

# The competency building process of human computer interaction in game-based teaching

Adding the flexibility of an asynchronous format

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**Abstract - This paper builds upon the authors' previous research in which the competency building process of individuals was analyzed in a purely synchronous computer game-based teaching technology. The issue of heterogeneity of speed of adaptation to the learning tool, identified in the synchronous context, is here addressed by introducing the flexibility of an asynchronous format, in which students are given the opportunity to complete the game at their own pace.**

**Experts count game-based teaching amongst the technologies likely to have the largest impact on education over the next five years. Massively Multiplayer Online Games (MMOG) are based on multiple interactions between different humans in virtual worlds. A MMOG teaching game was created in a virtual world. Participant discourses based on written chats were collected and exploited by netnography. Visual data was filmed and analyzed by the semiotics method then compared to the discourse analysis. First results show interesting differences between synchronous and asynchronous modes, in the interaction and collaboration within and across teams.**

**Index Terms - human-computer interaction - netnography - teaching technology - virtual world**

## INTRODUCTION

Several recent studies [1][2][3] corroborate that today's students, labeled Digital Natives by Prensky [4] and Gamers by Beck & Wade [5], grew up with videogames and share special characteristics pertaining to their learning and information seeking behavior.

A study conducted by the US National Center for Educational statistics [6] shows evidence indicating that

the students who are most at risk of failure in the traditional classroom setting, also spend an average of twenty seven minutes per day more than their counterparts, using video games. Several researchers [7][8], find that the way traditional schools are organized could be disabling for some students who might otherwise thrive in a different learning environment. The New Media Consortium/Educause joint 2012 report [9] includes game-based teaching in their list of technologies likely to have the largest impact on education over the next five years.

In this context, in-depth understanding of the way competences are built in the human-computer interaction of game-based teaching technology is important. Our previous research in this area [10] provided preliminary results in a purely synchronous context. Deeper analysis enabled us to identify the rigidity of the purely synchronous format to be incompatible with the heterogeneity of speed of learning of the students performing the gaming task [10]. Hrastinski [11] asserts that an asynchronous format provides students with more control and flexibility throughout the learning process. This motivated us to add an asynchronous dimension to our study and analyze the impact of the modification on the human computer interactions of the students in our game-based teaching exercise.

## 1. Teaching in Virtual Worlds

In recent years, the education community has been paying more and more attention to Internet based three-dimensional (3D) virtual worlds (VW). VWs borrow from gaming concepts, real-world physics simulators and streaming data/audio/video technologies to provide opportunities for real time simulation, experiential

learning and collaboration in an online virtual environment [12]. KZero [13] reports there were about 1.7 billion user accounts and 280 million unique active VW users in Q1, 2012. There were 85 different virtual worlds in Q4, 2012 [14]. In the second half of 2012, Facebook also entered the 3D VW environment by launching a beta of its own VW called Cloud Party [15].

Second Life (SL), created by Linden Labs in 2003, remains among the most popular virtual worlds. It provides its users with the freedom to build their own environments [16] for their own purposes.

SL provides its residents with a wide range of interaction tools [10]:

- Written and oral means of synchronous communication including chat, instant messaging (IM), group chat, voice chat and voice messaging.
- Asynchronous means such as group notices, notecards, textures and IM to emails.

Users enter a VW as avatars, a visual representation of themselves through which they control the human computer interaction, navigating the virtual environment and interacting with other avatars [17]. Researchers have found strong correlations between the social norms and behavior of avatars and their users [18][19][20], suggesting that avatars behave similarly to the humans operating them.

## II. The teaching game

As described in our previous research [10], we used a design science methodology to build a computer game-based marketing teaching artifact [21]. We adapted a case study, described by Bal et al. [22] as “*the most potent pedagogical tool for showing marketing students the problems their discipline is able to solve*”, from a paper format into a gaming format.

The case study “Selling Green Dots in Second Life” [23] was selected (along with its teaching note) from the Harvard/Ivey library of business case studies. Nineteen distinct sections of the narrative were identified and each rendered in a graphic or ‘texture’ format which was uploaded into SL. Each note was assigned to one of 4 roles and a spreadsheet was used to track their placement around a selected SL location.

The test population consisted of 250 undergraduate students from an Australian university. They were asked to create an avatar, choose 3 teammates and undertake basic SL training. They were then assigned to one of 14x1-hour tutorial sessions during which the rules of the game were presented. During the tutorial session students entered the virtual world in teams of 4. Each avatar was assigned one of 4 designated roles. Their mission was to explore the virtual location and collect all the case notes within a week. They were free to spend as much time as they wished on performing the task. Each avatar could collect only the notes assigned to their designated role. Once each team member had gathered all their assigned

notes, they had to meet with their team members and complete the case study by sharing the collected information. Each team then developed a case analysis, agreed on a proposed solution and prepared a presentation of their findings and recommendations.

## METHODOLOGY

### I. Methodological choices

To get a better understanding of the competency building process within the VW teaching game, we used a discovery approach described in grounded theory methods [24][25][10]. We used an anthropological methodology enabling us to collect and analyze data in a natural, given social space, without exerting any influence on the studied population. An adapted observation method reinforced the coherence in our ontological, epistemological and methodological choices. We started by adapting the research tools to the virtual field in a test phase. Then we collected data by filming participant avatars as they completed the various tasks they were assigned, by observing them and by collecting chat logs of interactions that took place between the participants in the virtual world. Finally, we conducted qualitative interviews with a sample of the participants to clarify behavior that was not self-explanatory from observation alone. We then analyzed the data and compared our first results to those that had been produced during a specific control phase. Finally, a cross member check was performed at all phases of the analysis.

It is important to note that where the computer game took place in a remote asynchronous context, we were unable to film the students operating their avatars [10], focusing only on the data visible in the VW.

Consistently with past research [10], we treated visual data separately from written data, in our analysis phase: for the visual data, we used constructed grids by applying the semiotic method [26] and for written data, we used the netnography method [27] [28]. For a deeper understanding of content analysis of chats, we also used a classical content analysis methodology [29][30][31]. All these methods were adapted to the specificities of the VW environment.

At the final stage of the analysis, in order to get a better understanding of the coherence of findings coming from visual and written data, we consolidated the findings resulting from both methods, using a socio-anthropologic approach [32], through which visual and written data can be analyzed at the same time. It enabled us to build an observation grid that took into account all the important social aspects that were experienced by avatars in this particular social virtual space.

### II. Observation process

More than 45 hours were filmed and analyzed with our observation grid. It was important that the researchers

behaved like anthropologists and took field notes [32][33] without being present in the game as an avatar. The field notes were based on the filmed material and the observation process was adapted to the technology. The field notes included visual avatar behavior and chats.

During the control phase, a separate member of our research team produced observation notes. The content of these notes was analyzed and compared to the analysis based on the main data. This comparison confirmed recurrence and coherence of both steps. Finally, each result step went through a cross member check of every researcher in our team to confirm the results.

### III. Observation factors

Specific observation factors were defined by starting the analysis with a test phase, to look for emerging factors that were then taken as observation factors and applied to the whole gaming process.

These factors dealt mainly with the different types of interactions that enabled, or did not enable, competency building. The observed factors used to understand the process of competency building and its evolution are grouped under four headings:

**1. Identification of types of interaction:** First we needed to understand what kind of interaction was experienced by non-verbal avatar behavior during the game. This addressed only visual data with the question: *“What are they really doing?”*

**2. Interaction connection to written data (chats):** Next we focused on the direct connections between identified avatar interactions. We took into consideration only those chats undertaken during visual avatar interactions, applying the question: *“Is what they are saying connected to what they are doing?”*

**3. Interaction connection to the game:** At this stage, both written and observed data were integrated in the analysis. We considered: *“are - group or “one-to-one” - interactions directly linked to content exchanges about the game, or were other social exchanges experienced?”*

**4. Social exchanges contribution to competency building:** When other social exchanges were identified, we wanted to know: *“how social exchanges contribute to competency building?”*

## FINDINGS

### I. Understanding the technology

First of all, students needed to understand the different “technical” operations and means available to avatars. The first step undertaken by all avatars is training themselves on the various means of communication and navigation. We clearly observed avatars greeting one another by chat in the welcome area and some communicating with the professor avatar through chat or IM. Avatars then went through the tasks of walking, running, flying and for fast learners, teleporting.

### II. “Playing” the teaching game

Observing students participating in the teaching game enabled us to identify a succession of avatar movements and periods of immobility. Periods of immobility were generally found to be due to constraints of the technology, avatar movement had more to do with the strategies adopted by students as part of their competency building process.

During the teaching game, students “talked” exclusively through written exchanges in the form of “chat” or “Instant Messaging” (IM), both of which involved typing. Student avatars could not simultaneously move and “talk”.

#### A- Immobility:

Avatars remained motionless in the five following situations

- 1) Communication: chat communication could clearly be identified by the observer as avatars performed a “typing movement”. This generally took place when there was at least one other avatar within the 20 meters chat range allowed by the SL platform. As the game started, these exchanges took place exclusively amongst students. Along the days, an increasing number of students trusted themselves to communicate with strangers to build up their competency in the game. Here is an example of observer notes describing such a situation: *“His movements indicate that he is chatting with some people around at the pub. I can see the hands occasionally in typing mode”*. Sometimes avatars were motionless while there were no other avatars around. In some cases, immobility can be explained by one of the four following situations, however, in other cases, this immobility can be explained by communication with an avatar positioned beyond the 20 meter range. For this type of communication, avatars used IM, which does not trigger a typing movement and could, therefore only be assumed. In some cases, this type of communication would be followed by a targeted move in a specific direction, showing that the exchange that took place provided the avatar with a clear indication as to what to do next. Lastly, this type of communication could even sometimes end with a teleport to or from the avatar with whom the IM conversation took place, indicating that one of them had sent a teleport offer to the other.
- 2) Thinking: in some cases, avatars suddenly stopped, generally after having been moving

around for a while without finding any information. This stop would last more or less long and was often followed by a targeted move in a specific direction where a case note was located, indicating that the thinking process had been useful. In most cases, this thinking process could include looking at the game map that was provided to the students, and sometimes even browsing through all the case notes that had already been collected by the avatar. Here is an example of observer notes describing such a situation: *"I can see her walking, and then suddenly she stops, standing still for several minute before teleporting close to the rental office area"*.

- 3) Reading newly collected clues: after retrieving one of the case notes assigned to them, some of the students took the time to read it thoroughly to see if it included some information as to where to go next. In these situations, the observer could see the playing avatar interacting with one of the objects meant to give a case note, then standing still for a while, before moving on to continue the teaching game. This type of situation could be clearly recognized by the fact that the player was following the order in which the case notes were meant to be retrieved. Here is an example of observer notes describing such a situation: *"He arrives at the telephone booth. He clicks on it. His role should allow him to get the checklist. He stands still for a few minutes, then teleports to the SIM management office"*.
- 4) Idleness: in some cases, avatars stood still for an extended period of time before logging off or being logged off by the system. When the idleness had been going on for long, the observer could clearly see a tag on the avatar indicating him/her as "away". Here is an example of observer notes describing such a case: *"There is only [avatar name]. She has an away tag"*.
- 5) Technical issue: in rare cases, bugs can occur, when either the player's equipment is not robust enough (eg: graphic card, or RAM (random-access memory) not strong enough), or when the speed of his/her internet connection is too low. In gamers' jargon, this is usually known as "lag". In SL the player will either be seen motionless for a few seconds before being logged off, or he could be seen walking endlessly, for an extended period of time, beyond the limits of the world or through walls and obstacles before being logged off. Here is an example of observer

notes describing such a situation: *"I can see [avatar name] lagging in endless walk. He quickly crashes"*.

## B- Movement:

During the teaching game, individual avatars adopted one of the following four movement strategies:

- 1) Clueless random errand: Students who adopted this strategy moved erratically in all directions, walking or flying, rarely teleporting, generally ignoring all the case notes they were supposed to collect. In general, those who adopted this movement strategy ended up not spending much time in the game and rarely came back beyond the day of the tutorial session. Alternatively, students moved from this strategy to one of the three strategies described below, in which case, they were able to continue the game successfully. Here is an example of observer notes regarding one of the students using this strategy: *"He doesn't seem to be doing the hunt very systematically. He's now on Dublin. He walks. He flies [...] He is obviously not even looking at the map as there is nothing indicated on the map in this area."*
- 2) Fine-toothed combing: Students who adopted this strategy spent a lot of time playing the teaching game. They explored slowly and systematically every inch of the game location until they were done collecting all the case notes assigned to them. One of the students using this strategy spent 306 minutes playing the game, when the average time spent was in the 90 minutes range. Here is an example of observer notes describing such a case: *"[He] is still hunting. Was there already when I left about 2 hours and a half ago. He seems to be very eager to complete the case"*. In some cases, students started by adopting this strategy, until they understood how to read the map and teleport and moved to strategy number 3.
- 3) Hopping: Students who adopted this strategy generally played using the map that was given to them and either walked or flew or even teleported from one location to the other, where the map indicated that a case note was available. Here is an example of observer notes describing such a case: *"It is obvious that some use the map to teleport as I can clearly see them landing on the terrace of the Lord Mayor's House and that's where the map's landing point is located"*. Another variant of this situation was students who clearly followed the order in which the case

notes were meant to be retrieved, indicating that they took their inspiration from the case notes they had previously collected, to decide where to move next, then spotting this location on the map and walking, flying or teleporting there. Here is an example of the observer's notes describing such a strategy: *"[Avatar] [who was standing at the telephone booth] seems to have teleported to the SIM Management office. So she must be following the indication given by the texture, as the telephone booth texture indicates that there is some information at the SIM Management office"*

- 4) Following: Some avatars decided to trust and follow other avatars without thinking. Be it their team members, others who had the same role or some of their real life friends. Their strategy was not to take any initiative except for going wherever their colleague goes, hoping that this would help them achieve their goal. Here is an example of observer notes describing such a situation: *"one can clearly see who is a leader and who is a follower. [avatar 1] is the leader, she runs everywhere, and her team member [avatar 2] follows her, even forgetting to click on the items containing case notes"*. In some cases, those who followed this strategy only did so at the beginning of the game, before moving to one of the three previous strategies.

### III. Team strategies:

Beyond individual avatars behaviors, our analysis enabled us to identify five clear team strategies:

- 1) Team spirit: some teams decided, from the beginning, to stick together and play the game as a group. On the first day, these teams could be clearly recognized as they explored the game location all together, moving in general through teleporting, mostly because one member of the group felt more at ease with the game technology and mastered the "hopping" approach, teleporting his colleagues to the locations that he/she had identified as interesting from a game perspective. In the following days, the observer could clearly recognize some groups continuing to use this strategy that was described by one student, to the research team, later on: *"I'm using the world map, the mini map and the v2 map, then just teleporting the group to each point they need to explore. It's quicker that way and keeps us all coordinated"*.

- 2) Lonely wolf: some students preferred to adopt a strategy whereby each member of the group played the game separately. This enabled each individual team member to adopt the behavior that he/ she preferred, without being slowed down by the constraint of either having to adopt a behavior that they did not feel comfortable with, or by dragging fellow team members behind. The observer could clearly identify many students adopting this strategy, described by one of them by: *"Only takes 10 minutes when u don't have to drag team members with you"*. In some cases, this strategy was adopted by students as a first step to the team spirit strategy, whereby one player visited the whole game location, spotting where case notes were available, then logging with his team members, one by one or as a group, and teleporting them or telling them where they needed to go. Another variant of this strategy was adopted by students who asked their team mates to provide them with their log-in information then entered the game using these different identities to collect the game information. One student clearly described this strategy saying: *"I am helping out [avatar name] who was having computer trouble, my avatar is actually [other avatar name] but I collected all my info pieces already and [avatar name] couldn't log on"* or another one saying: *"hes giving me his login in a minute [...] ill just go through his inventory and then do the search again"*.
- 3) Piggy backers: some students preferred to regroup by role, playing the game with other students who had the same role and therefore could access the same information. Here is an example of observer notes describing such a case: *"I can see [avatar 1], [avatar 2] and [avatar 3] hunting together. They are all Dublin CFO"*.
- 4) Random collaboration: in some cases, students will work together in small constructions of 2, 4 or more avatars. They don't have the same roles nor are in the same teams. Apparently, these students prefer to collaborate with members of other groups because they knew each other before this teaching game. The groups building here seem to have more to do with real life experience and use this experience to build competencies in the virtual world, as a continuing social tool, rather than relying on the ad-hoc teams constructed for the game. Here is an example of observer notes

describing such a situation: “[avatar 1] and [avatar 2] are both hunting together. They are not in the same group”.

- 5) Give up: Some rare groups seem to have never adhered to the game concept. They just attempted to play the teaching game for the duration of the tutorial, mostly logging off before the end of the class and never coming back. An example of such a group played the game for an average of 25 minutes each, when the average duration was in the 90 minutes range.

#### IV. The winning strategies:

Overall, the time spent playing the game ranged from 13 to 306 minutes spread over 1 to 7 days.

From the 66 teams that played the teaching game, 8 were selected as winners, to present their results to the class. What differentiated these teams from the others was neither the length of time they spent playing the game as it ranged, on average for each winning team, from 49 to 206 minutes, nor the number of days they spent playing the game as it ranged, on average for each winning team from 1.3 to 4 days.

What really made the difference was the strategy adopted. Each winning team had a clear leader who spent at least double as much time as the rest of the team, playing the game. The role of this leader was clearly to organize the game for his/her colleagues, mostly identifying locations and either informing others, teleporting them or, in extreme cases, when there were technical or availability issues, logging in for them to perform the hunt.

Members of winning teams were either “fine-toothed combers” or “hoppers” with a “team spirit” group strategy. In general, the “fine-toothed combers” required more time to complete the game than the “hoppers” with comparable chances of success.

In some cases, the leader would start with a “lonely wolf” strategy to spot the various case note locations, before letting the “team spirit” take over and share this information with his/her team mates.

#### DISCUSSION AND IMPLICATIONS FOR FURTHER RESEARCH

In this study, we analyzed the evolution of visual and communication discourses along human computer interaction in a computer game-based teaching technology. Our findings show that, depending on their level of comfort with the technology as well as on the type of strategy they choose to follow, students require very different lengths of time to complete the teaching game with comparable chances of success.

This research builds upon previous research [10] where the teaching game was played synchronously by all students and highlighted that the speed of learning was

very heterogeneous amongst students and therefore, an asynchronous dimension, allowing more flexibility, might be more appropriate.

Our analysis shows that the a-synchronicity enabled students, who wanted to spend more time playing the game, to do so, giving a fairer chance for all participants to reach the level of expertise required to achieve better results. It also clearly allowed students to choose the strategy that better suited their needs, the chosen strategy being the real differentiating success factor.

It is worth mentioning that netnography [27][28] was less useful to the research in the asynchronous version of the game than it had been in the synchronous version, as available text communication was incomplete: clearly, lecturers were neither permanently around to capture all the chat that took place along the game, nor was it possible to cover the complete location of the game to always be close enough to “hear” chat. In addition, beyond chat range or for more private conversations amongst competing groups, students logically used IM, which could not be heard by the researchers.

Throughout the asynchronous version of the game, occasional technical issues appeared, that could only be solved if a lecturer was online. This clearly limits the scope of a-synchronicity to situations where either someone from the teaching team can be available or reachable within an acceptable period of time.

Similarly to our previous research, this study is limited to a marketing focused game-based teaching experiment in the three dimensional VW of Second Life, enhancing traditional case study teaching techniques. This leaves opportunities for further research work either by looking into expanding this method to cases pertaining to other areas taught in business schools, or to a comparable experiment in alternative three dimensional VWs such as Open SIM or Facebook’s Cloud Party [15]. Further research could also look into conducting the same type of analysis in the context of other types of game-based teaching technologies.

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