

An Exploratory Study in the Use of Gamer Profiles and Learning Styles to Build Educational Videogames*

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When designing and developing Educational Games, the educative and ludic values they provide should be balanced. Teachers have the knowledge on designing the best learning/teaching strategies, but they are not videogame designers who know the best mechanics to engage people. Under this perspective, this paper details a proposal to develop Adaptive Educational Games that uses adaptation rules that take into account Gamer Profiles to engage students in the use of the educational tool and Learning Styles to help the system to determine the teaching/learning methods, learning-objects and learning-services that best suit each particular student. In addition, we show the exploratory case study that we developed on an Adaptive Educational Virtual World and we analyse the obtained initial results. These results show that, although most of users affirm that the provided adaption rules were right, some preferences on their Learning Styles changed due to the Virtual World features.

Keywords: educational virtual worlds; adaptive systems; gamer profile; learning style

1. Introduction

Primarily geared to entertainment, the use of games for educational purposes is common [1–6] because they offer to the students the opportunity to explore and to make mistakes, and in this way, to learn from them, reach greater experiences and achieve the learning objectives [7, 8]. These games used to develop students' skills and to acquire knowledge are known as Educational Games (EG). They provide an excellent opportunity for teachers to implement student-centred learning methods, where students are immersed in an active learning process through their experiences. Moreover, to give the user a sense of presence, some of these EG are built as scenarios created through Virtual Worlds. In addition, when joining EG together with Adaptive Educational Systems (AES) [9], they allow content and scenario adaption according to prior knowledge and learning objectives for each specific user profile. The result of this synergy is known as Adaptive Educational Games (AEG) [10].

In spite of their advantages, when addressing the development of an EG, it should be taken into account the main challenges that may cause its success or failure. In particular, the educational and entertainment values should be balanced in the design stage [11]. These two factors are critical for the success of the game, because if students do not fun they will abandon it, and if the game is exceedingly entertaining (too playful) the educational value may decrease.

Nowadays, there are a lot of platforms for

designing 3D Virtual Worlds that allow developing and deploying EGs. Among them, we can mention Active Worlds [12], Second Life [13], OpenSim [14], OpenCobalt [15] and 3DVIA Studio [16]. However, all these platforms are generalists and they require some technical knowledge and programming skills. Fortunately, we can also find platforms specifically designed to develop EGs in 2D. This is the case of e-Adventure [17–19], a platform that allows developing conversational adventures, one of the most suitable genres for the development of EGs [8, 20, 21]. Moreover, e-Adventure has even been used to develop AEG [22]. Because e-Adventure is aimed particularly for teachers, no technical background or programming skills are necessary [18, 19]. However, it continues leaving the difficult task of designing the game on the hands of the teacher, who ultimately is responsible for the success or failure when defining both the game elements and mechanics that motivate the student as well as the teaching/learning method to use.

To achieve an easily manageable solution for teachers without any technical skills or game design knowledge, we propose to perform a process adaptation according to two kinds of profiles for the students, namely: a Gamer Profile to capture students' interest in the use of the EG; and a learner profile based on Learning Styles to adapt the learning process to each specific student, and thus help to determine the best teaching/learning method to use as well as the learning objects and services that best fit each particular student. Merging these two profiles with platforms specifically designed for

teachers without a technical background, a whole framework for the implementation and deployment of AEGs will be available.

In order to explore the viability of our approach, we have performed an exploratory case study. Thus, We computed the corresponding profiles for some students and preliminarily check the perceptions they notice while performing a learning activity within a 2D Virtual World.

The structure of the rest of the contribution is as follows: in section 2 the main kinds of Gamer Profiles are described; section 3 briefly examines the Learning Styles model we use; in section 4, the proposed adaptation process is detailed; section 5 explains in detail the exploratory study we performed in order to check the viability of our approach; section 6 gives a discussion about the obtained results; finally, section 7 concludes with some final comments and points out the future work.

2. Using Gamer Profiles to cause motivation

As mentioned above, in order to motivate students and prevent neglect, apathy and disinterest situations during the learning process, we propose to use Gamer Profiles. In this sense, there are not many proposals about user models and guidelines. In this context, the most widely used model is the one defined by Richard Bartle [23, 24], who identified four Gamer Profiles based on users' behavioural patterns in a multigamer online game. Bartle noted that every gamer is mainly focused on specific interests within the game, namely: achievements, explorations, socializing with others and imposition to others. Based on this, Bartle outlined a typology by identifying four Gamer Profiles that can be summarized as follows:

- *Achievers*: they earn achievements and points. Their main objective is to seek to reach the highest level in the game. For this type of gamer, it is important the hierarchy within the game and the speed with which they can achieve the status. They can perform exploration, socialize or impose in the game, only in order to earn more points and to achieve the goals of the game.
- *Explorers*: they seek to discover and understand how things work, looking for surprises that can be carried out throughout the game. They seek the secrets that serve as a knowledge base for other gamers. They can perform actions of other sort of Gamer Profiles only to change the settings or level in order to continue their main goal, i.e., the exploration.
- *Socializers*: they are interested in communicating

with other gamers. The inter-gamer relationships are important to them. They are proud of their friendships, their contacts and their influences. They can perform the actions of other kinds of gamers when looking to improve their social relationship within the game.

- *Killers*: they usually try to disrupt other gamers' game and try to impose to them. They seek dominance over other gamers and feel proud of their reputation and skills, which are often shown in battles. They can perform the activities proper of other type of gamers in order to wreak havoc on the game.

The above profiles emerged from a two-dimensional analysis according to pairs of interests in the game: Action-Interaction and Gamers-World. The first dimension is associated with how the gamers act with objects/people within the Virtual World, while the second is related to what receives such action within the Virtual World [23].

According to these two dimensions, Bartle identifies that: *Achievers* are interested in acting on the world, making the game actions in order to master it; *Explorers* are interested in interacting with the world; *Socializers* are interested in interacting with other gamers and somehow communicate with them to make friends; and finally, *Killers* are interested in acting on other gamers, interfering or taking actions that might disrupt them.

When using this model within an educational context, it is interesting to notice that only *Achievers*, *Socializers* and *Explorers* profiles would accommodate, but not *Killers*. Therefore, while designing the EG, we must take into account only the first three kind of gamers. Nevertheless, although not necessary during the design process, it could be interesting to identify the *killer* type, because they are those users that are not really willing with the learning task neither the educational tool.

Starting from the Bartle's model, some other proposals have raised. In particular we can be highlighted the Social Engagement Verbs proposed by Kim [25] and the Marczewski's Gamification User Types [26].

Thus, on the one hand, the Social Engagement Verbs model [25] associates verbs to each kind of gamer. Particularly, this model distinguishes four kinds of gamers depending on what they prefer to do within the game: *Express*, *Compete*, *Explore* or *Cooperate*. Thus, it can be identified the kind of gamer according to the actions they choose to perform in the game. Later, based on these four main verbs, Kim proposes a list of some related verbs that allows classifying potential gamers. Particularly, those who *compete* also like *win*, *beat*, *brag*, *taunt*,

challenge, pass, fight, etc.; those who *cooperate* use to *join, share, help, gift, greet, exchange, trade*, etc.; those who *express*, prefer to *choice, customize, layout, design, dress up, showoff*, etc.; and those who *explore* also seek to *view, read, search, collect, complete, curate*, etc. In addition, according to her approach, Kim redefines the Gamer-World dimension from the Bartle's model by Gamer-Content, in order to reflect what receives the action performed by the gamer. In addition, the Killer gamer is removed and substituted by a new one who *express*.

On the other hand, also based on the Bartle model, the Marczewski's Gamification User Types [26] model can be seen as the more complex by extending the previous one. According to what their motivation is, Marczewski identifies six gamer types, namely: *Achievers* motivated by mastery, *Socializers* motivated by relatedness, *Philanthropists* motivated by purpose, *Free Spirits* motivated by autonomy, *Players* motivated by rewards, and *Disruptors* motivated by change. Among them, the *Player* type is the more willing to play, *Disruptor* is not willing to play at all, and the rest are more or less willing to play because their motivations are not related directly with the game. Starting from these gamer types, Marczewski extends the *Player* and the *Disruptor* user types in four subtypes each one. He even proposes a set of game mechanics to use when gamifying an application according to each user type.

The main drawback for the Kim's and the Marczewski's proposals is that they have no solid empirical evidences that proves its validity, and this is the main reason why the Bartle's model keeps been the base. Accordingly, taking into account the Bartle's Gamer Profiles, we have the necessary elements to ensure that students are encouraged to use the EG, because it is more attractive according to their preferences as gamers.

3. Using Learning Styles to adapt the learning process

A widely accepted definition of Learning Style is the "*cognitive, affective, and physiological traits that are relatively stable indicators of how learners perceive, interact with, and respond to the learning environment*" [27]. Such is its influence in the learning process that *if the teaching strategy is matched to the same type of Learning Style, the student will learn more quickly and retain the information form longer* [28], and, as Felder points out, those students who have a strong preference for a specific Learning Style may have difficulties in the learning process if the learning environment is not suited to them [29, 30].

Thus, taking this idea into account, in order to adapt the learning activities flow as well as to

determine the best suitable content to display for a specific student, we propose to add features to model the Learning Style in the user profile.

Although there are several broadly used models and we can find lots of reviews in the state of art [31–33], in this particular paper we make use of the Learning Styles proposed by Felder-Silverman [29], [30], which is one of the most used in Adaptive e-Learning Systems [33]. The Felder-Silverman model identifies five differentiated dimensions. These dimensions provide insight into how students prefer to organize (inductive/deductive), process (active/reflective), perceive (sensing/intuitive), receive (verbal/visual) and understand (sequential/global) new information. This way, Learning Styles indicate the students' preferences for the different ways the information can be presented, accessed and processed. For example, some students capture better the information in a sequential way, i.e., step by step, while others prefer to access the same information in a global way regardless of the details. According to this, from the adaption point of view we can use the guidelines provided by Felder-Silverman [30] and Felder-Solomon [34].

Thus, *active* students learn better by working with the learning material, applying and trying things. They are interested in communicating with others and prefer to learn by working in groups where they can talk and discuss what they have learned. Meanwhile, *reflective* students prefer to study and work alone. *Sensing* students have a predilection for learning facts, using their experiences on particular facts as the main source of information. They seek to solve problems with standard approaches and tend to be careful with details. They are considered realistic, sensible and practical, and they like to relate what they have learnt to the real world. Opposite, *intuitive* students prefer to learn abstract concepts like theories with general principles. They like discovering possibilities and relationships, and tending to be more innovative and creative. Regarding the format data is displayed, *visual* students always prefer and will better remember the information they have seen in pictures, sketches, diagrams, graphs, etc., unlike *verbal* students who prefer textual information, whether or not it is written or spoken. Considering the way information is understood, *sequential* students choose incremental steps, having a linear progression in the learning process. They tend to look for logical and structured solutions to any raised problem. However, *global* students use a holistic thinking process and they learn by doing large jumps. They seek an overview to the problem, do not look at the details, and are able to solve complex problems with innovative solutions; however, they have difficulties explaining how they have done it.

With these Learning Styles, we have the necessary elements for students to obtain a better use of the teaching materials provided to them, being more productive the teaching/learning process.

4. Describing the adaption process

To facilitate the task of designing the adaptation rules and their subsequent implementation in the AEG, the simplest and most common way is to use Event-Condition-Action (ECA) rules. That is, triggering certain events in the system (either directly by users interaction or not) is subject to a condition, and some action is executed according to its fulfilment [35, 36].

Thus, the values of such conditions associated with events can force the users in the game to overcome challenges and levels, guide them through more appropriate alternative paths according to their profile, include or remove items on the scene, etc.

As introduced in the previous sections, what we propose is to address an adaptation process from two perspectives. On the one hand, this adaptation should allow motivating the user in the use of these kinds of environments, avoiding situations of neglect, apathy or disinterest while using the educational tool. On the other hand, it must facilitate the user's learning process.

According to this, the proposed adaptation process is the one detailed in Fig. 1. Initially, students must fulfil two questionnaires: one to determine the Learning Style according to Felder-Silverman [29, 30] and another one to determine their Gamer Profile based on the classification proposed by Bartle [23, 24]. With the results of these initial questionnaires we have a user model that considers

both profiles. Specifically, on the one hand, to obtain the Learning Styles we use the Index of Learning Styles Questionnaire defined by Felder and Soloman [34], which is available at <https://www.engr.ncsu.edu/learningstyles/ilsweb.html>. On the other hand, we use the test defined by Downey and Andreasen [37] to identify the Gamer Profile, which is freely available at <http://www.andreasen.org/bartle/questions-en.dat>

With the information gathered from these questionnaires, the adaptation is performed in two steps. The adaptation rules defined for the initial setup of the AEG are similar to the specified in Fig. 2. As we can see, a first adaptation will cause the AEG presents a specific scenario according to the student's Gamer Profile, i.e., there will be a default game set up based on each Gamer Profile. Each scenario must be designed so that it has available those game elements that best define each gamer type, this way, their interest in the use of the tool is taken.

Accordingly, in order to implement the “*set_-scene*” part of the adaption rules of Fig. 2, while building the virtual scenarios we must introduce the corresponding gaming mechanics, and follow recommendations like those provided in [23, 24, 26] to introduce gamification in learning environments. As some example applications of game mechanics applied to educative environment we can mention [38–40].

Thus, as general gaming mechanics, the environment should provide progress panels to give user feedback, introduce a narrative story to involve the users, maintain curiosity and mystery to motivate and encourage them, create time pressure with a schedule, give rewards and badges based on actions and events, etc. Later, specifically for *Achievers*,

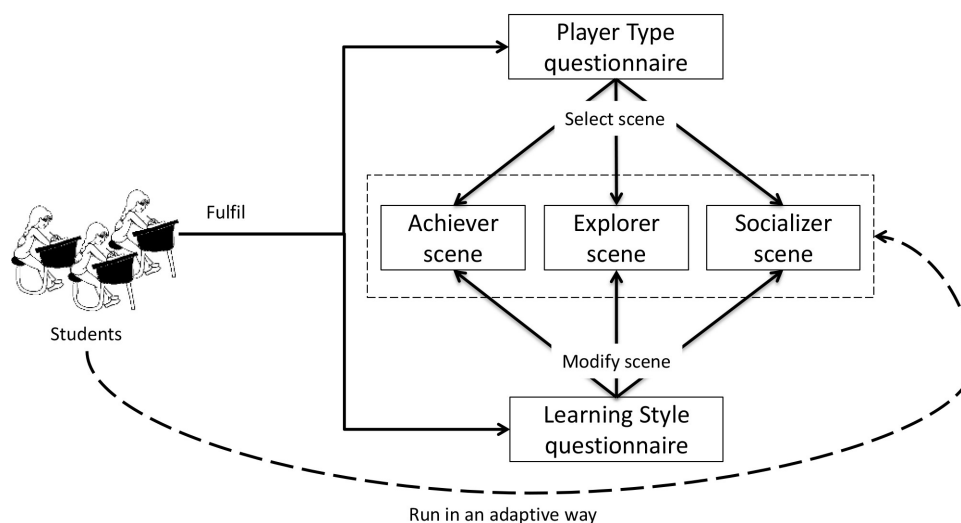


Fig. 1. Adaptation process in an Educational Game using Gamer Profiles to select the scenario and initial settings, and Learning Styles to suit the Learning Style.

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IF (profile == socializer)
THEN
    set_scene (socializer);

    IF (processing == active)
    THEN active_services (work in group);

    IF (perception == sensory)
    THEN show_information (facts);

    IF (input == verbal)
    THEN highlight (textual learning objects);

    IF (understanding == global)
    THEN active (map);

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Fig. 2. Simplified template of an adaption rule for scene selection and the corresponding activation of learning objects and services.

challenges and a sense of progression through levels should be introduced, as well as leader boards, so that they can compare their achievements. For *Explorers*, a lot of extra-information, tips, and concept interrelations should be provided (inherent to the learning nature of the environment). For *Socializers*, we should include collaborative features to offer the user the possibility of communication among them, in order to allow game mechanics like building social networks, get social status, facilitate social discovery, feel social pressure and competition, sharing knowledge, etc.

Going back to our explanation with Fig. 1, after leading the users to the corresponding scenario according to their gamer profile, we perform a second adaptation by altering the previously selected scenario to enable, show or highlight the learning objects and services it contains, according to the values that the students present depending on the dimensions related to their Learning Styles.

To implement this part of the adaption rules (“then” part of rules in Fig. 2) we must follow the indications given by Felder et al. [29, 30, 34] to better fit the Learning Style. Thus, students that process information in an active way will prefer do to learning activities and work in-group, rather than reflect about the activities and work individually, which is adequate for reflect students; intuitive students better perceive abstract information, and in the opposite, sensing students will prefer real facts; visual students will prefer graphics, diagrams, charts and so on, rather than text and lectures, which is the preferred by verbal students; and sequential students need gain understanding in linear steps against global learners that needs to perform jumps and randomly connections.

As we can see in the adaption rule shown in Fig. 2, we highlight, show or activate those contents and services that the students better prefer according with their Learning Style, but we do not hide or deactivate the learning content that does not fit their preferences. This is because, on the one hand, sometimes it is really difficult to find more than one

alternative for the same learning content, and on the other, the learning preferences can be affected by users’ emotional moods, social context, etc.

Using this kind of adaption rules, we try to ensure that students are encouraged to use the AEG, because it is more attractive according to their preferences as a gamer, and also, we allow them to obtain a better use of the teaching materials.

5. An exploratory study

5.1 Case outline

In order to explore the viability of our approach, we performed an exploratory study to check the user perceptions while performing a learning activity within a 2D Virtual World. Thus, we built a tourist-educational Virtual World where users learn topics about specific locations. The Virtual Worlds have been built with scenarios implemented with e-Adventure, where the learning experience changes depending on adaptation rules as previously stated.

In our study, 15 volunteers from Ecuador with an age range between 25 to 30 years participated. Initially the user profiles were computed for the participant by collecting their Gamer Profile and Learning Style by using the questionnaires indicated in the previous section. Then, each participant was directed to the scenario that best fit her preferences according to her user profile as a gamer. Later, the corresponding set of adaptation rules was triggered according to each user Learning Style. Finally, the level of acceptance about the adaption rules was evaluated for each user.

5.2 Brief description of the game scenarios

The game is a first-person adventure where a tourist arrives to Ecuador and looks for a travel agency for a tour. In the travel agency, the users fulfil the tests. With the most stood out Gamer Profile, a scenario is assigned looking for motivating the users to continue the activity and so discover the city. Once in the specific scenario, the users must make a little tour where they will learn the history and culture of the city. The way the information is presented, agrees their Learning Style. At the end of the tour we try to check users’ perception about the adaptation rules.

It was really difficult to identify a learning scenario that takes into account every Gamer Profile. Therefore, since we wanted to check the perceptions students noticed while performing a learning activity within a 2D Virtual World, we created distinct scenarios with different learning content. Thus, the three different scenarios were as follows:

Scenario for Achiever: It is a tour made by the Ecuadorian coast called the “Route of the Spondy-

lus". The educational content of this scenario is about the "*spondylus princeps*" seashell, known by Incas as the "*red gold*". The script within the Virtual World is about the legend that tells that the Spaniards, knowing that the natives used these shells as currency, collected and exchanged them by gold. In pre-Columbian culture, this shell symbolizes the great respect Incas had to nature and their gods, governed by the Pachamama (Mother Earth) and Inti God (God Sun). Today it is known that the appearance of this mollusc was a sign about the rains caused by El Niño.

This scenario motivates the players to act on the world by manipulating elements and performing actions. The players must achieve individual goals interacting with game activities like solving puzzles and crossword, improving time to give a better solution compared to other users, etc. The game will give a badge with every reached achievement. These badges give a perception of symbolic status to the players.

Scenario for Explorer: It is a journey through a lake in the Ecuadorian highlands, where the gamer is given a GPS, a map and all the information to make a trip around the lake and to know its landscapes. The adaptation on this scenario allows the users to use tools like the map, the GPS, etc. until they reaches certain goals, such as searching hidden puzzles whose solution is only reached with the knowledge acquired during the exploration. The educational content of this scenario is about the formation of the *Cuicocha* lagoon and volcano, the information about the flora and fauna that exists in that area. The script is based on an Andean legend about the place, which tells that Inca shamans used the lake for rites since the gods bathed in there.

This scenario motivates the player to interact in the world using a leaderboard with the percentage of discovered secrets found in the scene. The *explorer* player must not only to reach the end of the game, but also to discover all the hidden doors in the scenario. With each found door, the gamer earn points that can later be exchanged by virtual goods (e.g. a virtual key for another door).

Scenario for Socializer: It consists of a visit to a town in the Ecuadorian highlands, which is very popular among tourists for its waterfalls and adventure sports. The scenario begins in a bar where users can find other players to do the trip with. The adaptation in this scenario is based on giving the users a chat service, so that they can socialize with other players who are in the same scenario, creating situations where they need to use the chat to overcome challenges. The educational content is about the origin of the city of "*Baños de Agua Santa*", the formation of waterfalls and the importance of this city as a neutral place for refugees from the civil war

that occurred in the middle of the nineteenth century.

This scenario motivates the player to interact with other players. The goal of the game is to allow creating relationship between the players to promote the opportunity to share ideas. Players earn points for each new inter-player link and information exchange. In addition, the earned points can be exchanged for virtual goods like badges, and after obtain some specific badges, the membership to an "elite" group can be gained.

As we can see, there is no scenario for the *Killer* Gamer profile because it has no sense in an educational context.

Later, as previously described, once the player is engaged in the corresponding scenario, the system first display and highlight the educational content according to the user Learning Style preferences. Next section will detail the profiles we computed for the enrolled users.

5.3 Computing the user profile

Table 1 details the Gamer Profile and Learning Style computed of each user. As can be seen, the percentage of Socializers is very low compared to the vast majority of *Achievers* and *Explores*. Meanwhile, we can note that there is a predominant Learning Style: *visual-sequential-sensory-active*.

Because the Bartle test provides values between 0% and 100% for each type of gamer, to select the appropriate scenario we take the predominant one for each specific user (shown in bold in the table). Since the Felder-Silverman model is used to identify the Learning Style, we obtain values in the range $[-11, 11]$ for each dimension. The adaptation rule shall apply only where there is a clear trend to one end of the corresponding dimension. However, when a moderate value is obtained in a certain dimension, i.e., a value in the range $[-1, 1]$, the system does not consider discriminant either ends of the scale and so it highlight to the user that learning material and services associated to both ends.

Taking this into account, for example, user 15 has a predominant *Socializer* Gamer Profile and his Learning Style is *visual-sequential-sensitive-active*. With this profile, she was assigned to a Socializer scenario where the learning experience implies to work in group, the presented content is based on facts, she must use a maps containing graphs and figures, the challenges in the scenario (puzzles) must be performed in sequential order, and additionally for this specific profile a chat service is presented.

5.4 User preferences within the virtual environment

After finishing the activity, each user was asked to indicate which items within the virtual environment

Table 1. Computed Gamer Profile and Learning Style for each user

User	Gamer Profile			Learning Style							
				Process		Perceive		Receive		Understand	
	Achiever	Explorer	Socializer	Act.	Ref.	Sen.	Int.	Vis.	Ver.	Seq.	Glob.
1	80.00%	26.67%	33.33%	-9		-11		-7		-11	
2	53.33%	40.00%	46.67%	-3		-1		-5			1
3	60.00%	27.67%	53.33%	-3		-3		-1		-5	
4	73.33%	40.00%	13.00%	-5		-3		-3		-9	
5	60.00%	26.27%	20.00%	1		-5		-7		-3	
6	67.67%	46.67%	20.00%	-3		-3			1		1
7	53.33%	67.67%	13.33%		5	-5		-3		-3	
8	46.67%	53.33%	33.33%	-1		-5		-3			1
9	40.00%	53.33%	40.00%		1	-1		-5			1
10	53.33%	60.00%	46.67%	-7		-3		-5		-7	
11	60.00%	66.67%	26.67%	-5		-3		-5			1
12	46.67%	53.33%	26.67%	-11		-7		-7		-7	
13	33.33%	66.67%	33.33%		3	-5		-7		-5	
14	26.67%	60.00%	66.67%	-5		-9		-5		-7	
15	60.00%	40.00%	66.67%	-5		-11		-5		-9	

Table 2. User preferences within the Virtual environment (✓ match; ✗ not match; ≈ in the acceptable range)

User	Gamer Profile	Learning Style								Tolerable Matches
		Process		Perceive		Receive		Understand		
		Act.	Ref.	Sen.	Int.	Vis.	Ver.	Seq.	Glob.	
1	Achiever	✓		✓		✓		✓		4/4
2	Achiever	✓		✓		✓		≈		4/4
3	Achiever	✓		✓		✓			✗	3/4
4	Achiever	✓		✓		✓			✗	3/4
5	Achiever	✓		✓		✓		✓		4/4
6	Achiever	✓		✓		≈			✓	4/4
7	Explorer	✗		✓			✗		✗	1/4
8	Explorer	✓			✗	✓			✓	3/4
9	Explorer	≈		✓		✓			✓	4/4
10	Explorer	✓		✓		✓		✓		4/4
11	Explorer		✗	✓		✓		≈		3/4
12	Explorer	✓		✓			✗		✗	2/4
13	Explorer		✓	✓		✓		✓		4/4
14	Socializer	✓		✓		✓			✗	3/4
15	Socializer	✓		✓		✓		✓		4/4

were more useful or favoured, i.e., the users must indicate their preferences for the educational material included within the virtual environment.

Table 2 shows the user preferences gathered by asking the participants after performing the experience. The Gamer Profile column shows the dominant dimension. In the corresponding dimensions

for the Learning Style, the preference for each user in the corresponding dimensions is indicated.

In the table, we have marked with a *check* (✓) those preferences that matches with the computed profile, with a *cross* (✗) those preferences that do not match, and with an *approximately equal* (≈) those preferences that do not match but the computed

user profile is within the moderate range and thus it has not been considered as discriminant, i.e., a value in the range $[-1,1]$.

In order to verify the matching between the preferences from Table 2 and the profile determined with the initial questionnaires and shown in Table 1, the last column shows the number of matches. This way we can check if the adaptation rule, fulfilled the same goal within the virtual environment.

Thus, we can see matches for all dimensions of users 1, 2, 5, 6, 9, 10, 13 and 15. These results show that the proposed adaption was appropriate. It is interesting to notice that user 2 and 9 prefer a global understanding instead of sequential. In these cases, for moderated values (those in the range $[-1,1]$) the system did not consider discriminant either ends of the scale. It looks that it was the right decision, because the tendency within the virtual environment for those users was different than the computed with the questionnaire. During the experience, all these users were satisfied with the environment, the learning objects and services provided, the puzzles to solve, the grants, the gadgets, etc.

For users 3, 4, 8, 11 and 14 it looks that the adaption is acceptable with 3 out of 4 matches. While interviewing these users, they prefer a more global understanding rather than sequential within the Virtual Environment.

However, there was one case (user 7) that was not comfortable at all with the adaptation, and that was reflected in these two tables. The user profile obtained with the questionnaires does not fit the user preferences. Although the user was a volunteer, she showed no interest during the experience, the suggested adaptation seemed bore her and the learning experience did not achieve the goal.

6. Discussion and future works

As both Bartle [18] and Felder [20] mentioned, not always the adaptations according to user profile will be the most appropriate because Gamer Profiles and Learning Styles could be influenced by the user mood, and therefore their preferences may vary. Moreover, EG can make the peculiarities of the environment influence the learning process and even depend on the game playability [41–44] and usability [41, 45–48].

These can be the reasons why those users with verbal perception prefer *visual* elements, and those with a sequential understanding opt for a *global* experience. Users perceive the virtual environment for fun, but not as an educational tool, forgetting the perception about themselves as learners, and that led them to answer the questionnaires in certain way.

In spite of the results we have obtained through

this exploratory analysis, the extrapolation and generalization are really limited. Thus, we are working on our next research step to perform an experiment to obtain strong results. This implies to have a control group and an experimental group with enough users so that we can obtain results with statistical significance.

In addition, although it is difficult to identify a unique environment where implementing game mechanics for every Gamer Profile and to provide learning content for all the Learning Styles, we are centring our effort in the design of a unique virtual environment rather than one for each Gamer Profile. To do so, we are taking into account that exploration is in the nature of the learning process itself, that collaborative learning processes can be used in several learning contexts and subjects, and that achievements and goals are essential parts of the assessment and evaluation process in every academic subject.

Hence, by gamifying specific instructional designs and using a virtual environment that suits playability and usability principles for eLearning systems, we will have the framework to develop a deeper experiment to be able to obtain more generalized results.

7. Conclusions

Educational Games and Virtual Worlds look to be good frameworks to build Adaptive Educational Systems. However, even using development platforms designed specifically for teachers without a technical background, it is necessary to achieve an easily manageable solution for those teachers without any technical skills or game design knowledge. Therefore, our aim is to identify those elements that capture students' interest in the use of educational tools as well as to determine the teaching/learning strategy and the learning objects and services that best suit the learning process for each particular student.

Thus, in this paper we propose to perform an adaptation process according to the Gamer Profile to capture students' interest in the use of the Educational Game, and a learner profile based on Learning Styles to adapt the learning process to each specific student.

In order to explore the viability of our approach, along the paper we detailed an exploratory study where we computed the corresponding profiles for some users and preliminarily check the perceptions they noticed while performing a learning activity within a 2D Virtual World.

This preliminary experience points to the fact that using Educational Games and Virtual Worlds as educational tools can make the peculiarities of the

environment influence the learning process. The Gamer Profile seems to be useful in identifying the scenario where students feel most comfortable. However, once there, students appear to prefer visual elements and to favour an experience more typical of a global understanding, independently their Learning Style.

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