and collaboration. In the brief research here described, the multiplayer capabilities of the learning process were not observed and must be the next natural step.

In the technical side of the work, the client and server communication will be added to the prototype in order to turn

it in a proper MMOG. It was found a new hypothesis that such kind of game can promote better the CTL than other genres. Also, the gameplay will suffer a drastic change by addition of a chain quest system, which will contain the educational content associated with problem solving situations.

Furthermore, questions have been raised. Why many users did not increase their score between sections and why some had even decreased it? The exact reason why the Card Game Interface was better is not clear but to the concepts previously discussed. The nature of it must be better investigated and the interface improved for the next researches. Chance is that the answer is related to the first two questions and may present a different path to follow as well.

For now is possible to assume that some level of contextual learning can be done through a Video Game with a proper interface. Whether the game context helped or not is another question for the near future. A proper ambient will be needed for that and a narrowed target audience as well. A controlled test inside a school's computer lab may serve the purpose.

It is also possible to state that the Trading Card Interface helped to improve the scores. Better investigation on this matter along with design improvements over its elements may enlighten the hidden processes that allowed those results and point to the design and development guidelines for future games.

These results can point easily to some topics discussed before, as the principles proposed by Sato [7] and Crawford [5]. The prototype was developed with problem solving and discovery in mind, with a big world to be explored. It carried purpose, building and application but it must be admitted that it lacked the connection, cooperation and transferring principles, yet to be developed and tested.

The interface here proposed is not new in games. It is not even new in MMOG, although scarce used in history. The research has found however that it can help improve the information transferred to the user during gameplay and the future researches will follow the same direction toward better games that can also bear useful and educational data whilst entertain the player in its contextualization.

There's a lot of work ahead and here some important points became clear whilst some others appeared. The future research lays over the improvement of the prototype; the adequacy of method and approach; the application of user tests and evaluation; and a better way to contextualize educational content inside a game.

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