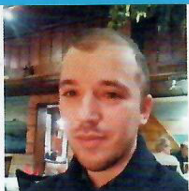


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# BEHAVIOUR CHANGE THROUGH SERIOUS GAMES

It is widely accepted that serious games have a high potential in introducing players to educational topics, but there is still little methodology and tools that focus on behavioural change instead of knowledge transfer, addressing design, analysis, and scientific evaluation. One of the primary goals of the »eConfidence« project is to fill this gap.



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The »eConfidence« project is a European project created by six partners from four different European countries. The project is funded by the »European Union's Horizon 2020« research and innovation programme. eConfidence has started with the intention to create and test a methodology to improve the development of serious games. The methodology intended to combine models from game development, behavioural psychology, and educational data analytics. Each partner had a different role to fulfill in the project. The scientific partners »Faculty of

Humanities and Social Science, University of Rijeka (FHSS)« from Croatia and the »University of Salamanca (USAL)« from Spain provided the project with theoretical background. Two separate games related to bullying and safe use of the internet have been developed to test the new methodology: The game related to the topic of bullying was developed by the »ITCL Institute of Technology« from Spain, while Nurogames GmbH from Germany developed the game about the safe use of the internet. The consortium later tested the games in ten schools from four countries. European Schoolnet (EUN) from Belgium contributed

The first step for ABA is to measure a base line, after which the process of behaviour change can be started. The results need to be compared with the baseline, and the method adjusted if needed. The change is set in motion by reinforcing the right behaviour while punishing bad behaviour (Figure 1).

Punishment and reinforcements can be both positive and negative. Positive reinforcement is often represented in games as rewarding player with points, while negative reinforcement is presented as escaping negative experience with appropriate behaviour. Positive punishment is presented in games as unpleasant feedback of the game to player's behaviour, while negative punishment is presented as losing points or advantages. Additionally, it is important how the reinforcement is scheduled. It's important not to reward every desired behaviour as if the reinforcement at some points stops it would also stop the desired behaviour. Important variables that can be used for the scheduling of reinforcements are the time interval between the reinforcements and the number of occurrences of desired behaviour till reinforcement.

The Intervention Mapping Protocol is made for planning and designing of behaviour change. It is performed in six steps. First, the needs of the intervention should be defined. As next the objectives of the intervention are translated in matrices. The third step is to select the methods and strategies for the theory-informed intervention. After this the actual intervention program is developed. Fifth step is the preparation for adaptation, implementation and sustainability. And the last step is to plan for the evaluation of the results.

Learning Analytics is about collecting in-game data to observe the current and predict the future learning progress of students. This model should also provide help to teachers to improve their teaching technics. The model tries to track who has made what, how it was done and why it was done. The number of activities also plays a significant role.

The collecting of data related to the learning analytics and working with underaged students have brought up concerns about



Basketball court, locker room or class room - School of Empathy offers a variety of settings.

to the communication with the schools. The schools accessed the games through the Xtend Platform created by »EVERIS«.

### The theory behind the project

To have a set of common terms and methodologies, FHSS and USAL advised ITCL and Nurogames in models like Applied Behaviour Analysis (ABA), Intervention Mapping Protocol (IMP) and Learning Analytics (LA).

The ABA deals with observing and measuring behaviour and aimed at behaviour change.

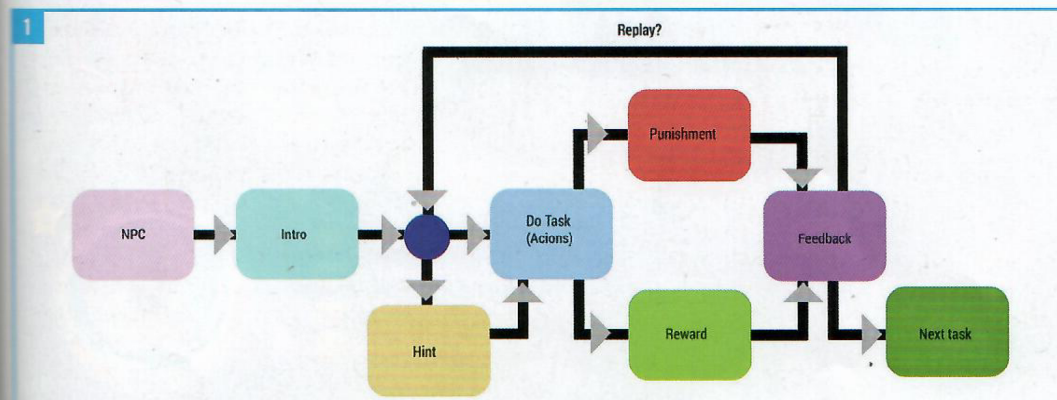


Figure 1: General flow chart for tasks in the games.

## Roles and associated attributes in School of Empathy

Role	Victim	Bystander	Bully
Attributes	Self-esteem Courage Strength	-	Self-esteem Self-control Anger Boredom

»It was vital that we don't directly teach the players but reward the right behaviour and punish bad behaviour.«

data protection, and ethical issues, which everybody who is working in this field needs to take into account. In close cooperation with ethical committees and regarding the newest data protection laws (including GDPR) the consortium has worked out a framework. EUN needed to collect consent forms. The student's data needed to be anonymized and the game saves no personal information except the information produced in the games. The data in the games can't be connected to the consent forms.

### From theory to mechanics

For the development of the game design, ITCL and Nurogames needed to integrate the scientific theory into the game design. Both games incorporated the aspect of repetition by creating topic relevant minigames. To facilitate the immersion and the transfer of knowledge from the game to the real world, both game developers decided to put the players into a familiar everyday situation. The concept of the ABA, which is already part of normal game development was more emphasized in the design of the games. It was vital that we don't directly teach the players but reward the right behaviour and punish bad behaviour.

An additional aspect needed to be taken into consideration is that behaviour change can be only achieved over a longer time, which meant certain minimal playing time for the games. In a discussion between the partners about the feasibility of an extended playtime in schools, it was agreed that the game needs to be played at least six hours.

From the technical part, the project consortium decided to use EVERIS' Xtend Platform which is accessible through a browser. Xtend Platform is a Moodle-based learning management system (LMS) similar to learning management systems introduced in many schools all over the world. The browser as platform meant possible performance limitations for the game developers. Both games were created using Unity as their game engine.

The game about bullying prevention, called »School of Empathy«, is set in a school and reflects the life of students from three points of view. These points of view are a victim, a bystander, and a bully. The gameplay of the victim and bully are similar as in both roles the player needs to choose answers in the dialog and play minigames. In both cases, the player should empathize

Figure 2: Dialogs in the School of Empathy game



with the respective role and feel the harassment of the victim and learn to deal with the own aggressions as the bully. The bystander role has different gameplay; as bystanders need to recognize, classify bullying situations and choose appropriate reactions i.e. protecting the victim. In the game, the player has different attributes depending on the current role which also indicate the improvement in the game (Table 1).

The possible answers in the dialogs of the victim and the bully are first limited, but the player can unlock new answers after increasing the indicators within each role (Figure 2). School of Empathy incorporates three minigames, which resemble school subjects. In the minigames, the player in the victim role needs not only to master the game but also defend from bully attacks. The possibility to defend rises with higher self-esteem. As a bully, the player will also need to master the game but also decide if he wants to sit up his anger blocking the game for a couple of seconds or to attack the victim, which will result in a punishment.

The game dedicated to the safe use of the internet, called »Go Online«, is set in an average household environment and shows a normal day at home in the life of a teenager. The premise of the game is to prepare yourself for the upcoming birthday of the player's avatar. The player can improve the household of the game environment with decorative items. Go Online includes five minigames dealing with different topics of safe use of the internet, including »friends in social networks«, »passwords«, »posting of photos«, »popup windows«. The gameplay of the minigames was inspired by known game concepts like »Arkanoid« or »Endless Runner« (Figure 3). Four minigames are made for a single topic respectively while the last minigame is made to repeat the knowledge of the previous games and briefly added some topics not represented in other minigames. Outside of the minigames the player needs to fulfill household jobs like cleaning, cooking and feeding fish. These jobs should provide the players with a pause for the acquired knowledge to settle down. In »Go Online« the player collects two resources: experience points and merits. The experience points are needed to gain higher levels, while the merits are needed to buy decoration items. Merits were used instead of money to avoid conveying a materialistic worldview to children. The minigames are made to be the main supplier of experience points while the household jobs are the primary source of merits.

In both games, specific metrics need to be saved for the analysis of the player's interactions. ITCL and Nurogames worked with FHSS and USAL to find metrics which show the behaviour of the players in the game and make them analyzable from the point of view of behaviour change.

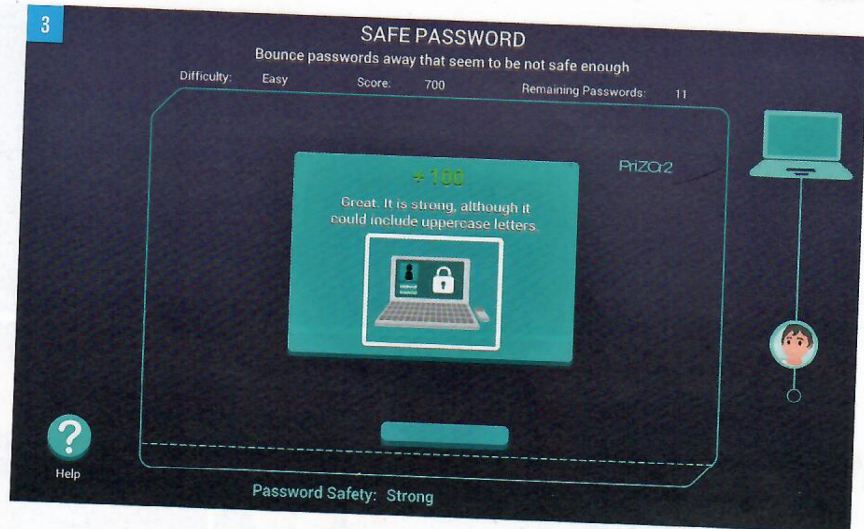
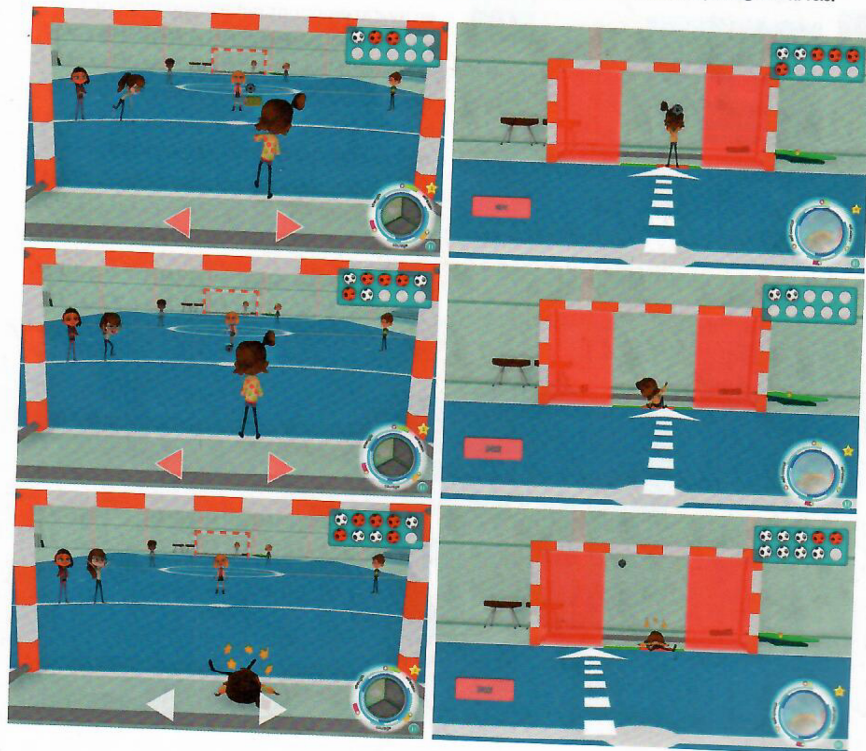


Figure 3: Minigame about choice of a safe password

### Making the games graphically appealing to young players

The target group of the eConfidence project was teenagers between 12 and 14 years. To make the games appealing to the teenagers, ITCL has made and evaluated a survey filled out by approximately 55 children. The outcome was that although the most teenagers seemingly preferred realistic graphics, their favorite games were made in non-realistic style. The wish to customize the own avatar was also an essential result of the survey. Early in the development, the consortium decided that the two games will have different graphical styles. The reason for it was that two games with different graphical styles

In various minigames, players have to either bully a fellow student or need to defend against their actions, depending on their role.



## Case Study

Making Games 01-02/19



Figure 4: Body and facial animation in School of Empathy

**Go Online:** The World Wide Web can be a dark place, so be careful who you trust and who you add as your friend.

could solidify the independence of the outcome of the project from the graphical style of the game.

The gameplay of School of Empathy strongly relies on emotions of the avatar. For the graphics, it meant that facial expressions and body animation were necessary for the game (Figure 4). The 3D environment of the game consisted of a big school environment with classrooms, schoolyard, and gym. ITCL chose the colour scheme for the game through the previously mentioned survey with different colour schemes presented. The gameplay of Go Online was less dependent on avatar emotions but instead more on the minigames. The emphasis was lying on the games GUI. The goal of the GUI design was to make the minigames look like real-world browsers and social networks, but on the other hand stay abstract not to promote any

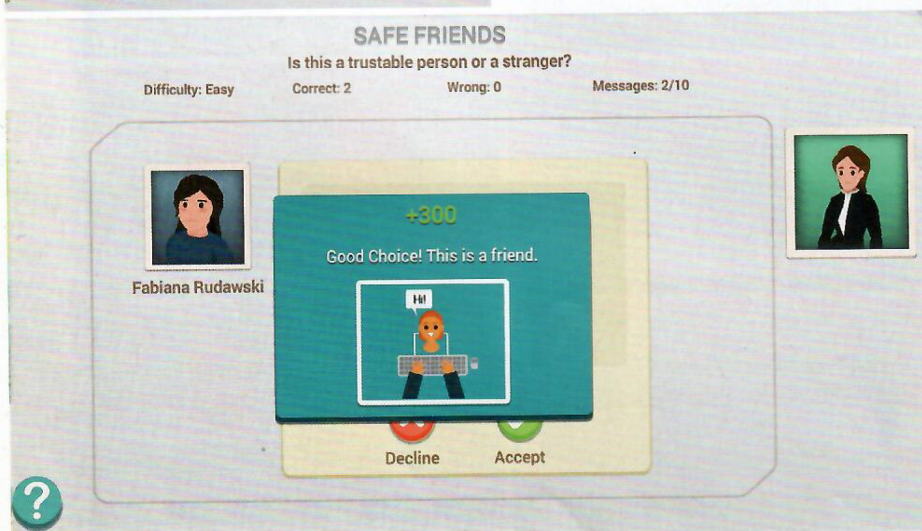
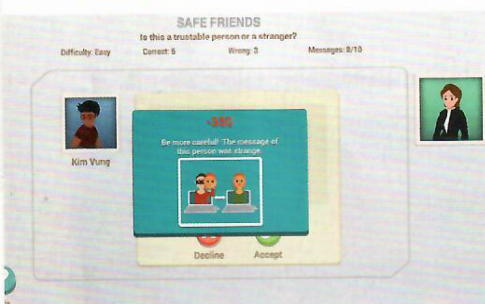
browser or social network and be independent of future changes in technology or trends. In the minigames, the player gets feedback over his actions with short texts and simple images. We decided to go with the short texts and simple images to not disturb the flow of the game but still give the player feedback which he can quickly grasp. As for the colour scheme for Go Online, Nurogames has oriented on the world's most popular colours, resulting in blue being the dominant colour of the game (Figure 5). The simplistic design of 3D models in the household was a choice made to avoid potential performance issues and to keep the game graphics from looking old after a short while.

### Development of the games

Nurogames and ITCL made the game development iterative in close cooperation with other partners. The iterative development leads to continuous improvement of the games. This phase also included the integration of the games into the Xtend Platform. EVERIS was assisting ITCL and Nurogames for the integration. For the integration of the games into the platform, the developers needed to build the games into a SCORM standard file and upload it to the platform, which was made possible through a SCORM Plugin for Unity. Integrated were the status of the game and the metrics needed by the research partners for the scientific evaluation of the metrics of behavioural change.

### Testing at schools

Already during the development, EUN in cooperation with the universities contacted and selected schools for our planned testing of the games at schools. To have more representative results, the partners decided to test



the game at Spanish and English-speaking schools. In cooperation with all partners, EUN decided on required criteria needed from schools to take part in the eConfidence project pilot test. After interviews and filtering out schools, that didn't meet the technical requirements, ten schools were selected to participate. Five schools were located in Spain; three schools in Malta, one in Ireland and one in the United Kingdom.

For the test, the pupils willing to participate in every school were divided into three groups. The first group played School of Empathy, the second played Go Online, and the last group was a control group that hasn't played any of the games.

First, every participating student from all three groups needed to fill out a pre-test questionnaire to determine the level of already existing knowledge and other relevant characteristics. Six playing sessions were planned for the groups selected to play one of the games. The last part of the test was the filling-in of the post-test questionnaire that should indicate, along with the game play data, the effect of playing the games.

The analysis of the pre-tests, game metrics, and post-test showed mixed results, which can be explained by a majority of students with high knowledge of the topics and a minority of students really in need of improvement. The games showed to be more suitable for players with less knowledge of the topics, as this player showed measurable improvement in their knowledge. The improvement was also depending on the player's immersion into the game. The students responded mostly negative to the frequent repetitions, which were needed to promote behaviour change.

### Conclusion

The project showed that serious games can be beneficial to behaviour change if the games are correctly adjusted to the player's knowledge level. Additionally, we learned that immersion of the players is essential to achieve behaviour change results. The

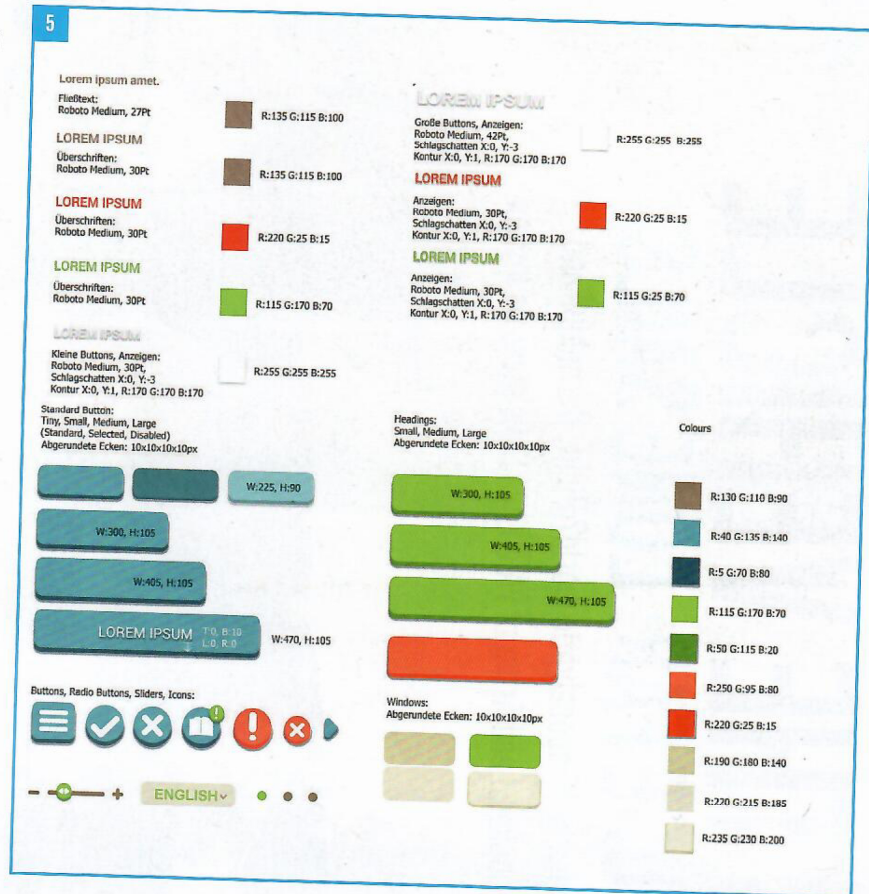


Figure 5: Graphic style guide of Go Online

repetitions in the game need to be made with caution to avoid boring the students, especially in games with more extended playtime. Outside of the pilot test results, we faced different points of view between developers and researchers. Overcoming this difficulty was very fruitful as good communication allows more in-depth understand and full use of each other's expertise in each other's working field. The good collaboration of researchers and developers is the key point for successful creation of serious games and games with a specific topic.

Jevgenijs Danilins

Go Online's goal is to teach players the safe use of the internet. The game is set in everyday household.

