

## Applications of Learning Analytics to assess Serious Games

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### Purpose

We summarize our experiences regarding three applications of Learning Analytics (LA) for Serious Games (SGs) [1] with different purposes:

- A. Validate and deploy games in schools. The SG **Conectado** has been designed to address social problems (bullying and cyberbullying) [2].
- B. Validate game design when information cannot be directly gathered from users. The SG **Downtown** was designed for improving independent life of users with Intellectual Disabilities (ID) who struggle with communication issues [3].
- C. Improve evaluation and deployment of games. The SG **First Aid Game** was already validated and data mining models were applied to predict knowledge after playing [4].

All three games have been tested with target users in actual classrooms, as described in the following section. Results and implications of the use of analytics in those three scenarios are later explained.

### Design

#### A. Conectado

*Conectado* is a videogame to raise bullying and cyberbullying awareness for students (12-17 years old). The game places the player in the role of a student suffering cyberbullying by schoolmates and promotes empathy through mini-games presented as nightmares and dialogues with other characters. Choices taken in the game alter the story, e.g. the ending is determined by the relationship with classmates and parents and whether players have asked the teacher for help or not.



Figure 1. Captures of *Conectado*.

The game was tested with N=257 high-school students from three educational centers in Spain, in June 2017.

### B. DownTown

*Downtown, a Subway Adventure* is a spy game for players with ID (18-45 years old) to train them in using the subway transportation system of Madrid (Spain). The game was developed in a 3D realistic perspective so players can identify the scenarios with reality. Users can navigate in the game as in real life, choosing the routes from one station to another. *Downtown* also includes quests to train daily skills (e.g. independence, long and short memory, spatial vision) and social aspects to promote users' independent life.



Figure 2. Captures of *DownTown*.

The game was tested with N=51 adults with ID (Down Syndrome, mild cognitive disability or certain types of Autism Spectrum Disorder) in May-June 2017. Students played a total of 3 hours. Interaction data captured included character and accessibility preferences, timestamps, attempts, correct/incorrect stations during the route, number of clicks in the interface and progress.

### C. First Aid Game

*First Aid Game* aims to instruct cardiopulmonary resuscitation (CPR) maneuvers for students (12-16 years old). The knowledge to be learned is assessed with questions that players can retry when choosing a wrong option. The more mistakes the user makes, the less score is given for that situation.

The game was validated in a usual pre-post experiment with a control group in 2011 with more than 300 students in four secondary schools of Aragon (Spain) [5]. Learning was slightly lower in the experimental group but still significant.

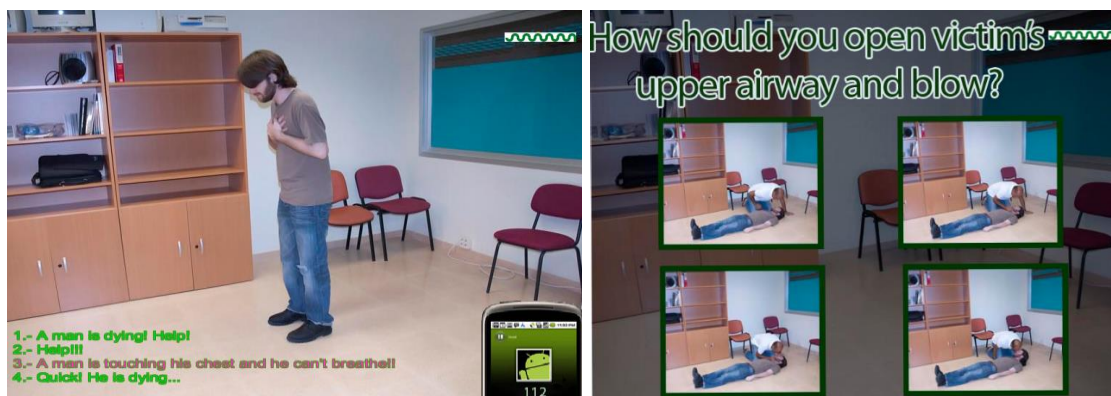


Figure 3. Captures of *First Aid Game*.

The game was tested with N=227 high-school students from one school in Madrid (Spain) in January-February 2017. Data captured from tests included knowledge in pre- and post- tests, opinion; interaction data comprised scores, correct/incorrect answers, interactions and times.

## Results

### A. Conectado

The increase in cyberbullying awareness was measured in pre-post tests, each containing eighteen 7-point Likert items to validate the game. The average score in pre-test was 5.72 (SD=1.26), compared to 6.38 (SD=1.11) in post-test, a statistically-significant effect.

### B. DownTown

Most students (85.8%) reached a destination; half of the mistakes (50.8%) occurred during the first 30 minutes of playing (once students completed a few routes to understand the mechanics).

### C. First Aid Game

Best models for predicting pass/fail obtained 89% precision, 98% recall and 10% misclassification rate; for predicting scores in range [1-15], mean error was 1.5 (SD=1.33). Predictions without pre-test information were slightly worse but differences were not significant.

## Implications

We have summarized our experiences and results for three different applications of LA for SGs:

- A. Validate and deploy a SG in school that increases cyberbullying awareness.
- B. Validate a SG that trains using the subway without explicit feedback from students.
- C. Improve evaluation and deployment of a SG predicting knowledge after playing to avoid carrying out the post-test.

All three applications are intended to foster the use of Serious Games in real contexts for different targets, simplifying their validation, evaluation and deployment using Game Learning Analytics data.

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## Resources

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