Abstract

The design of teaching contents and learning methodology in the formal and non-formal education systems is not a new aspect anymore but it becomes a challenge in the context of e-learning, blended learning or in educational games supported by innovative technology. The present paper describes the development of RePlay, an interactive 3D gaming platform, used as an instrument for psychological counselling for children with a low level of antisocial behaviour. The structure of the paper consists of two main parts. The first part of the article is entirely dedicated to the description of the guiding principles in designing RePlay's content and strategies used for setting the game's target group. It contains a presentation of Global Success Theory [1] on which the entire process of game content development is relying and an overview on antisocial behaviour in parallel with the description of stages and procedures used in setting the target group of this gaming platform. Also, this first part contains a description of the game activities and their content. Within the second part of the article, along with a description of installation and use requirements, are presented the software and hardware components within RePlay platform, emphasising on the innovative aspects of the implemented technology. RePlay is a result of three years interdisciplinary co-operation of a team involving specialists in psycho-pedagogy and engineers. Given its results the RePlay project was chosen as a successful showcase among FP7-ICT projects.

Keywords: Serious games, content design, interactive environment.

1 SHORT PRESENTATION OF “REPLAY” PROJECT

By the end of 2010 an interdisciplinary team with members working in academic, non-profit area, respectively industry, finalised "RePlay", a FP7-ICT project which was chosen by European Commission as a successful showcase given the innovative technology integrated in the final result, for the strategy proposed to support counselling sessions and the efficient collaboration among members of the consortium as well.

The project aimed to design and develop an innovative strategy to support psycho-pedagogical counsellors in schools, during the evaluation process of decisions that youngsters with antisocial behaviour (ASB) take in certain situations and also, to offer an attractive tool to facilitate interactive psycho-pedagogical counselling sessions. The final result was a fully functional 3D gaming platform integrating the following instruments and technologies:

1. 3D Video Game with multimedia content/scenarios psychologically related to ASB; these contents are organized in six main educational activities different from a play session to another;

2. Interactive and wireless balance board for game control;

3. A range of interactive systems for playing sessions (wireless trackball, joystick, keyboard);

4. A user recognition system designed to improve the way user interacts with the system and to increase the level of implication;

5. Questionnaires and observation forms for counsellors/ psychologists.

The guiding principles in developing the content of the game and the components of the platform are described in two sections of this paper. One section presents the psycho-pedagogical fundamentals of the game scenarios and the strategies used to achieve end users’ expectations regarding the game content. The other section describes software and hardware development process and the innovative characteristics proving platform’s technical importance.
2 PSYCHO-PEDAGOGICAL FUNDAMENTALS ON GAME SCENARIOS

For nowadays youngsters, considered to be ‘digital natives’ [2], new technologies including gaming technology are very popular. Besides their entertainment roles, gaming technologies brought new perspectives for education and its paradigms through the serious games [3,4] which are designed based on educational objectives. Serious games started to be used widely in teaching and learning situations, some of them being part of formal curricular settings [5] and also used as therapeutic tools in counselling [6,7].

The content of the RePlay game and the software development would not have been possible without the valuable input brought by the RePlay team members with expertise in psycho-pedagogical counselling. The valuable support brought by these members established the guiding line for game’s scenarios which are theoretically based on the Global Success (GS) theory [1] and practically, on the results from the focus groups organized during the first stage of RePlay project, on the data collected through surveys and interviews involving teachers, experts in ASB and of course, youngsters which are the end users of this game.

Because the GS theory claims the importance of the interaction between several dimensions (see Fig. 1) from an individual’s life environment, interaction that influences his global success, the members of the project team considered it as basis for the game’s framework.

According to GS theory [1] the interdisciplinary project team elaborated the contents of the game. These are dilemmatic situations during which the users of the game have the possibility of saying “no” in different circumstances, emotions control contents which require association of images with different emotions, decision taking contents which involve the youngsters in a process of analysing the positive or negative consequences of the taken decisions, contents for empathy development involving users’ ability to name emotions and finally, contents for emotions control which require recognizing emotions in different social circumstances and positive emotions association with certain concepts that describe supportive environments for reaching success.

![Fig. 1. Global Success as Multidimensional Concept [1]](image-url)
These dimensions were classified according to the following criteria:

1. Nature of abilities (general, special; intellectual, psycho-physical, academic, artistic, leadership, etc.; systematic and non-systematic developed abilities [8], multiple intelligences [9], WICS [10], emotional intelligence [11]);
2. Areas of social expression (school, family, group of friends, group of mates, hobbies etc.) in which GS can be examined through the individual’s projects, actions and results;
3. Psychological processes mainly involved (cognitive: sensations, perceptions, representations, thinking, intelligence, imagination, memory, language, intuition; affective; motivational; volitional; courage [12]; personal talent [13]);
4. Factors of ability development mainly (hereditary, social environment, formal, non-formal and informal education; chance; spiritual or religious);
5. Fields of aspiration (professional, family or social integration, etc.);

The vision of RePlay is to use gaming technology as a means of motivating young offenders into a better awareness of how and why they behave the way they do and encourage them to take greater responsibility for the consequences of their decisions and behaviour. Also, the success rate during game’s activities is a very high motivator for children. That is why it was important to recommend a theoretical framework for our game scenarios and to organize them based on the end users’ preferences, previous experiences and already known instruments. The scenarios are engaging children in different play and re-play learning sessions in order to guide and support them to go beyond their limits and be more successful.

Intending to cover GS’s dimensions project’s team settled the specific objectives for the first stage of the project as follows: identifying a range of key variables related to the rehabilitation of young people with behavioural problems and integrating them into the design of the game; defining user driven specifications and content from both categories of users (end users – youngsters on one hand and teachers and school psychologists on the other hand); defining functional specifications for software and hardware components; developing an initial prototype for testing and refinement; organizing and coordinating three test beds in three different European countries involving end users (young people) and teachers and school psychologists in order to generate user-driven feedback for application refinement; developing the protocol and tools to assess the socio-organizational and ethical impact of the RePlay technology on the already mentioned two categories of users.

2.1 An Overview on Antisocial Behaviour and Approaching Techniques in RePlay Context

As mentioned, one of the first specific objectives of our consortium was to narrow on the nature of ASB amongst children and youngsters. In this order, our research addressed:

1. Types of antisocial behaviour (ASB)
2. Identification, definition and classification
3. Classification of the causes of ASB
4. Overview on current techniques for understanding and addressing ASB
5. Estimation of the value and use of games and gaming technology for understanding and addressing ASB

The main research method used to obtain the information mentioned in the list above was the focus group, structured on the following five aspects:

- Section 1: Anti-Social behaviour (types, causes and effects)
- Section 2: How are the issues related to ASB currently dealt with?
- Section 3: The use of games and playing activities in addressing ASB
- Section 4: Activities carried out in ASB programmes
Section 5: RePlay Project - Users Reaction

Thus, in each of the three partner countries were organized focus groups with a number of 40 experts (Romania - 16, Spain - 12 and United Kingdom - 12) from different interest areas: professors from faculties of psychology and education sciences, sociology, social science, teachers, social workers, and specialists involved in youth justice/youth offending and behavioural psychologists. Another important source of information was the specialised literature on ASB. At the end of this first stage, the experts finalised a list with ASB types (see Table 1) which is not exhaustive but represents the main types of behaviours mentioned during the focus groups’ sessions. The proposed classification was made in terms of high and low level activities manifested especially in three contexts, school, home and community:

Table 1. ASB types based on the criteria level of activity

<table>
<thead>
<tr>
<th>High level activity – examples</th>
<th>Low level activity – examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>physical violence, criminal damage, abusive/ aggressive behaviour, verbal aggression</td>
<td>Non-engagement, challenging authority [14], not following instructions, attention seeking, inability/refusal to compromise or share in the classroom, lack of cooperation or manners, lack of communication, absenteeism from school, teasing and bullying [15], littering, low-level vandalism, not following rules or routines, overly competitive behaviour; behaving in a withdrawn manner; physical posturing; showing off</td>
</tr>
</tbody>
</table>

After classifying the types of ASB, our team focus shifted on developing an understanding of the main causes of these behaviours. This was a crucial aspect because it facilitated the process of correlation between the objectives of the game and real world experiences of children and young people. By having this information available, the design and development of a convincing and engaging narrative within the game, became possible [16].

Once the types and the causes of ASB established, the next step we had to make was building an inventory of the current techniques for understanding and addressing ASB. As the experts involved in the focus groups underlined, the environment and the approaching techniques used by counsellors during behavioural assessment, might induct inhibition to the subjects of the therapy sessions. An overall statement of the focus groups was that talking therapies predominate [17], which presents a practical challenge. There is, inherently, a need to record the outputs of counselling sessions. This usually happens in the most obvious way: the care professional takes notes or fills out a form as the interview progresses. This creates a negative dynamic between the professional and the young person – they may feel they are being tested; or they may feel that they are not being listened to as the person they are talking to is more concerned with completing the form; or they may feel conscious about the answers they are giving, aware as they are that everything is being “recorded”.

When we summarised the data collected during the focus groups and from the literature, the conclusion was that there are few if any tools currently available which use technology and, in particular, gaming technology within psycho-pedagogical counselling field [18]. The participants involved in the focus group claimed also that children might feel more comfortable if the talking sessions would be combined with gaming sessions [17]. The main benefit of employing gaming techniques within this context is that they can create an environment that is familiar to young people [19]. Playing a game is an activity that many young people feel comfortable with and feel is “theirs”. The simple dynamic of having a game to play reduces the formality of the situation and creates greater opportunities for more honest and direct exchanges, both within the context of the game itself and outside of it.

Although the types, causes and the approaching techniques were delineated, the project team was concerned by the issue of end users’ age. During the focus group sessions, one aspect became clear:
the most effective way to deal with ASB is to address the problems as early as possible. As a child gets older, the manifestation of ASB becomes more serious, ultimately leading to criminal activity. In addition, the effectiveness of interventions at this stage might become less certain. Also, the number of young people exhibiting lower level types of behaviour is much greater than those behaving in a more serious manner. While there is clearly an application for RePlay at any age, an overall conclusion was that a younger age group would be the best target audience for an initial RePlay prototype. Young people between 10 and 14 tend to exhibit the most pronounced “early warning signs” of potentially problematic behaviours [17]. Plus, during this age phase they are going through significant personal transitions – puberty, change of school etc. – which might lead to ASB scenes. Thus, the age group 10 – 14 years provided the initial focus point for content development.

In order to get significant results during counselling sessions, based on the focus groups conclusions and GS’s theory, the consortium decided that RePlay will address low level activity of ASB. The notion of “early intervention” became a key idea. Addressing ASB, is increasingly seen as part of a wider approach to deal with criminal behaviour. This approach is predicated on the notion that prevention is better (and cheaper) than therapy.

2.2 Value of RePlay in Psycho-Pedagogical Counselling

All dimensions of the GS [1] could be adapted by an appropriate scenario of the game and introduced on the same technological platform.

The area and the target group to which RePlay addresses are youngsters with a low level of ASB. For a success rate amongst older pupils, the game has to be attractive and not repetitive, involving motor skills, and also, to ensure data collection regarding user’ preferences on the platform and their decisions during the game.

The RePlay solution allows users to interact in a distributed gaming environment, share and exchange ideas, and cooperate with their school counsellors in pursuit of educational objectives. In this way, communication skills, the facility for mutual accountability and the abilities for social learning are the main competences aimed by this counselling strategy. The education and rehabilitation program is based on a nondirective and subliminal curriculum (the 3D game scenario contents).

RePlay project proved that the concept of interactive gaming can be used to improve learning capabilities and provide users with an opportunity to “replay” their role in society after a dysfunctional start. The technology developed provides users with a simulation in which they can learn by doing. Users are able to implement decisions, observe and monitor the impact of their decisions in a given situation and learn from the experience. As such, the gaming environment will prepare young people for the challenges they will face as active and constructive contributors in society. Moreover, the technology provides the school teachers and psychologists with a useful tool through which the counselling and rehabilitation process can be assessed and managed more effectively.

Given the potential of the technology, project RePlay also outlines a future research and development agenda in this area in terms of new gaming technologies, new contents, new assessment methodologies and new application domains.

3 REPLAY PLATFORM – SOFTWARE AND HARDWARE DEVELOPMENT

The stage of software and hardware development represented a second stage of our project and had as starting point, the information structured during the first stage of the project, already described in the previous section (see Fig. 2).
During this stage there were two distinct phases: creating and testing the first prototype followed by its improvement and finalization of the software and hardware components [20]. Both these phases were essential for finalising the product of RePlay project and generated experiences considered to be good practice examples that might be used in any project with the same objectives.

3.1 Software Development

At the end of the first part of the project, the consortium had established the types and causes of ASB as well as end users’ range of age. Also, other data upon which the conclusions were drawn and decisions regarding games’ development were taken, was generated through the interviews organized with 30 potential end users from the three countries involved in the project (Romania, Spain and UK). These interviews were supervised by the experts who deal with children and young people on a day to day basis. The main objective was to gather users’ views and opinions on a potential gaming platform for children by using semi-structured interview method.

The criteria used in selecting the participants were the age (10-14 year), gender (boys and girls) and gaming console usage. All the young people interviewed had at that time at least one video game console, although the majority had more than one (a handheld PSP or Nintendo DS-type console and a Playstation 3, Xbox, Wii-type console) at home. Youngsters’ preference on the types of games were: sports games (skateboarding, snowboarding, wrestling, basketball, football), games with routes and missions to complete, games with weapons, with shooting and action and games involving singing (more common among girls or played as a family). Regarding the interactivity feature, their preferences were on games that are played in the first person, in which they become the main characters or those where they can control or create scenarios, where they can interact with others (multiplayer) particularly if it is possible through the internet and finally, games which are challenging (have different levels of difficulty, missions, riddles etc.)

Once these data collected during the interviews, a blueprint of the scenarios and an inventory of game’s characteristics were planned. Furthermore, basic functionalities of the interactive platform and the graphic engine have been defined in order to fulfil with the main requirements highlighted by experts and users.

By confronting all the information from interviews, focus groups and literature [21,22,23,24], the consortium decided on the game main theme: a sports game where the user races a futuristic segway over different scenarios, going trough different trials and tests, with the main objective to reach new levels and to improve his/her best time. Each level has different types of routes (corridors, tunnels, labyrinths, ramps etc.) and offers the opportunity to the user to pick up different objects which might increase the speed of their character, help it to jump or fly during the race.

Starting from these details the software developers were able to design the first version of the game which included: counsellor’s interface, games menu, balance board interactive settings, graphical 3D interface, educational contents (text, images, audio). A 3D scenario through which the user can
navigate by means of the platform interaction was designed and programmed by engineers at Brainstorm Multimedia Company using an 3D engine based on Brainstorm © eStudio software. This enabled the development of a robust and well tested 3D application in approximately 12 months. The educational contents proposed by the experts in psycho-pedagogical counselling were inserted only at the end of each racing level, as youngsters’ preferences showed during interviews.

The virtual segway used in the game is hold by a sphere that just touches the ground in one point, which situation is specially suited for equilibrium mini-games where the user has to pass through a narrow corridor, or to avoid items spread on the ground. This feature and velocity is also one of the capabilities of the vehicle. It can turn and go fast, jump, break, etc. For the vehicle dynamics, equilibrium and collisions, a physics module was developed and integrated into Brainstorm © eStudio as a tool for dynamics animation. Depending on the user inputs, different forces and torques were calculated and applied to the vehicle. Gravity, joint forces, motors, and servos are calculated every frame and based on them the vehicle acceleration, velocity and position is updated.

One of the advantages and strong points of the software component is that it permits content changes by means of user menu selection. The idea was to build a modular form of the game and setup a series of high level tools and models that apply to the first level and will make possible new levels design at relatively low cost in terms of time. To do so, every text, questionnaire, event or goal followed a series of rules that made them compatible with the game core. In this way not only the game pieces were designed to be reusable during different stages and different parts of the scenarios but also new pieces (mini-games) can be created following these interfacing rules and made compatible with the game. As part of this modular design, the explanations, the questions and answers are modules written in plain text files and using common audio files (.wav and .mp3). This approach not only makes the system extensible but also it can simplify the translation to other languages and can allow modifications of the contents when needed, depending on the culture.

Even though the educational content is adaptive, the scenario numbers are limited. At the moment, we consider that this is not an impediment, given that a user will not have more than five playing sessions.

Given the fact that the platform stores users’ data, not only their preferences regarding game’s settings and customisation but personal data like name, date of birth etc., the software team focused also on the security matters. The counsellor or the expert has a user account and a password to access the data base which is encrypted. Fraudulent attempts in accessing these files are controlled by limiting the number of unsuccessful login attempts and by saving the date, time, code and erroneous passwords that have been entered, in a specific register along with other relevant data that may help uncover who is behind the unauthorized access attempts. For experts who study the evolution of every user and need to obtain information and statistics, the database system is developed to include answers from the questionnaires and the decisions taken during the scenery exploration. The users have to login every time they use the system and interaction data are recorded in the database.

Once a user is registered and had at least one playing session his/her data are recorded. Later, depending on the choices made during the game, the platform offers different content for the scenarios but strongly related to the previous sessions. One important advantage is that the game included the possibility for users to have alternative reflections on their choices (Play and Re-play). It is essential for the experts to analyze users’ the answers during different stages of the race and record the evolution they make in their process of choosing.

3.2 Hardware Development – Balance Board and Communication between Peripherals

The minimum requirements regarding the functionality of the gaming platform are a computer running at least Windows XP as OS, the usual computer peripherals (monitor, keyboard, and mouse), the balance board or a joystick. The game can also be migrated to Mac or Linux systems since the engine is cross-platform.

A big challenge for the engineers, members of the consortium, was the design and the development of a physical segway which is a balance board that helps the users to guide their avatar through the game’s levels. Considering the technical constraints and user feedback, the following platform requirements were set up: light and easy to transport, folding platform to be stored easily, flexible, robust and safe, to operate wirelessly, attractively designed. The engineers considered two
possibilities to guide the user's avatar and its virtual segway: joystick or a balance board specially designed for the game and which will be described in the subsection below.

The communication between the balance board and the host computer is carried out wirelessly, by means of a Bluetooth © interface. However, a USB link can also be used, both for communications and for battery recharging. The platform acts like a joystick that steers the virtual vehicle in the game. When the user tilts it, the avatar inside the game behaves in the same way. It has four directions of movement and captures users’ movement on two axes. The platform fosters “active play” in contrast to a classical joystick. The system forces the user to move and therefore do some exercise.

Also, it disposes of an open wireless protocol for exchanging data over short distances from fixed and mobile devices, standard for wireless communications indoors electronic devices (not only computers). It has a the capacity of self-connecting if the signal is lost and maximum communication range of 300m (outdoor), runs on batteries which can be charged via USB has low power consumption and many additional modules commercially available. A big advantage of this balance board is that the computer recognizes it as a joystick and does not require any software driver to be installed and also, it send warning signals if the sensors stop working.

![Fig. 3. Second Prototype – RePlay Balance Board](image)

There are some interactions difficult to translate from the balance board movement (jumping, crouching etc.) but the final version of the balance board has a pressure sensor implemented which detects these moves. Besides the tracking elements, the accelerometers placed inside the platform detect the tilt at every instant. In order to track their movements, the users can wear an optical trackable t-shirt that translates their body movements into events in the system. Given the fact that RePlay is a dynamic game during which the user moves a lot, the intensity and trunk’s direction can be tracked by using this t-shirt. The intensity of the moves could be another indicator regarding user's behaviour and by using this trackable t-shirt the intensity can be recorded and transformed in values which can help assessing youngsters’ temperament.

For the tasks where the user must select from different menu options, answer questions or simply manage the game there was needed a mouse as interaction element. As it was difficult to manage a mouse once on the platform, a trackball has been selected to be placed on top of the handle bar.

4 CONCLUSIONS AND FURTHER WORK

One of the challenges of RePlay project was to bring together and facilitate collaboration under an educational purpose, between organizations from the academic, non-profit and industry fields. The expected result was a commercial off-the-shelf [5] game which covers a niche segment: organizations and professionals working with youngsters with a low level of ASB. A strong point of the project was the strategy adopted by the consortium to design the 3D game in a modular form, which permits the introduction of new scenarios and a flexibility of the educational content. Thus, this game can be used as a sequel by organizations from education, social or even health fields which are implementing programs addressing not only to youngsters with a low level of ASB, but to different groups with a particular characteristic to work on (youngsters dropping out school, people with special needs, people with abilities in leadership, youngsters with performances in alternative sports etc.).

The innovative technology including the balance board, trackball and the trackable t-shirt might be used not only within this game but as a self standing instrument for collecting data regarding individuals’ moves or as components in other playing consoles.

Overall, this particular project will have a follow-up through the future research plans that will imply the usage of RePlay platform, observation and assessment instruments as well.
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REFERENCES


