

UNIVERSIDAD COMPLUTENSE DE MADRID

FACULTAD DE INFORMÁTICA



TESIS DOCTORAL

USO DE TÉCNICAS DE LEARNING ANALYTICS PARA LA VALIDACIÓN,
MEJORA Y APLICACIÓN DE JUEGOS SERIOS EN LA CLASE APLICADO AL
CIBERBULLYING

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Baltasar Fernández Manjón
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MEMORIA PARA OPTAR AL GRADO DE DOCTOR

PRESENTADA POR

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Madrid, 2020

**DECLARACIÓN DE AUTORÍA Y ORIGINALIDAD DE LA TESIS
PRESENTADA PARA OBTENER EL TÍTULO DE DOCTOR**

D. Antonio Calvo Morata, estudiante en el **Programa de Doctorado en Ingeniería Informática**, de la Facultad de Informática de la Universidad Complutense de Madrid, como autor de la tesis presentada para la obtención del título de Doctor titulada:

Uso de técnicas de learning analytics para la validación, mejora y aplicación de juegos serios en la clase aplicado al ciberbullying

Y dirigida por Baltasar Fernández Manjón, Iván Martínez Ortiz y Manuel Freire Morán

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Fdo.: Antonio Calvo Morata

"Cuanto más te acerques a la luz, mayor será tu sombra"
(Kingdom Hearts)

Agradecimientos

Y pensar que todo este camino empezó por varias “casualidades” cuando terminaba el trabajo de fin de grado. Casualidades como decidir hacer el TFG con Rotaru, elegir el trabajo propuesto por Balta entre todos los que habíamos visto, o aceptar un pequeño contrato asociado a un proyecto en el grupo e-UCM. Ese mismo año ya bromeaban Javi y los dos Ángeles, que en ese entonces se encontraban cerca de terminar sus tesis, diciendo – ¿Ya os ha dicho Balta que vais a hacer un doctorado? – Y resulta que aquí estoy, terminando ese doctorado que supieron, antes que yo mismo, que iba a hacer.

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Sobre este documento

Este trabajo de tesis doctoral es una recopilación de publicaciones de acuerdo con lo expuesto en la Normativa de Desarrollo del Real Decreto 99/2011, del 28 de Enero (BOE 10/02/2011), por el que se regulan las enseñanzas oficiales de doctorado en la Universidad Complutense de Madrid^{1 2}.

A continuación, se enumeran los artículos presentados:

- Antonio Calvo-Morata, Cristina Alonso-Fernández, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón, **Creating awareness on bullying and cyberbullying among young people: validating the effectiveness and design of the serious game Conectado**, [Documento interno e-UCM mandado a revista para su publicación]
- Antonio Calvo-Morata, Cristina Alonso-Fernández, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón, **Serious games to prevent and detect bullying and cyberbullying: a systematic serious games and literature review in Computers & Education**, vol 157, November 2020, doi: 10.1016/j.compedu.2020.103958.
- Antonio Calvo-Morata, Dan-Cristian Rotaru, Cristina Alonso-Fernández, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón (2020): **Validation of a Cyberbullying Serious Game Using Game Analytics**. IEEE Transactions on Learning Technologies, vol. 13, no. 1, pp. 186-197, 1 Jan.-March 2020. DOI: 10.1109/TLT.2018.2879354.
- Antonio Calvo-Morata, Cristina Alonso-Fernández, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón (2019): **Game Learning Analytics, Facilitating the Use of Serious Games in the Class**. IEEE Revista Iberoamericana de Tecnologías del Aprendizaje (RITA), November 2019. DOI: 10.1109/RITA.2019.2952296.
- Antonio Calvo-Morata, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón (2019): **Applicability of a cyberbullying videogame as a teacher tool: comparing teachers and educational sciences students**. IEEE Access, DOI: 10.1109/ACCESS.2019.2913573.
- Antonio Calvo-Morata, Concha García-Diego, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón (2019): **Conectado in the classroom: applying a video game for the prevention of bullying at the school**. 12th annual International

¹ <https://www.boe.es/eli/es/rd/2011/01/28/99/con>

² <https://edocorado.ucm.es/normativa>

Conference of Education, Research and Innovation (ICERI 2019), 11th - 13th November, 2019, Seville (Spain). DOI: 10.21125/iceri.2019.0434.

- Antonio Calvo-Morata, Cristina Alonso-Fernández, Iván Martínez-Ortiz, Manuel Freire, Baltasar Fernández-Manjón (2019): **Game Learning Analytics for Educators**. IEEE Global Engineering Education Conference (EDUCON), 9–11 April, 2019, Dubai, UAE. DOI: 10.1109/EDUCON.2019.8725089.
- Antonio Calvo-Morata, Cristina Alonso-Fernández, Manuel Freire, Iván Martínez-Ortiz, Baltasar Fernández-Manjón (2018): **Making understandable Game Learning Analytics for teachers**. 17th International Conference on Web-based Learning (ICWL 2018), August 22nd - 24th, 2018, Chiang Mai, Thailand. DOI: 10.1007/978-3-319-96565-9_11

...

De acuerdo a la normativa, este documento incluye un índice con los títulos de los capítulos, un estudio del estado del arte, una descripción de los objetivos propuestos para esta tesis y una discusión sobre el contenido incluido en los artículos presentados.

Adicionalmente se presenta un capítulo con conclusiones y posibles líneas futuras de investigación relacionada con el tema.

Finalmente, se incluye una bibliografía con las referencias de los artículos mencionados en esta tesis doctoral.

Resumen

La investigación sobre juegos serios, es decir, aquellos juegos cuyo objetivo principal no es el mero entretenimiento, ha demostrado sus beneficios en áreas muy diversas, como por ejemplo en la medicina, la investigación o la educación. Estos juegos pueden ayudar a aprender o concienciar, entrenar habilidades y protocolos, evaluar estudiantes e incluso reducir el dolor en tratamientos médicos. La validación de estos juegos serios se realiza, en la mayoría de los casos, mediante métodos similares a los tradicionalmente empleados para la validación de cualquier herramienta educativa. De este modo, los juegos serios se suelen validar bien mediante cuestionarios externos o bien mediante entrevistas y métodos de observación. Aunque el uso de cuestionarios sigue siendo el método más aceptado y frecuente, cada vez se realizan más estudios que realizan una validación de los juegos serios en base a las interacciones del jugador con el videojuego. El efecto del videojuego en el jugador se estudia analizando los datos de interacción recogidos, a los que se aplican técnicas de analíticas de aprendizaje, y que en inglés se ha llamado *Game Learning Analytics*.

Recientemente se ha incrementado el número de investigaciones que recogen los datos de interacción de los jugadores y utilizan dichas evidencias para estudiar los efectos del juego. No obstante, estos proyectos se centran sobre todo en usar técnicas de análisis de datos para analizar el comportamiento del jugador o para evaluar su conocimiento comprobando si las decisiones que toma dentro del juego son correctas o no. Pero, en general, el uso de analíticas de aprendizaje para la validación de juegos es todavía minoritario y es necesaria más investigación sobre su aplicación efectiva. La validación científica de un juego puede ser un proceso más costoso que su producción, lo que repercute en que haya muy pocos juegos evaluados de forma rigurosa y contrastable que estén disponibles para el uso de la sociedad en general. Uno de los campos donde existen muy pocos juegos validados es el de los juegos serios como herramientas de prevención del acoso escolar (i. e., bullying y cyberbullying). Además, el problema del acoso escolar es muy amplio y diverso, de modo que los diferentes videojuegos que encontramos se centran en diferentes aspectos concretos (incrementar concienciación, enseñar estrategias de prevención o las características del problema, detectar conductas de riesgo). A esto se le suma que muchos de los videojuegos descritos en la literatura que abordan el acoso escolar lamentablemente no están disponibles.

Esta tesis propone estudiar el uso de los juegos serios como herramientas de prevención de bullying y cyberbullying escolar, para lo que se ha desarrollado el juego Conectado. Además, propone aplicar técnicas de *Game Learning Analytics* en todo el ciclo de vida del juego: desarrollo, validación y aplicación en la clase. Por un lado, este

enfoque permite obtener mayor evidencia de los beneficios de los juegos serios en el campo de la prevención del bullying y el ciberbullying, así como de su efectividad a la hora de incrementar la concienciación de los jugadores. Por el otro, permite comprobar los beneficios del uso de técnicas de *Game Learning Analytics* en un juego concreto, dando además la oportunidad de, con la experiencia obtenida, generalizar los procesos de modo que puedan aplicarse a otros juegos serios similares.

Palabras Clave: Juegos serios; Videojuegos educativos; Ciberbullying; Bullying; Analíticas de aprendizaje;

Abstract

Research on serious games, that is, games which main purpose is not solely entertainment, has demonstrated their benefits in many fields, including medicine, research and education. Serious games can help to learn, raise awareness, train skills and protocols, assess students and even reduce pain in medical treatments. These games are usually validated by methods similar to those used for traditional educational tool validation, such as external questionnaires or interview and observation methods. Although questionnaires continue to be the most widely used and accepted, an increasing number of studies are being conducted to validate serious games based on player's interactions with the video game. The effect of the video game on the player is studied by analysing the data collected applying learning analytics techniques in what has been called Game Learning Analytics.

Recently, there has been an increase in the number of studies that collect player interaction data and use this evidence to study the effects of the game. However, these projects primarily focus on using data analysis techniques to either analyse the behaviour of the player or to evaluate their knowledge by checking whether or not the decisions they make within the game are correct. In general, the use of learning analytics for game validation is still very rare, and further research is needed on their effective application. The scientific validation of a game can be more expensive than its production, which explains why only very few games that have been rigorously and verifiably evaluated are available for use by society as a whole. One of the fields where there is scarcity of validated serious games is that of bullying and cyberbullying prevention tools. Furthermore, the problem of bullying is very broad and diverse, so the video games that we find focus on different aspects (raising awareness, teaching prevention strategies or the characteristics of the problem, detecting risk behaviours). In addition, many of the video games described in the literature that address bullying are unfortunately not available.

This thesis studies the use of serious games as tools to prevent school bullying and cyberbullying. For this purpose, the game Conectado has been developed and Game Learning Analytics techniques have been applied throughout its whole lifecycle: development, validation and application in class. On the one hand, this approach can provide more evidence of the benefits of serious games in the field of bullying and cyberbullying prevention and of their effectiveness in increasing awareness on players. On the other hand, it allows the benefits of the use of Game Learning Analytics techniques to be put under test. Initially, these benefits are tested for a particular game; however,

based on the experience of this game, a generalization of the corresponding processes is proposed, making them applicable to similar serious games.

Keywords: Serious games; Educational video games; Cyberbullying; Bullying; Learning Analytics;

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Estructura de la tesis

Esta tesis doctoral utiliza el formato de recopilación de publicaciones. Las publicaciones que forman este trabajo se encuentran integradas en el capítulo 6. Los capítulos previos a éste proporcionan el contexto al trabajo realizado donde se explica los objetivos de la tesis, el planteamiento realizado y un estado del arte desde el que se parte.

El documento se estructura de la siguiente forma:

- Capítulo 1. Introducción
- Capítulo 2. Estado del arte
- Capítulo 3. Objetivos y planteamiento de la tesis
- Capítulo 4. Discusión integradora y contribuciones
- Capítulo 5. Conclusiones y trabajo futuro
- Capítulo 6. Artículos presentados

Por último, se incluyen las referencias bibliográficas completas que se han utilizado en este documento.

Capítulo 1. Introducción

Esta tesis propone estudiar el uso de los juegos serios como herramientas de prevención de bullying y ciberbullying escolar para lo cual, además del estudio teórico, se ha desarrollado un juego llamado Conectado. También propone aplicar técnicas de *Game Learning Analytics*, es decir, la recogida y el análisis de los datos de interacción de los jugadores en Conectado, para mejorar las distintas fases del ciclo de vida del juego: desarrollo, validación y aplicación en la clase. Este capítulo introduce la motivación y el origen de este trabajo (sección 1.1), los objetivos de la investigación (sección 1.2), y la relevancia y prevalencia del problema del bullying y el ciberbullying (sección 1.3) que justifica la importancia de crear nuevas herramientas para ayudar a combatir ambos problemas en los centros educativos.

1.1. Motivación

Este trabajo surge con motivo de dos eventos durante mi carrera académica. El primero de estos dos eventos fue mi contratación y participación dentro del grupo de investigación e-UCM con el cargo de investigador contratado dentro del proyecto europeo H2020 RAGE. En este proyecto, una de mis tareas fue colaborar en el desarrollo de un sistema de analíticas de aprendizaje en el que se recogieran, analizaran y visualizaran de forma comprensible los datos de las interacciones de los usuarios realizadas en distintos juegos serios. El otro evento que motiva este trabajo es HackForGood 2016, primer *hackathon* en el que participé y donde se propusieron numerosos retos basados en la temática de problemas de la sociedad. Los participantes, distribuidos en grupos multidisciplinares, debíamos abordar uno de estos retos con algún tipo de solución tecnológica. Entre los retos propuestos estaba el de crear una herramienta para abordar el ciberbullying en las escuelas. Decidimos proporcionar una solución a dicho reto mediante un videojuego, que diseñamos y del cual desarrollamos un pequeño prototipo lineal con 5 minutos de duración (en las 48 horas de *hackathon*). Tanto la idea como el prototipo fueron muy bien aceptados por el jurado que evaluaba las soluciones propuestas, ganando así varios de los premios que fueron repartidos el último día del evento.

Siempre me han gustado los videojuegos y con mi trabajo dentro del grupo e-UCM, desde que realicé el trabajo de fin de grado en 2014, me he dado cuenta de todas las posibilidades que estos ofrecen, no solo como un recurso para el ocio, la más común, sino también como herramientas educativas, de apoyo, terapia o evaluación entre otras muchas. Después de HackForGood 2016, partiendo de las ideas del prototipo original desarrollado durante el evento, surgió la oportunidad de rediseñar y desarrollar un

videojuego completo con el objetivo de prevenir el bullying y el ciberbullying en la escuela, de modo que pudiera ser usado como una herramienta por los profesores. Además, se decidió incorporar aspectos de la investigación que estábamos llevando a cabo con el proyecto RAGE para integrar las analíticas en el ciclo de vida del videojuego y así lograr un mejor producto.

Usar un videojuego como una herramienta, en este caso educativa, no es algo completamente nuevo: los videojuegos llevan aplicándose desde hace años en distintos dominios. Se han aplicado con éxito en campos vitales para la sociedad como son los de la educación (Girard, Ecalte, & Magnan, 2013; Randel, Morris, Wetzell, & Whitehill, 1992), la salud (Kato, 2012) y la investigación (Cooper et al., 2010). Se ha estudiado la efectividad y los beneficios de aplicar los videojuegos con distintos objetivos como, por ejemplo, enseñar y evaluar conocimientos en distintas materias de conocimiento como física, informática o idiomas (Muñoz et al., 2009; Papastergiou, 2009; Segers & Verhoeven, 2003; Shute, Ventura, & Kim, 2013); mejorar el comportamiento (Majumdar et al., 2013); entrenar habilidades sociales y de comunicación (Gebhard et al., 2018) o aprender procesos y protocolos médicos (De Paolis, 2012; Torrente et al., 2014; Youngblood et al., 2008); concienciar (Rebolledo-Mendez, Avramides, Freitas, & Memarzia, 2009); e incluso reducir el dolor percibido por un usuario (Bidarra et al., 2013; Ingadottir et al., 2017).

Tradicionalmente, la validación de estos juegos serios se realiza mediante el uso de instrumentos externos a los juegos como son los cuestionarios y entrevistas a los usuarios. Sin embargo, con el desarrollo de la ciencia de datos y la generalización de los enfoques analíticos se han empezado a aplicar este tipo de técnicas en la validación de juegos serios. Denominamos analíticas de aprendizaje (en inglés *Learning Analytics*, LA en adelante) al tipo de ciencia de datos que se emplea en el ámbito educativo que, mediante la recogida y procesamiento de datos de interacción del alumno y su entorno, pretende estudiar y mejorar los procesos de aprendizaje. Cuando estas técnicas con fines educativos son aplicadas en juegos serios hablamos de *Game Learning Analytics* (GLA en adelante) (Freire et al., 2016a). Aunque el uso de GLA está en crecimiento, el análisis de su eficacia es todavía limitado debido a que aún son escasos los estudios rigurosos que hacen uso de estas técnicas. Cabe destacar que el uso más habitual de GLA en los juegos serios es el de la evaluación de competencias de los jugadores (Alonso-Fernández, Calvo-Morata, Freire, Martínez-Ortiz, & Fernández-Manjón, 2019). Sin embargo, evaluar al jugador mediante sus acciones y respuestas, aplicando GLA, en un juego serio que no esté enfocado a la mera transmisión de conocimiento (p. ej. en juegos que buscan crear una concienciación, o favorecer un cambio de comportamiento) puede no ser el mejor método. En este tipo de juegos pueden plantearse situaciones en las que no existe una respuesta

correcta y otra errónea, y los jugadores pueden jugar de manera exploratoria recurriendo a comportamientos que no mostrarían en situaciones reales. También hay que tener en cuenta que la información recogida y analizada al aplicar técnicas de GLA puede aportar beneficios a los distintos perfiles implicados en el desarrollo de juegos serios como los desarrolladores, los investigadores y los educadores. Este trabajo pretende explorar el uso del juego serio Conectado como herramienta educativa dentro de la clase y también el uso de las analíticas durante el ciclo de vida de este juego serio. Conectado tiene como objetivo la prevención del bullying y el ciberbullying en el ámbito escolar a través del incremento concienciación y del desarrollo de empatía en los alumnos, ámbito donde, por ahora, no se ha documentado la utilidad de las técnicas de GLA.

1.2. Línea de investigación

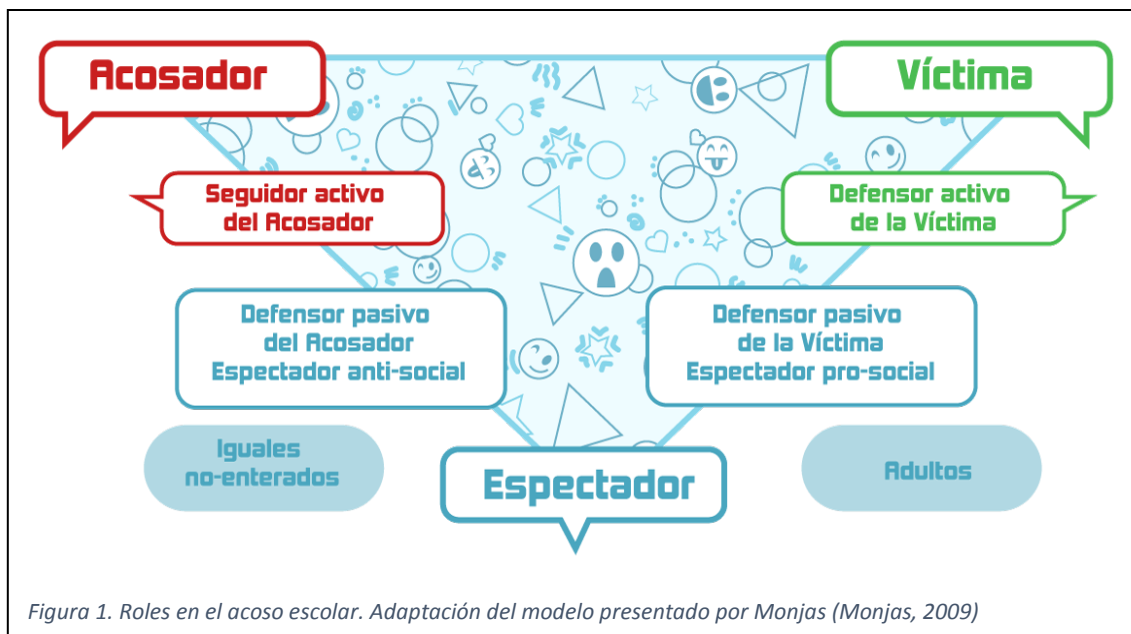
Como se ha mencionado previamente, el principal objetivo de este trabajo de tesis es estudiar el uso de los juegos serios como herramientas de prevención de bullying y ciberbullying escolar para lo cual además del estudio teórico se ha desarrollado un juego llamado Conectado, cuyo objetivo es la prevención del acoso escolar a través de la concienciación y la empatía. Además, se propone aplicar técnicas de GLA para mejorar las distintas fases del ciclo de vida del juego: desarrollo, validación y aplicación en la clase. Este objetivo general se ha abordado a través de una serie de objetivos más concretos que aparecen a continuación:

1. Hacer un estudio del estado del arte de los recursos existentes para abordar el acoso escolar, principalmente tecnológicos, centrándose en los juegos serios creados específicamente para el bullying y el ciberbullying.
2. Desarrollar un videojuego que sirva como herramienta de prevención del bullying y el ciberbullying a través de la concienciación y la empatía, proporcionando a la comunidad educativa una herramienta eficaz para crear un debate posterior al uso del videojuego que ayude a afianzar y potenciar el efecto del mismo.
3. Integrar analíticas en el proceso de validación combinadas con otros métodos tradicionales, como cuestionarios pre-post, para estudiar como las técnicas de GLA pueden mejorar el proceso de desarrollo, validación y aplicación de este tipo de juegos.
4. Validar científicamente el videojuego, tanto desde el punto de vista de su diseño como desde el punto de vista de su aplicabilidad y efectividad.

1.3. El bullying y el ciberbullying

El bullying es un problema global de ámbito social que afecta a todos los países del mundo independientemente de su cultura o de su educación (Menesini & Salmivalli, 2017; Zych, Ortega-Ruiz, & Del Rey, 2015). Se habla de bullying cuando una persona es víctima de conductas agresivas a lo largo del tiempo y de forma repetida. Estas conductas agresivas pueden ser muy variadas, agresiones físicas y/o verbales tanto de forma directa o indirecta, conductas que aíslan al individuo del grupo o conductas que crean sentimientos como indefensión y temor en las personas. Además, existe una diferencia de poder entre el grupo de acosadores o acosador y la víctima (Olweus, 2001). En los casos en los que estas agresiones hacen uso de un medio tecnológico se habla de ciberbullying. Al usar la tecnología se presentan nuevos tipos de conductas agresivas que no tenían lugar anteriormente, como puede ser la suplantación de identidad (Smith, 2015; Ybarra, Boyd, Korchmaros, & Oppenheim, 2012). Si bien cualquier persona, independientemente de su edad, puede verse afectada por el bullying o el ciberbullying (Nielsen, Tangen, Idsoe, Matthiesen, & Magerøy, 2015), esta tesis se enfoca en la victimización de jóvenes en el ámbito escolar, concretamente en la etapa de educación secundaria. En este ámbito existen algunas circunstancias especiales ya que, por ejemplo, se ha comprobado cierto grado de solapamiento entre ambas conductas, de agresión y de victimización, dándose casos en los que una víctima puede ser a la vez agresor de otros estudiantes (Beran & Li, 2007; García-Fernández, Romera-Félix, & Ortega-Ruiz, 2015; Olweus & Limber, 2018). En adelante usaremos la palabra “(ciber)bullying” para referirnos a ambos problemas de acoso (bullying y ciberbullying) entre iguales y en un ámbito escolar.

El bullying, si bien con algunas restricciones respecto a su definición actual, comenzó a estudiarse en los años 70 en los países nórdicos (Olweus, 1978). Desde entonces, pero sobre todo desde mediados de los años 90, el bullying ha sido un tema que ha cobrado gran relevancia en el resto del mundo (Olweus, 1996). Han aparecido numerosas investigaciones sobre el problema, tanto para estudiar sus características y evolución a lo largo de los años como para desarrollar métodos y herramientas que permitan su prevención y detección. Este incremento de interés sobre el problema también se ha visto reflejado tanto en los medios de comunicación que tantas veces han cubierto casos reales (El País, 2005; Tremending, 2020; Verne, 2016), como en los propios centros educativos, que buscan y aplican distintos tipos de recursos de concienciación, prevención y detección. Los gobiernos de distintos países también han lanzado campañas para paliar el problema e incluso leyes que permitan afrontar mejor los aspectos jurídicos de dichas situaciones. Si bien en sus inicios el bullying se limitaba principalmente al espacio físico y temporal de la permanencia en la escuela, la expansión y generalización de la tecnología como medio de comunicación rompió estas barreras, dando origen al



ciberbullying y añadiendo una nueva dimensión al problema. Con el uso de la tecnología ya no es imprescindible una interacción física entre víctima y acosador, permitiendo además que las situaciones de acoso se den en cualquier lugar y en cualquier momento.

En ambos casos, bullying y ciberbullying, existen tres roles principales que intervienen en las situaciones de acoso: la víctima, el acosador/agresor y los observadores (Monjas, 2009; Salmivalli, 2010; Salmivalli, Lagerspetz, Björkqvist, Österman, & Kaukiainen, 1996):

La víctima es aquella persona que es objeto del acoso. Los estudios sobre el bullying tradicional indican que personas que parecen más débiles, inseguras, tímidas, con miedo a ser dañadas y con menos amigos o que se consideran menos atractivas o saludables físicamente tienen más riesgo de victimización (Delfabbro et al., 2006; Ledley et al., 2006; Olweus, 1993). Por otro lado, en el caso del ciberbullying no hay un perfil tan claro y el riesgo parece estar más asociado al tipo de uso de las redes sociales y a tener un perfil personal más fácilmente manipulable. Además de las diferencias físicas o de aspecto, pertenecer a grupos minoritarios como el LGTBIQ+ o tener una mala relación familiar con los padres o tutores legales también incrementan el riesgo de victimización (Finn, 2004; Hemphill, Tollit, Kotevski, & Heerde, 2015; Larrañaga, Yubero, Ovejero, & Navarro, 2016; Smith et al., 1999). Por otro lado, algunos estudios han encontrado que la cibervictimización en centros educativos normalmente lleva también asociada una victimización tradicional (Gradinger, Strohmeier, & Spiel, 2009). Otros estudios también señalan la existencia de un perfil víctima-agresor, donde una víctima de (ciber)bullying es a su vez (ciber)agresor (Ybarra & Mitchell, 2004).

El acosador o agresor es aquella persona que lleva a cabo el comportamiento agresivo, de forma física o psicológica, contra la víctima. Al igual que en el caso de la víctima, el perfil del agresor es más claro que el del ciberagresor. Los estudios señalan que, en general, los acosadores en los casos de bullying tradicional son impulsivos y agresivos, con falta de empatía y sin sentimientos de culpabilidad (Olweus, 1993). Esta falta de empatía y del sentimiento de culpabilidad son características comunes a los ciberagresores (Steffgen, König, Pfetsch, & Melzer, 2011).

Los observadores son aquellas personas que son conocedoras del caso de (ciber)bullying. Según la forma de actuar ante la situación, hay diferentes tipos de observador: los observadores pueden ser seguidores del acosador, proporcionando estímulos positivos como pueden ser las risas ante el acoso; pueden ser defensores de la víctima, apoyando a las víctimas o bien mediante estímulos negativos reprochando el comportamiento del agresor; o pueden ser espectadores neutrales o indiferentes no tomando partido, en algunos casos por indiferencia y en otros por miedo a que la situación de acoso se vuelva contra ellos (Bastiaensens et al., 2014; Monjas, 2009). Los estudios indican que el rol del observador es crucial a la hora de prevenir el acoso ya que mediante sus actos pueden reforzar el comportamiento violento o por el contrario terminar con el mismo. Cuando los observadores se ponen del lado de la persona agredida pueden invertir la balanza de poder que tiene el agresor sobre la víctima (Lynn Hawkins, Pepler, & Craig, 2001; Padgett & Notar, 2013). Además el rol del observador es el más prevalente: estudios recientes muestran porcentajes superiores del 60% de observadores en casos de ciberacoso en adolescentes (González Calatayud, Prendes Espinosa, & Bernal Ruiz, 2019).

Es muy importante combatir el (ciber)bullying desde etapas tempranas ya que es un fenómeno muy frecuente y con unos efectos muy serios y dañinos en las víctimas. Ambos problemas, bullying y ciberbullying, tienen una alta prevalencia, si bien esta varía según el país y el continente de estudio. Una de las limitaciones principales a la hora de estudiar el (ciber)bullying y su prevalencia es que no hay una única manera de medir la magnitud del problema y, por tanto, los resultados varían según los instrumentos utilizados. Estos resultados dependen de los comportamientos que se reconocen como bullying y/o ciberbullying, de la frecuencia considerada y durante cuánto tiempo se produce la agresión. Los diferentes estudios realizados describen una prevalencia de entre el 10% y el 65% según el país, e incluso puede llegar a ser mayor en casos de colectivos específicos como el LGTBIQ+ (Due, Holstein, & Soc, 2008; UNESCO, 2017). Si bien el ciberbullying tiene una menor incidencia en la escuela que el bullying, su prevalencia va del 5% al 21% y este porcentaje ha aumentado en los últimos años (UNESCO, 2017).

En España, el estudio realizado en 2016 por Save the Children España sobre estudiantes de secundaria de 12 a 16 años muestra que, de media, el 9,3% sufre acoso, un 6,9% ciberacoso y el 3,7% sería víctima de ambas modalidades (Calmaestra et al., 2016). El estudio realizado por EU Kids Online sobre estudiantes españoles de 9 a 17 años muestra datos peores ya que en su informe de 2018 describe que el 33% sufre (ciber)bullying, mostrando además una tendencia creciente al comparar los datos con los informes anteriores de 2010 y 2015 (Garmendia et al., 2018). Estos porcentajes de prevalencia varían según las regiones de un mismo país sin ser despreciables en ninguna de ellas. En el caso de España, y según el estudio de Save the Children España, Andalucía es la comunidad más afectada y Cantabria la que menos, con una diferencia del 6,5% en ciberbullying y un 6% en bullying (Calmaestra et al., 2016).

No obstante, hay que destacar que también existen pequeñas diferencias en función de la edad y del género. Las agresiones físicas de bullying son más comunes entre los chicos mientras que en las chicas es más común el bullying psicológico. Los estudios también describen que la prevalencia del ciberbullying es mayor entre las chicas, siendo la diferencia entre ambos géneros mayor que la que se da en el caso del bullying. En cuanto a la edad, el (ciber)bullying es más común en el último año de primaria y durante los primeros cursos de secundaria, entre los 11 y los 15 años (Ballesteros, Santiago Pérez de Viñaspre, Díaz, & Toledano, 2018; UNESCO, 2017).

A la alta prevalencia del (ciber)bullying hay que sumar los numerosos y serios efectos negativos que puede tener en la víctima y que se han estudiado desde diferentes campos como la psicología, la psiquiatría, la educación o la criminología (Bender & Lösel, 2011; Hugh-Jones & Smith, 1999; Ivarsson, Broberg, Arvidsson, & Gillberg, 2005). Entre estos efectos negativos en las víctimas podemos encontrar problemas de comportamiento, concentración y regulación emocional, que en jóvenes pueden resultar en absentismo en el ámbito académico (Grinshteyn & Tony Yang, 2017; Wolke, Woods, Bloomfield, & Karstadt, 2001). También se dan efectos sobre la autoestima que pueden producir aislamiento social, sentimientos de soledad, depresión, ansiedad y estrés postraumático (Bonanno & Hymel, 2013; Chang et al., 2013; Kaltiala-Heino, Rimpelä, Marttunen, Rimpelä, & Rantanen, 1999; Ortega, Elipe, Mora-Merchán, Calmaestra, & Vega, 2009; Piñuel & Oñate, 2007). En los casos más extremos se han llegado a documentar ideación suicida, trastornos psicológicos graves e incluso suicidios (Ballesteros et al., 2018; Kaltiala-Heino et al., 1999; Katsumata, Matsumoto, Kitani, & Takeshima, 2008; Nielsen et al., 2015).

Debido a la alta prevalencia y los efectos tan negativos para la salud de los jóvenes del (ciber)bullying, es necesario seguir trabajando para crear herramientas que permitan

abordar ambos problemas. Aunque lo más común es encontrar recursos para su prevención, también es necesario crear recursos que permitan detectar los casos de acoso y afrontarlos antes de que afecten al clima escolar y ocasionen daños en la salud de las víctimas. Nosotros consideramos que una de las herramientas educativas más prometedoras que puede ayudar a afrontar el acoso escolar son los juegos serios. Los juegos serios permiten mostrar los diferentes aspectos del (ciber)bullying de una manera alternativa donde el jugador tiene un rol activo. En el capítulo 2 se describen los diferentes recursos que podemos encontrar a la hora de abordar el bullying y el ciberbullying para analizar con más detalle algunos aspectos de los juegos serios y su uso como herramientas de prevención y detección de estos tipos de acoso escolar.

Capítulo 2. Estado del arte

La alta prevalencia y los serios efectos del bullying y el ciberbullying han motivado la aparición de muchos proyectos en todo el mundo para combatir ambos problemas. Los enfoques son muy variados: desde herramientas y campañas de concienciación, a otros recursos que ayudan a prevenir, detectar y abordar estos casos de acoso escolar. La complejidad intrínseca del (ciber)bullying (debida, entre otros, a la diversidad de agresiones, o los diferentes roles y perfiles involucrados), hace que distintos profesionales busquen soluciones al problema mediante estrategias muy diferentes. Este capítulo describe las herramientas existentes para la prevención del bullying y el ciberbullying haciendo especial hincapié en los juegos serios. Concretamente, la sección 2.1 resume los principales tipos de recursos identificados y proporciona ejemplos de los mismos. La sección 2.2 introduce las ventajas de los videojuegos como herramientas educativas. Por último, la sección 2.3 analiza aquellos juegos serios con publicaciones científicas asociadas que tienen como objetivo la prevención o detección del (ciber)bullying.

2.1. Recursos para la prevención del bullying

Como hemos mencionado previamente, el bullying en el ámbito escolar es un problema global que se estudia desde hace varias décadas en todo el mundo. A largo de los años, se han empleado enfoques muy diversos y se han creado numerosos recursos para prevenir y combatir el acoso en las escuelas:

- Estrategias, normas escolares y protocolos de actuación (Smith, Smith, Osborn, & Samara, 2008). Estos recursos son implantados a nivel de centro educativo y definen cómo y cuándo deben actuar los diferentes profesionales que trabajan en el centro, qué actos se deben considerar (ciber)bullying y en qué casos se debe contactar con las autoridades pertinentes. Estos recursos pueden variar mucho entre los diferentes centros de un mismo país y se ven influidos por las leyes y la cultura de la región en la que se implantan. A la hora de prevenir el ciberbullying, por ejemplo, una de las estrategias aplicadas consiste en adoptar soluciones tecnológicas que impiden, limitan o monitorizan el uso de los dispositivos electrónicos y de las redes sociales en el horario escolar (García, 2019; Pérez, 2019)³.

³ Ejemplo herramienta de monitorización en el aula y de documento de normas escolares respecto al uso de dispositivos móviles (último acceso el 21/06/2020):

- <http://www3.gobiernodecanarias.org/medusa/ecoescuela/ate/ciudadania-y-seguridad-tic/centros-educativos/cauce/control-aula/>
- https://malmesburyprimaryschool.co.uk/wp-content/uploads/2018/02/E-Safety-Policy_2018.pdf

- Programas de prevención y detección (Gaffney, Farrington, Espelage, & Ttofi, 2019; Polanin, Espelage, & Pigott, 2012). Los programas son conjuntos de recursos que se implantan, por lo general, a nivel de centro educativo y pueden involucrar a diferentes perfiles de usuarios. Normalmente combinan varias estrategias, por ejemplo, concienciar a los estudiantes sobre la gravedad del problema mientras se forma a los profesores para saber actuar si identifican un caso. Un ejemplo de programa de prevención es Kiva (<http://www.kivaprogram.net/>), compuesto por recursos muy diversos como manuales, videos y videojuegos, que también proporciona formación para los profesores y familiares. Estos recursos están adaptados según la edad de los alumnos con los que se utilice. Los programas de prevención y su efectividad están ampliamente estudiados en la literatura (Gaffney, Ttofi, & Farrington, 2019).
- Campañas de prevención. Las campañas son conjuntos de acciones que se realizan normalmente de manera excepcional en un periodo de tiempo limitado. Tienen el objetivo principal de concienciar y dar visibilidad al problema. Hay numerosas asociaciones y fundaciones que crean campañas de lucha contra el bullying, muchas veces en colaboración con grandes empresas. Por ejemplo, Nobully.org colaboró en 2017 con Burger King en una iniciativa contra el bullying (<https://nobully.org/initiative/burger-king/>). Netflix también realizó una campaña antibullying relacionada con el estreno de la serie “Por 13 razones” en 2018. En esta campaña se realizó además un experimento social con el objetivo de mostrar la importancia de las palabras y el impacto que pueden llegar a tener en otros (Iglesias, 2018). La Fundación Mutua Madrileña en colaboración con la Fundación Anar realiza desde 2016 una campaña antibullying anual en la que publica material de apoyo e informes de estudios realizados sobre la incidencia del acoso escolar y sus efectos (<https://www.acabemosconelbullying.com/>).
- Webs, blogs y redes sociales. Existen numerosas plataformas que haciendo uso de estos medios digitales recogen información y noticias sobre el (ciber)bullying. Un ejemplo es PantallasAmigas (<https://www.pantallasamigas.net/>), que surgió como una iniciativa para promover el uso seguro de las TIC y de internet. Su web recoge noticias y material didáctico enfocado sobre todo al problema del ciberbullying. Además, participa en numerosos eventos sobre el (ciber)bullying, la convivencia escolar, el uso de internet y de las redes sociales o la ciudadanía digital. Otros ejemplos

de páginas web internacionales que actúan como agregadores de noticias y recursos son (<https://aifs.gov.au/>) y (<https://www.stopbullying.gov/>).

- Teléfonos, chats y correos de ayuda. Diversas asociaciones y fundaciones incluyen medios específicos para reportar casos de acoso y proporcionan información sobre cómo actuar y apoyo psicológico. Tanto los observadores como las propias víctimas y sus familiares pueden recurrir a estos teléfonos para pedir ayuda. Ejemplos de estos medios son los Teléfonos Anar (<https://www.anar.org/necesitas-ayuda-telefono-ninos-adolescentes/>) en España o el número de ayuda de Childline (<https://www.childline.org.uk/get-support/contacting-childline/>) en el Reino Unido.
- Recursos multimedia, actividades didácticas, guías y libros. Existen múltiples recursos creados como parte de programas y campañas o de manera individualizada que se encuentran recogidos en diferentes páginas webs centradas en el (ciber)bullying. Estos recursos abarcan desde historietas para los más pequeños hasta anuncios de televisión, canciones y videojuegos. También existen libros y guías para profesionales de la educación, así como cursos formativos (EDUCACIÓN 3.0, 2020).

Por lo general, todos los recursos mencionados siguen un conjunto de estrategias a la hora de abordar el problema:

- Informar y educar sobre las características del (ciber)bullying. ¿Qué es? ¿Por qué se da? ¿Qué efectos tiene? Etc.
- Enseñar a identificar casos de (ciber)bullying.
- Enseñar estrategias para actuar ante el (ciber)bullying.
- Cambiar el comportamiento de los estudiantes para reducir el riesgo de que se vean involucrados en casos de acoso.
- Concienciar sobre el problema y darle visibilidad.
- Proporcionar apoyo psicológico a los distintos perfiles afectados por los casos de acoso, tanto a víctimas como a sus familiares y tutores.
- Limitar (o aconsejar sobre) el uso de la tecnología dentro de la escuela.

Existen numerosos estudios sobre los recursos para la prevención del acoso en la escuela, sin embargo, la mayoría de estos se centran en los programas de prevención y

son pocos aquellos sobre recursos individuales. Una ventaja de los recursos individuales es que pueden integrarse y complementarse entre ellos según las necesidades de la comunidad educativa, que comprende profesorado, padres, alumnos y personal administrativo.

2.1.1. La representación del bullying en los videojuegos

Como un problema social que es global, y al igual que otros problemas como pueden ser el machismo, el racismo o la homofobia, el acoso aparece representado en medios como el cine⁴, la televisión⁵, la literatura⁶ e incluso la música⁷. Si bien estos recursos no tienen como objetivo principal ser una herramienta educativa para abordar el problema del acoso, pueden ser utilizados en el aula para hacer reflexionar, mostrar la realidad del (ciber)bullying y los efectos devastadores que puede tener (Hughes & Laffier, 2016; Tomaszewski, 2013). Al igual que las películas, las series y los libros, los videojuegos son un medio donde la cultura, la sociedad, sus problemas y conflictos pueden ser representados. Pero no solo esto, el jugador puede interactuar dentro de esta simulación, experimentando de esta forma la cultura, la sociedad y los problemas que aparecen en el videojuego (Muriel & Crawford, 2018; Squire, 2006).

El problema del acoso aparece representado en los videojuegos comerciales de venta al público (*COTS games*) si bien esta representación parece ser escasa y, actualmente, no ha sido estudiada. Algunos ejemplos de videojuegos en los que aparece recogido este problema en su trama son:

- Life is Strange, una aventura gráfica en tercera persona desarrollada por Dontnod Entertainment y distribuido por Square Enix en 2015. El videojuego está dividido en 5 episodios y en su trama muestra diversos problemas entre los que están el acoso escolar, la depresión, el suicidio, las drogas y las violaciones. Muchos de los personajes que aparecen en el videojuego son adolescentes y su historia se desencadena en la academia de Blackwell, en la ciudad ficticia de Arcadia Bay (Oregón) después de que Max Caulfield, protagonista del juego, descubre que tiene el poder de viajar

⁴ Ejemplos de películas donde aparece el acoso representado:

<https://www.imdb.com/list/ls021536537/>

<https://psicologiamente.com/cultura/peliculas-sobre-bullying>

⁵ Ejemplos de series y películas donde aparece el acoso representado:

<https://pdabullying.com/es/resource/47-series-y-peliculas-para-trabajar-el-bullying>

⁶ Ejemplos de libros donde aparece el acoso representado:

<https://www.readbrihtly.com/10-honest-books-bullying-teenagers/>

⁷ Ejemplos de música que trata algún aspecto del acoso:

<https://ciberintocables.com/canciones-bullying/>

<https://www.vix.com/es/btg/musica/56629/no-mas-violencia-luchamos-contra-el-bullying-con-estas-7-canciones>

en el tiempo. En su página web está disponible el primer episodio de manera gratuita (<https://lifeisstrange.square-enix-games.com/es/games/life-is-strange>).

- Persona 5⁸, un juego de rol de simulación social, en tercera persona y con combates por turnos, fue desarrollado y distribuido por Atlus en 2016. La trama se desarrolla después de que el protagonista es transferido a la academia Shujin. Él y sus compañeros tendrán que luchar por liberar a la sociedad moderna de Tokio de la corrupción de sus deseos. Durante el juego el jugador experimenta todo un año escolar en una academia de Tokio, donde debe asistir a clase y relacionarse con los diferentes personajes que aparecen en el juego para conseguir bonificaciones y avanzar en la trama. Uno de los temas más recurrentes del videojuego es el abuso de poder de los adultos ante los jóvenes, estando también presente el acoso escolar entre iguales tanto físico como psicológico.
- GYLT⁹, es un juego de acción y puzzles desarrollado por Tequila Works y publicado en 2019. En este videojuego, el jugador controla a Sally, una niña que se adentra en un mundo paralelo y de pesadillas del pueblo en el que vive, y en el que debe rescatar a su prima. La mayoría de sucesos se desarrollan en las aulas, patio y pasillos de una versión tenebrosa de un colegio, donde Sally debe combatir sus miedos y demonios.

Los videojuegos pueden ser un recurso para mostrar el problema del acoso y permitiendo que los jugadores experimenten las consecuencias de sus actos de una manera segura dentro del videojuego. Sin embargo, también existen problemas a la hora de aplicarlos como herramientas educativas como puede ser la dificultad para ajustarlos al currículo que se quiere impartir o al horario y duración de las clases. Por sus características, los juegos serios sí son una de las herramientas que se han estudiado y considerado efectivas para abordar el problema del (ciber)bullying. En la siguiente sección se analizan y contextualizan los juegos serios enfocados al ámbito educativo.

2.2. Los videojuegos como herramienta educativa

El término *juego serio* (o *serious game* en inglés) define a los juegos cuyo propósito principal va más allá del entretenimiento. Aunque no están pensados para ser jugados principalmente por diversión y entretenimiento, esto no significa que los juegos serios no sean o no deban ser entretenidos (Abt, 1970). Este término comenzó englobando a

⁸ Página oficial del videojuego Persona 5: <https://atlus.com/persona5/home.html>

⁹ Página oficial del videojuego GYLT: <http://www.gyltthegame.com/>

cualquier tipo de juego, por ejemplo juegos de mesa, sin embargo en la actualidad se usa principalmente para referirse a los juegos digitales (Zyda, 2005). Los juegos serios llevan usándose muchos años en distintos ámbitos (p. ej., educativo, militar), pero fue a partir del año 2000, con la generalización de la tecnología, cuando su mercado empezó a extenderse y su aplicación creció en dominios como el entrenamiento de profesionales, la educación, la religión, la salud, el arte y la cultura, la publicidad o el campo militar (Djaouti, Alvarez, Jessel, & Rampnoux, 2011; Laamarti, Eid, & El Saddik, 2014). Los dominios donde más ha crecido su uso tanto a nivel de mercado como de investigación son los de la educación y la salud (Boyle et al., 2016; Calderón & Ruiz, 2015; Djaouti et al., 2011). Para que un videojuego sea considerado juego serio no es suficiente con que pueda usarse para un propósito diferente al del entretenimiento, este propósito debe tenerse en cuenta y reflejarse desde las primeras etapas de diseño y desarrollo del videojuego.

Cualquier juego puede ser beneficioso aplicado en el contexto y con el propósito adecuados. En el ámbito educativo, se habla de aprendizaje basado en videojuegos o *digital game-based learning* para referirse a la metodología que integra los videojuegos en el proceso formativo de los alumnos. Esta metodología consiste en descubrir e inventar formas de incluir la reflexión y el pensamiento crítico en el aprendizaje, ya sea incorporado directamente en el propio juego o bien mediante un proceso posterior a este (p. ej., discusión), normalmente dirigido por un profesor (Prensky, 2001). La naturaleza altamente interactiva que proporciona un videojuego permite que el estudiante tome un rol activo en su proceso de aprendizaje, lo que contrasta con el rol pasivo de otras metodologías tradicionales (p. ej., clases magistrales). Este rol activo permite un aprendizaje más efectivo al mantener la atención del jugador durante largos periodos de tiempo, y proporciona un entorno donde el jugador puede experimentar de forma segura mientras recibe una realimentación rápida sobre sus acciones (Prensky, 2001).

Si bien cualquier videojuego puede tener beneficios y aplicarse de manera educativa, el proceso para lograrlo puede ser sumamente complicado si el juego no está diseñado para ser usado con fines educativos. Por ello, han ganado mucha relevancia los juegos serios cuyo diseño y propósito se enfocan a ser utilizados como herramientas educativas. Estos juegos tienen en cuenta variables como el entorno de uso, el currículo, el tiempo de las clases y el rol del profesor, superando así algunas de las barreras que dificultan o incluso impiden el uso de otros videojuegos en entornos reales. Sin embargo, siguen existiendo otras barreras como la falta de conocimiento y formación en nuevas tecnologías o la falta de recursos que permitan evaluar y controlar a los estudiantes durante la sesión de juego (Jean Justice & Ritzhaupt, 2015). El campo de los juegos serios es muy amplio y diverso, donde aquellos más enfocados a la educación también son

llamados juegos educativos, diferenciándose así de otros tipos de juegos serios con distintos objetivos como pueden ser el entrenamiento profesional, basados en simulación o enfocados a cambiar otro tipo de actitudes.

Los juegos tienen diversas ventajas sobre otras herramientas educativas debido a sus características particulares, lo que facilita que puedan ser aplicados de manera efectiva con fines educativos. Algunas de estas características y beneficios intrínsecos a los videojuegos son:

- Representan y simulan entornos o sistemas complejos, permitiendo al jugador interactuar con objetos y experimentar situaciones que de otra manera no sería posible por motivos de seguridad, coste o tiempo, entre otros (Corti, 2006; Squire & Jenkins, 2003).
- Promueven el aprendizaje. Desde pequeño, el ser humano aprende mediante el juego a interactuar con los objetos y con los demás, lo que le permite adquirir diferentes habilidades complejas (p. ej., negociación, resolución de conflictos) y desarrollar la imaginación. Al igual que el juego tradicional, los videojuegos permiten la exploración de distintas alternativas e incluso la comunicación e interacción con terceros mediante los personajes no jugables o los juegos multijugador (Szczyrek, 1982, VanSickle 1986, Randel et al., 1992, in van Eck, 2006).
- Permiten desempeñar un rol activo. El jugador debe interactuar y obtener información para usarla durante el propio juego, formular hipótesis y contrastarlas con sus acciones, con el propósito de avanzar y completar tareas, resolviendo las dificultades que se le plantean (Oblinger, 2004).
- Rompen la denominada “barrera de los 10 minutos de atención”. Los videojuegos proponen retos, muestran progresión, tienen ciclos cortos de retroalimentación e incluso pueden adaptar su dificultad a las capacidades y necesidades del jugador. Todo esto permite retener la atención y el interés del estudiante durante largos periodos de tiempo (Chen, 2007; DeKanter, 2005; Ravenscroft, Lindstaedt, Kloos, & Hernández-Leo, 2012).
- Proporcionan una retroalimentación rápida, esto permite que el propio jugador vea las consecuencias de sus interacciones y si las opciones que elige son adecuadas (DeKanter, 2005).

En el ámbito educativo, los juegos serios han demostrado ser motivadores y efectivos con distintos propósitos, siendo capaces de aumentar la concienciación, enseñar conocimientos, cambiar el comportamiento e incluso mejorar habilidades complejas del jugador como, por ejemplo, las habilidades sociales (Calderón y Ruiz, 2015). The Oregon Trail (MECC, 1971) fue uno de los primeros juegos serios con un propósito educativo que se desplegó con gran éxito y aceptación en muchas escuelas de Estados Unidos. Este juego, que toma la forma de una aventura conversacional, fue creado en 1971 por tres profesores de historia, Don Rawitsch, Bill Heinemann y Paul Dillenberger, para enseñar a sus estudiantes cómo era la vida de las familias que habían hecho la ruta de Oregon, una de las principales rutas de migración en Norteamérica en el siglo XIX. En 1978 se creó su versión gráfica, que fue mejorada y comercializada en 1985.

Desde entonces, ha aumentado el interés de la comunidad educativa por la metodología de *digital game-based learning*, y numerosos estudios han demostrado la efectividad de los juegos serios como herramienta educativa. Por estos motivos, cada vez más empresas y desarrolladores se suman a la creación de este tipo de videojuegos siendo un mercado en alza. Por ejemplo, Microsoft en 2016 publicó Minecraft Education Edition, una versión del famoso juego Minecraft enfocada al uso en clase y creó una plataforma (<https://education.minecraft.net/>) donde compartir material y guías para enseñar materias tan diversas como química, biología, geometría o programación. Otro ejemplo es Valve, que junto a foundry10 publicó una versión educativa del videojuego Portal 2 en 2012 (foundry10, 2012) enfocada a enseñar conceptos de física (p. ej. la gravedad, la oscilación, el momento, o la velocidad). También Electronic Arts, junto a



Figura 2. Imagen del juego serio The Oregon Trail.



Figura 3. Imagen del juego Minecraft Education Edition.

GlassLab, decidió crear una versión educativa de uno de sus juegos y publicó en 2013 SimCityEDU: Pollution Challenge! (Electronic Arts, 2013) para concienciar sobre la polución en las ciudades y estrategias para combatirla.

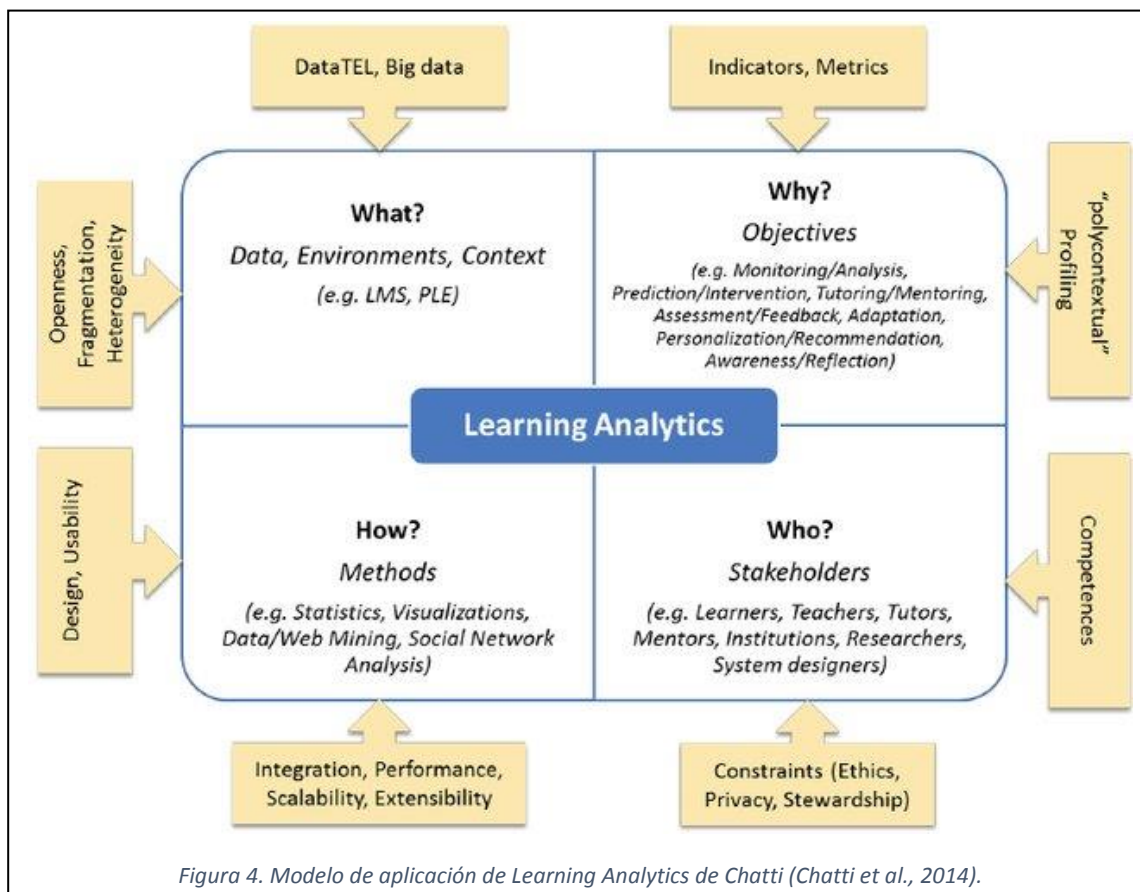
Las editoriales tradicionales también han mostrado interés por este tipo de videojuegos como complemento a sus libros. Un ejemplo es la editorial McGraw-Hill y sus juegos Practice Marketing. También existen empresas enfocadas por completo a los videojuegos serios. Un ejemplo en España es la empresa GameLearn, cuyo modelo de negocio centrado en la formación corporativa mediante el uso de videojuegos serios ha tenido un gran éxito empresarial.

2.2.1. Las analíticas de aprendizaje

Como hemos mencionado, una de las barreras a las que se enfrentan los profesores y educadores cuando utilizan videojuegos en el aula es perder el control y no saber qué es lo que realmente está pasando con cada uno de sus alumnos. Normalmente a los docentes les falta información sobre qué están haciendo los estudiantes en cada momento, si están aprendiendo y cuál es el efecto real del videojuego. Para abordar estos aspectos, en la última década han surgido disciplinas que hacen uso de las analíticas con el objetivo de mejorar el funcionamiento de los procesos educativos que utilizan las nuevas tecnologías. Esta metodología, denominada Analíticas de Aprendizaje, o *Learning Analytics* en inglés, tiene como objetivo "medir, recoger, analizar y presentar los datos sobre los alumnos y su contexto, con el fin de comprender y optimizar el aprendizaje y los entornos en los que este aprendizaje se produce" (Long & Siemens, 2011). Los contextos educativos en los que más se están aplicando las analíticas de aprendizaje son los sistemas de gestión de aprendizaje o por sus siglas en inglés LMS, como por ejemplo

Moodle, y en los MOOCs o cursos online masivos y abiertos. Los MOOCs han sido el mayor impulsor de las analíticas debido al gran número de alumnos que participan, haciendo inviable realizar un seguimiento individual de cada uno de ellos mediante métodos tradicionales (Fundación Telefónica, 2020). Estas técnicas de analíticas de aprendizaje que se basan en la recolección de los datos y las interacciones del usuario con el sistema también son aplicables a la mejora de los procesos educativos con juegos serios, en este caso denominándose *Game Learning Analytics* (Freire et al., 2016b).

Las grandes empresas y desarrolladoras de videojuegos hacen uso de las analíticas para estudiar y mejorar la experiencia de uso de sus videojuegos (*Game Analytics*). Estas métricas analizadas van dirigidas a medir distintos aspectos del uso del videojuego, como, por ejemplo, para evaluar su rendimiento (uso de memoria y CPU) en diferentes máquinas o para conocer qué elementos del juego tienen más éxito y mejorar así futuros productos. Aunque incorporan técnicas propias de las *Game Analytics*, el objetivo principal de las *Game Learning Analytics* es entender y mejorar los aspectos relacionados con el aprendizaje de los estudiantes, en la línea de las analíticas de aprendizaje. A pesar del uso de las analíticas en la industria del videojuego y en las plataformas educativas, su aplicación en los juegos serios es todavía limitada (Alonso-Fernández et al., 2019; Chaudy, Connolly, & Hainey, 2014). Sigue siendo mucho más común el uso de



cuestionarios a la hora de evaluar lo que han aprendido los jugadores, conocer su opinión sobre el juego o validar su diseño (Boyle et al., 2016; Calderón & Ruiz, 2015).

Actualmente, los investigadores trabajan en proponer y desarrollar modelos y metodologías que permitan simplificar, mejorar y fomentar el uso de analíticas en juegos serios. Chatti propone un modelo para la aplicación de *Learning Analytics* con cuatro dimensiones (Figura 4): el “qué”, donde se definen los datos recopilados por el sistema, su gestión y su utilización; el “quién”, los actores a los que va dirigido el análisis; el “por qué”, el propósito de analizar los datos recopilados; y por último, el “cómo”, la forma en la que se realiza el análisis de dichos datos (Chatti et al., 2014).

Por otro lado, Serrano-Laguna propone una metodología para integrar las analíticas en los procesos de diseño, validación y despliegue (Serrano-Laguna, Manero, Freire, & Fernández-Manjón, 2018). En esta metodología se parte de la recogida y establecimiento de los objetivos de aprendizaje del juego y de las mecánicas de juego más apropiadas para dichos objetivos. Durante las evaluaciones, se capturan los datos de interacción y, en base a su análisis, se realizan las primeras evaluaciones de aprendizaje que servirán para mejorar el juego si se encuentra algún problema de diseño o mecánica a optimizar. En

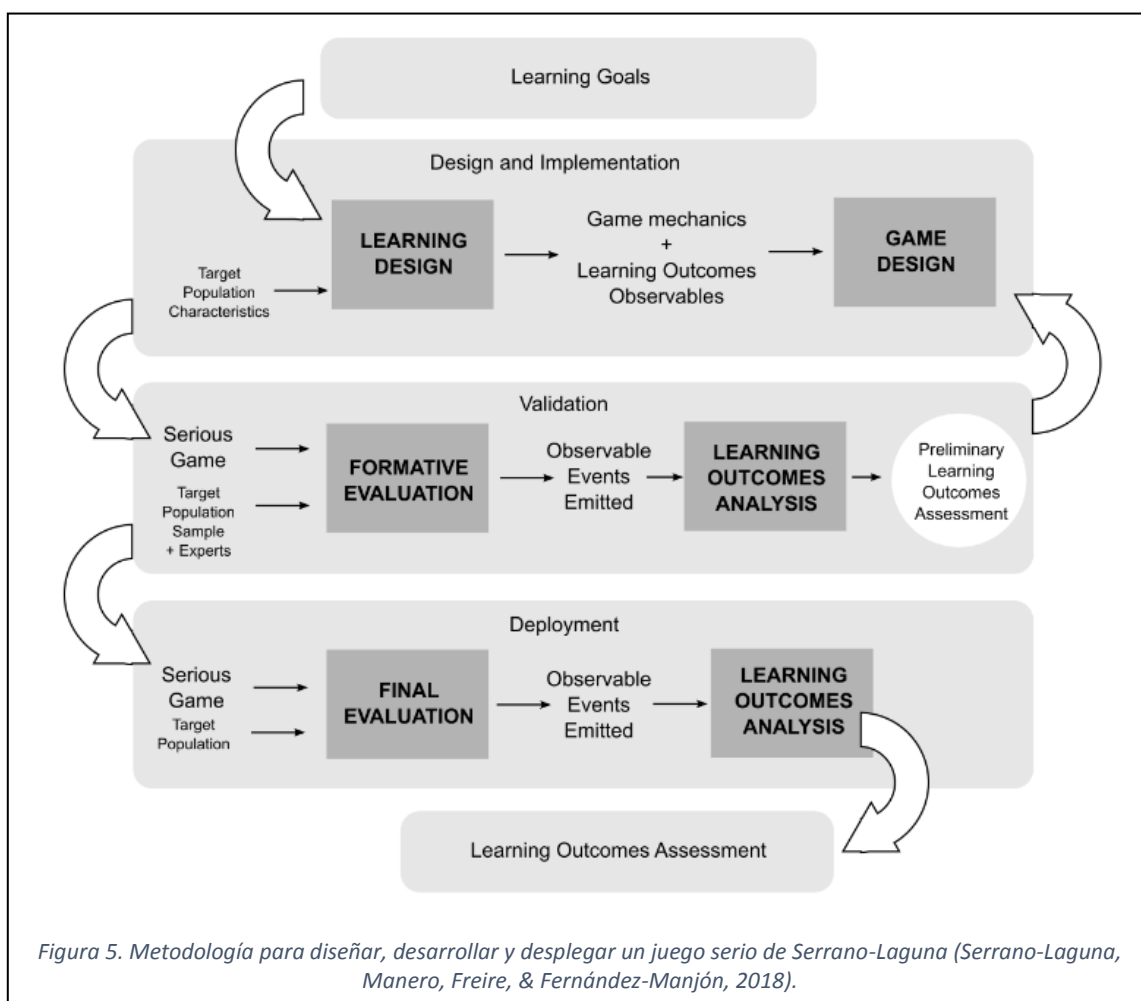


Figura 5. Metodología para diseñar, desarrollar y desplegar un juego serio de Serrano-Laguna (Serrano-Laguna, Manero, Freire, & Fernández-Manjón, 2018).

estas evaluaciones se valoran además la idoneidad y utilidad para los instructores de las interacciones recogidas. Si es necesario, se reiterarán las fases de diseño y validación. Finalmente, en la fase de despliegue, una vez el juego serio ha sido validado, se recogen las interacciones de los estudiantes y mediante su análisis se obtienen los resultados de aprendizaje de dichos estudiantes (Figura 5).

Uno de los problemas actuales del uso de analíticas en el ámbito de los juegos serios con objetivos educativos es la gran variedad de mecánicas de juego y de propósitos educativos que podemos encontrar. Por ejemplo, la metodología de Serrano-Laguna se centra en aquellos juegos con propósito de aprendizaje de conocimiento donde los propios juegos recogen datos mediante preguntas y acciones correctas o incorrectas y permiten evaluar el conocimiento del jugador. Otros juegos serios en los que las acciones y respuestas del jugador no se clasifican por correctas o incorrectas, por ejemplo, juegos con un propósito de concienciación sobre el (ciber)bullying, no permiten la evaluación del efecto del juego sobre el jugador únicamente mediante las interacciones recogidas. A pesar de ello, aunque su aplicación no ha sido ampliamente explorada, las analíticas de aprendizaje se pueden emplear con otros propósitos, como puede ser la validación del diseño de un juego serio.

2.3. Juegos serios para la prevención del bullying

Aunque el ciberacoso se realiza a través de las nuevas tecnologías y de los dispositivos electrónicos, nosotros consideramos que la tecnología también puede convertirse en una herramienta de prevención para abordar tanto el problema del ciberacoso como el del acoso. Los juegos serios son especialmente prometedores por sus características altamente motivadoras y su aceptación por los jóvenes. A pesar de que el acoso puede aparecer dentro de juegos multijugador y que permiten la interacción mediante chat y/o voz entre jugadores, los videojuegos pueden diseñarse para tener el efecto contrario educando sobre el problema. En este trabajo se realiza un estudio de los juegos serios como herramientas de prevención. Los resultados están centrados sobre todo en la última década (2010-2020), ya que hay muy pocos juegos anteriores sobre el tema, siendo una de estas pocas excepciones el videojuego FearNot! (Paiva et al., 2004).

La investigación realizada en este trabajo de tesis sobre el estado actual de los juegos serios con objetivos de prevención y detección del (ciber)bullying ha sido publicada en *Computers & Education* con el título *Serious games to prevent and detect bullying and cyberbullying: a systematic serious games and literature review* (Calvo-Morata, Alonso-Fernández, Freire, Martínez-Ortiz, & Fernández-Manjón, 2020). Para realizar este estudio y encontrar los juegos existentes que disponían de evidencias científicas se ha realizado previamente una revisión sistemática de la literatura. En las

siguientes secciones se describen los recursos revisados en la publicación y las conclusiones a las que se llegó una vez analizadas las publicaciones relacionadas, probando además la aplicación o el juego en caso de estar disponible.

2.3.1. Juegos serios con publicaciones científicas

En esta sección se describen 31 juegos serios con propósitos de prevención y detección del bullying y ciberbullying de los que hemos encontrado publicaciones científicas asociadas con el fin de establecer su validación científica.

Si hacemos una búsqueda en *Google Play Store* o en la *App Store* es sencillo encontrar aplicaciones para dispositivos móviles con información o teléfonos y chats de ayuda para víctimas. Sin embargo, estas aplicaciones raramente son o contienen videojuegos. Incluso cuando son videojuegos o aplicaciones gamificadas, la mayoría no tiene asociados estudios que demuestren su efectividad como herramientas educativas, aunque sí puedan estar basadas en estudios sobre el bullying y el ciberbullying. El único ejemplo encontrado en la literatura de una aplicación diseñada y desarrollada para dispositivos móviles es #StopBully (Neo, Teo, & Boon, 2018). Esta aplicación se creó con el objetivo de educar y concienciar sobre el bullying y el ciberbullying. Consiste en una agrupación de videos, la página de información de Befrienders.org, un botón de emergencia para que el usuario pueda contactar con la autoridad para informar fácilmente de los casos de acoso, dos juegos (uno de ellos con mecánicas de plataformas y el otro de ordenar palabras), cuestionarios sobre la cantidad de información que han obtenido al usar la aplicación y una serie de tiras cómicas animadas. El estudio muestra una buena aceptación si bien los jugadores tenían entre 20 y 30 años y se realizó sobre el conjunto



Figura 6. Imágenes de la aplicación #StopBully.

completo de la aplicación (no sobre los juegos específicamente). La aplicación no parece estar disponible actualmente para probarse.

Otro tipo de videojuego que podemos encontrar es el de los entornos virtuales como SimSafety (Kalaitzis, Valeontis, Delis, & Fountana, 2010) y School Life (Marietta, Viola, Ibekwe, Claremon, & Gehlbach, 2015). Los jugadores, representados por avatares editables y en tercera persona, pueden comunicarse a través de chats dentro del entorno. En el caso de School Life, el juego permite a los jugadores de secundaria situarse en los tres roles del bullying (víctima, acosador y observador) para crear empatía y ayudarles a entender a las personas que en casos reales se encuentran en dichas situaciones. El videojuego se probó con unas 260 personas de habla inglesa, y los resultados mostraron que aquellos jugadores que probaban el rol de observador y de víctima empatizaban con estos roles más que aquellos que solo jugaban en uno de ellos. Sin embargo, la evaluación es bastante discutible ya que 122 de los 260 usuarios no eran alumnos del grupo objetivo, sino que eran adultos con una media de 32 años contactados a partir de *Amazon Mechanical Turk*, una plataforma de colaboración abierta donde solicitantes registran trabajos y trabajadores completan a cambio de recompensas económicas. El juego actualmente no está disponible y parece que el proyecto no fue continuado, siendo la última actualización en su web de 2013 anunciando un prototipo con el que realizarán su validación de eficacia.



Figura 7. Imágenes los entornos School Life (izquierda) y SimSafety (derecha).

Por su parte SimSafety, que se basa en OpenSimulator, proporciona a profesores, padres y estudiantes de 9 a 11 años, un entorno para contextualizar y concienciar sobre el ciberbullying de una manera segura y controlada. Este entorno permite crear eventos especiales relacionados con el acoso, tiene minijuegos y los jugadores consiguen una puntuación según sus acciones dentro del entorno y según la ayuda que proporcionen a otros jugadores y avatares. Uno de los estudios describe la aplicación del entorno con cerca de 1000 estudiantes, pero únicamente resume como valoraciones finales que la experiencia fue positiva y entretenida, y que los profesores reportaron que los estudiantes estaban más concienciados sobre algunas situaciones de riesgo de ciberbullying después de haber jugado. Si bien OpenSimulator sigue estando disponible, SimSafety no lo está y



Figura 8. Imagen del juego Step In, Speak Up!

tampoco aparecen descripciones detalladas sobre los eventos y minijuegos incluidos ni sobre las actividades realizadas en el entorno virtual.

También encontramos otros videojuegos basados en simulaciones en los que se presentan situaciones aisladas de bullying. En ellos los jugadores interactúan en tercera persona, es decir, viendo una representación explícita del personaje que manejan en el juego, y reciben retroalimentación de las acciones realizadas. Para profesores encontramos Step In, Speak Up! (E. Bradley, Albright, McMillan, & Shockley, 2019) y At-Risk for Middle School Educators (E. G. Bradley & Kendall, 2019), ambos de la empresa Kognito. Los dos juegos usan las mismas mecánicas y el mismo estilo gráfico. El jugador toma el rol de profesor en una clase donde se le presentan diferentes situaciones, debiendo elegir sus acciones o respuestas. Los juegos proporcionan retroalimentación indicando si su actuación es correcta o no. Estos recursos tienen un coste por licencia, aunque se proporcionan demostraciones gratuitas de unos 10 minutos. En Step In, Speak Up!, el profesor aprende a interactuar con y entender a sus estudiantes LGTBQ+ para crear un entorno más seguro e inclusivo para evitar el bullying. La empresa presenta un estudio en el que han participado 2904 profesores, aunque analizando los detalles de la investigación parece que el número efectivo es mucho menor. Por ejemplo, únicamente presentan los cuestionarios posteriores al juego de 716 profesores en el grupo de control y 674 en el grupo de intervención. También realizan cuestionarios de seguimiento tres meses después, pero únicamente 118 profesores del grupo de control y 106 del de intervención los completaron. Los resultados muestran una buena aceptación y un incremento en la percepción de los profesores de su capacidad de enfrentarse a situaciones como las del juego. Otra conclusión del estudio es la necesidad de crear un entorno más inclusivo, así como tratar el tema con los alumnos y con otros profesores. At Risk for Middle School Educators enseña a identificar las situaciones de

riesgo de acoso y en las que se está produciendo bullying. Enseña a los profesores cómo deben enfrentarse a dichas situaciones, incluida la ideación suicida de los estudiantes. El estudio con 20 profesores muestra que, al finalizarlo, los docentes se ven más preparados para reconocer comportamientos de riesgo y las señales de estrés físico. Además, se encuentran más seguros a la hora de ayudar y recomendar servicios de apoyo.

Mii-School (Carmona, Espínola, Cangas, & Iribarne, 2010) y My School 4 Web (Cangas et al., 2013) presentan al jugador diferentes escenarios en forma de vídeos donde debe elegir entre varias opciones la que mejor le define. Estos dos juegos sirven como herramientas de detección y evalúan el riesgo de uso de drogas y la participación en situaciones de bullying de estudiantes de secundaria. Ambas aplicaciones presentan estudios de validación con más de 1000 usuarios cada uno, de España y Chile, usando grupos de control. En el caso de Mii-School se comparó un grupo de control, que realizaba un cuestionario con las mismas características que el juego, con el grupo de intervención



que usó el videojuego. Para My School 4 Web, los jugadores realizaban los cuestionarios y también jugaban al juego. Ambos juegos mostraron resultados similares a los obtenidos con los cuestionarios, siendo mejores los de My School 4 Web. Respecto a su disponibilidad, no hemos podido encontrar el recurso de Mii-School, y en cuanto a My School 4 Web es posible pedir acceso a él a través de su página web (<http://www.myschool4web.com/>).

Otros recursos y juegos no tienen nombre de producto. Por ejemplo McEvoy (McEvoy, Oyekoya, Ivory, & Ivory, 2016), Stavroulia (Stavroulia et al., 2016) e Inoue (Inoue, Imado, & Higasino, 2017) describen juegos en sus estudios. El primero, de McEvoy, presenta también una simulación VR (realidad virtual) en cuyo estudio con 78 estudiantes de secundaria de EE.UU. comparan su utilidad respecto a la de un vídeo. El objetivo es concienciar y crear empatía sobre el bullying, sin embargo, en el experimento la aplicación VR resulta menos efectiva que los vídeos. El estudio sugiere que el resultado puede ser debido a la pobreza de los gráficos y las animaciones usadas en la experiencia VR, lo que es coherente con el desarrollo de la tecnología VR que existía en 2016.

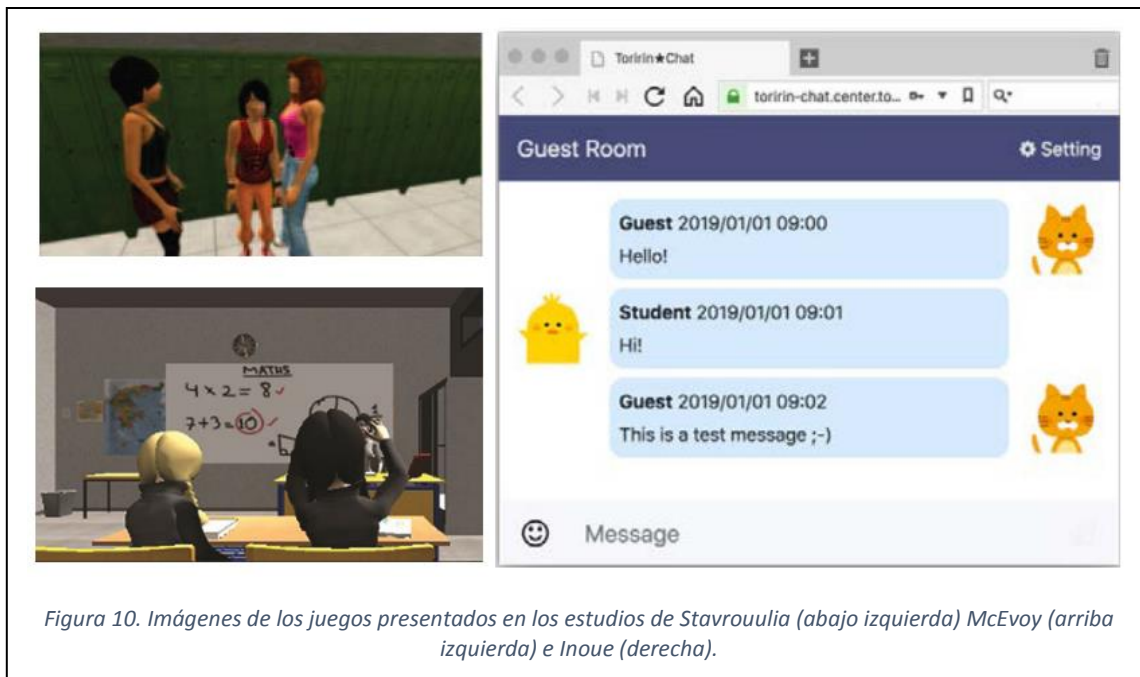


Figura 10. Imágenes de los juegos presentados en los estudios de Stavroulia (abajo izquierda) McEvoy (arriba izquierda) e Inoue (derecha).

El segundo de estos recursos es un prototipo de aplicación VR para entrenar a los profesores en la detección de situaciones de bullying. Los profesores visualizan varias situaciones y deben decidir cómo actuar, por ejemplo, regañando a alguno de los personajes. En el estudio piloto con 10 usuarios, la aplicación parece ser prometedora pero los escenarios presentados no fueron considerados útiles a la hora de enseñar a identificar un problema tan complejo como es el del acoso escolar.

El último, de Inoue, es una aplicación que simula una red social y aborda conjuntamente los temas del ciberbullying y la seguridad en la red. Tiene como objetivo enseñar a los niños con necesidades especiales a usar redes sociales de forma segura, es decir, a no proporcionar información sensible en las redes. La aplicación permite que los alumnos manden mensajes y emoticonos en diferentes escenarios configurados por el profesor, que tiene acceso a todos los mensajes que intercambian los estudiantes. El estudio, con 38 usuarios en Japón, tiene bastantes limitaciones ya que el profesor interviene durante la sesión y no se presentan datos científicos de su efecto, utilidad o aceptación.

Existen otros juegos serios compuestos por varios minijuegos. Cyberhero Mobile Safety (Hswen, Rubenzahl, & Bickham, 2014) presenta 6 juegos para enseñar a navegar por Internet de forma segura a niños de 8 a 12 años. El estudio realiza una validación con 108 usuarios de Nueva York donde, después de jugar, un cuestionario mide la percepción de los jugadores. Los resultados muestran que los jugadores disfrutaron y que percibieron útiles los mensajes y consejos que dan los diferentes juegos.



Figura 11. Imágenes del juego *Cyberhero Mobile Safety* (izquierda) y del presentado en el estudio de Ioannou (derecha).

Quest for the Golden Rule (Rubin-Vaughan, Pepler, Brown, & Craig, 2011) es un programa de prevención de bullying que proporciona tres juegos independientes donde el jugador debe tomar decisiones frente a distintas situaciones. Los estudiantes de 6 a 11 años pueden, en cada uno de los tres juegos, aprender qué es el bullying, entrenar habilidades sociales a la hora de hacer amigos y aprender a responder ante una situación de bullying. Los juegos fueron evaluados mediante cuestionarios pre-post en Canadá con entre 226 y 438 estudiantes dependiendo del juego. Los resultados fueron positivos y reportaron un incremento en los tres aspectos que abordaban: conocimiento, habilidades sociales y estrategias de prevención.

Ioannou en un estudio (Ioannou, 2019) presenta una actividad formada por varios juegos para tabletas digitales. En ellos los jugadores deben completar puzzles, relacionar conceptos y decidir cómo solucionar varias situaciones de bullying, desde los roles tanto de observador como de víctima, que se les presentan en vídeo. El objetivo de la actividad es educar socioemocionalmente para prevenir el bullying. En el estudio se describe un experimento realizado con 86 alumnos de 10 y 11 años en Chipre, donde se grabaron las sesiones y se realizaron entrevistas posteriores a estudiantes y profesores para comprobar su nivel de satisfacción. Los estudiantes disfrutaron de la actividad y los profesores percibieron el juego como una herramienta útil para utilizar en sus clases y que ayudaba a sus alumnos. Los datos recogidos muestran que el juego ayudaba a los estudiantes a trabajar en grupo y compartir sus ideas de manera organizada. Además, los jugadores



Figura 12. Imágenes del juego Cyberhero Mobile Safety (izquierda) y del presentado en el estudio de Ioannou (derecha).

mostraban empatía hacia la víctima de las situaciones presentadas por el videojuego a través de los comentarios que realizaban durante la sesión. Actualmente, ninguno de estos juegos parece estar disponible.

Juegos como Cooperative Cybereduca 2.0 (Garaigordobil & Martínez-Valderrey, 2018) y Stop the Bullying Now (Lievence, Vacaru, Liber, Bonnet, & Sterkenburg, 2019) tienen como mecánica principal realizar preguntas al jugador que debe contestar correctamente para conseguir puntos y avanzar.

Cybereduca es un videojuego por turnos, con opción de multijugador local, para estudiantes de secundaria. El videojuego ha sido desarrollado como complemento y refuerzo del programa de prevención Cyberprogram 2.0. Todos los estudios para comprobar la efectividad del programa se realizaron antes del desarrollo del juego, de modo que el videojuego no tiene experimentos propios. Cooperative Cybereduca 2.0 trata tanto el bullying como el ciberbullying y tiene como objetivo enseñar qué son, a identificarlos y a concienciar sobre ambos problemas.

Stop Bullying Now! enseña cómo actuar ante situaciones de bullying a profesores de alumnos con discapacidades. Este videojuego presenta un estudio realizado con 150 profesores y grupo de control, en el que se evalúa mediante cuestionarios pre-post y cuestionarios de seguimiento posterior. Los resultados fueron positivos en cuanto al incremento de la autonomía de los profesores para aplicar estrategias de apoyo a sus alumnos y con respecto al grupo de control al que se le proporcionó recursos sobre temas no relacionados con bullying.

Ambos juegos pueden jugarse de manera libre y gratuita en las webs <https://www.cybereduca.com/> y <http://www.stopnumetpesten.nl> respectivamente. Cybereduca está disponible en inglés, español y euskera, mientras que Stop Bullying Now! está disponible sólo en neerlandés.



Figura 13. Imágenes del juego presentado por el estudio de Lazarinis (arriba izquierda) y los juegos Stop the Mob (arriba derecha), Cyber Bullet (abajo izquierda), y FearNot! (abajo derecha).

Otros juegos son más narrativos y se centran en construir historias que plantean diferentes situaciones al jugador, para que empatee con los personajes que se presentan y experimente las consecuencias de sus acciones. La aplicación propuesta por Lazarinis (Lazarinis, Alexandri, Panagiotakopoulos, & Verykios, 2019) es un juego para niños de 6 a 10 años que cuenta varias historias sobre los problemas del mal uso de Internet, y tiene como objetivo ayudar a los profesores a tratar el problema del ciberbullying y el uso seguro de las nuevas tecnologías. Cuenta con un pequeño estudio con 42 estudiantes y 6 profesores en el que recoge su opinión sobre el juego, que fue positiva.

Tsai (Tsai, Tseng, & Weng, 2011) describe un videojuego para concienciar sobre el bullying. En el videojuego se presentan diferentes situaciones en tres fases. La primera fase describe y muestra una situación inicial. En la segunda fase el jugador puede elegir entre varias opciones que es lo que le sucede a la víctima en esa situación, si es perdonada, agredida física o verbalmente, etc. En la tercera fase el videojuego muestra las consecuencias de la opción escogida y da la opción al jugador de seguir el comportamiento violento o de perdonar a la víctima. El estudio piloto asociado únicamente describe que un 68% de jugadores eligió las acciones de violencia en la segunda fase y que, en la tercera, cuando se vuelve a preguntar al jugador, el 82% perdonó a la víctima.

Stop the Mob! (Walsh & Schmoelz, 2016) cuenta una historia en la que el jugador es observador del bullying que sufre un compañero de clase a lo largo de 5 escenarios y puede seleccionar qué hacer cuando se dan estas situaciones, pudiendo ayudarlo o ser cómplice del acoso. Según estas acciones, el estado anímico de la víctima varía y el jugador obtiene una puntuación. El objetivo principal de Stop the Mob! es dar al profesor una herramienta para introducir el tema del bullying en clase y facilitar el aprendizaje de prevención mostrando escenarios y cómo se debe actuar. La publicación relacionada con el juego es básicamente descriptiva, pero no describe ningún experimento ni prueba formal de su efectividad.

CyberBullet (Mikka-Muntuumo, Peters, & Jazri, 2018) aborda el problema del ciberbullying en jóvenes. Incluye varias mecánicas entre las que se encuentran encuestas, diálogos y toma de decisiones donde el jugador aparece en tercera persona y como víctima. El estudio sobre el juego no proporciona evidencias de su efecto final sobre el jugador.

FearNot! (Paiva et al., 2004; Watson et al., 2010) es un juego con numerosas publicaciones científicas que tiene el objetivo de que los jugadores de entre 8 y 12 años comprendan mejor las situaciones de observador y víctima, aumenten su empatía y adquieran estrategias de evitar el bullying. FearNot! presenta varios capítulos en los que se muestran situaciones de bullying al jugador. En ellos la víctima pide consejos al jugador, que le puede decir qué hacer, el personaje puede hacer caso o no al jugador. Los siguientes capítulos cambian según los consejos que el jugador proporciona y de las decisiones que toma el personaje de la víctima en base a esos consejos. Las evaluaciones con más de 1000 estudiantes de Alemania y Reino Unido incluyen grupos de control y demuestran que el juego es efectivo aumentando la empatía y enseñando maneras de actuar contra el bullying. Los resultados fueron mejores con los estudiantes alemanes que con los del Reino Unido.

En la fecha de la escritura de este documento, de estos cinco juegos, el único disponible es Stop the Mob! que se puede encontrar en versión web y en <http://www.playful-pedagogy.org/stop-the-mob.html>. Por otro lado, aunque FearNot! ya no está disponible, su código fuente es descargable en <https://sourceforge.net/projects/fearnot/>.

Hay otros juegos serios que combinan una mayor libertad y/o exploración con los escenarios más narrativos de bullying. StopBully (Raminhos et al., 2016) es un juego para jugadores de 10 a 12 años con varios niveles y escenarios. La mecánica principal son los diálogos y la toma de decisiones, añadiendo un mapa del juego donde el jugador puede explorar y moverse. Se puede jugar en el rol de observador, víctima o acosador. El

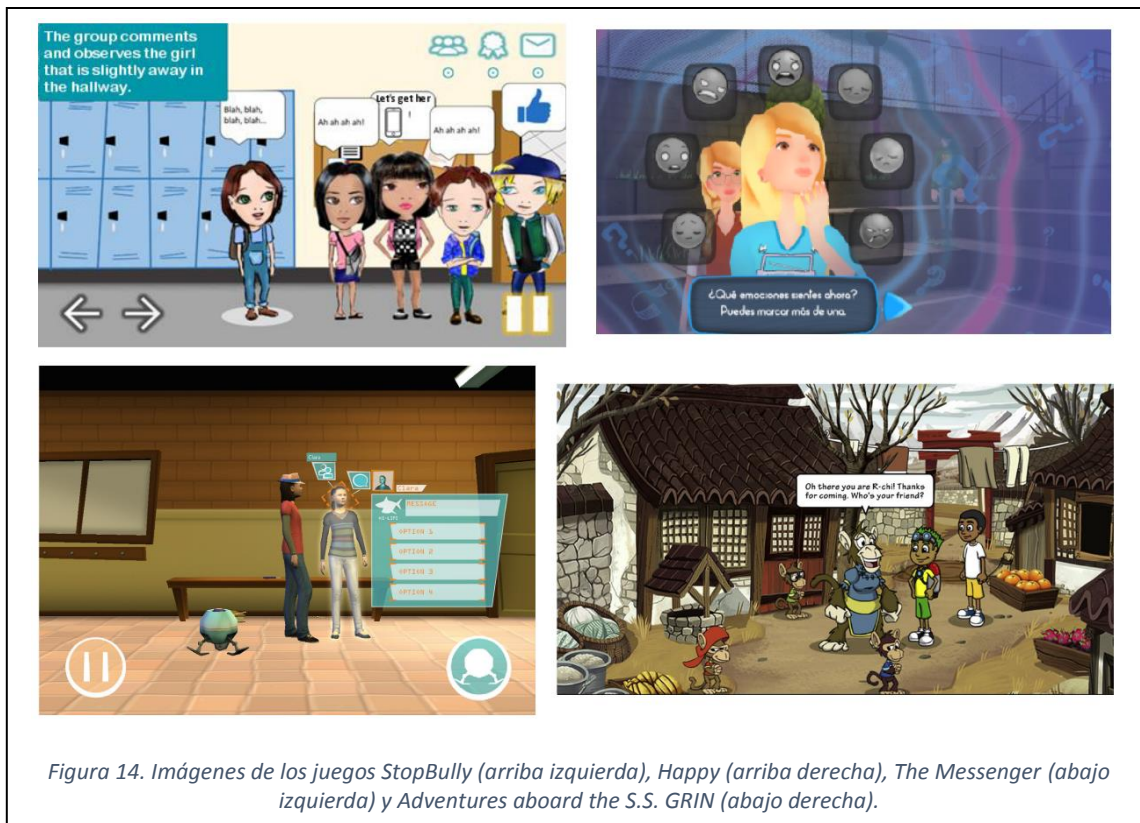


Figura 14. Imágenes de los juegos StopBully (arriba izquierda), Happy (arriba derecha), The Messenger (abajo izquierda) y Adventures aboard the S.S. GRIN (abajo derecha).

objetivo del juego es crear empatía, concienciar, y enseñar estrategias para evitar el bullying. El juego tiene varios estudios asociados donde se describen distintas evaluaciones con un total de unos 100 estudiantes portugueses para evaluar la aceptación y la opinión sobre los diferentes elementos del juego. Aunque las opiniones fueron positivas, no se describen resultados de la efectividad del juego en los aspectos de prevención, concienciación o empatía.

Rodrigues (Rodrigues, Neves, & Barroso, 2013) describe un prototipo de videojuego 3D. El prototipo pone al jugador como un estudiante nuevo en un colegio donde puede hacer amigos y debe completar misiones que se le asignan. Según sus acciones puede ganar o perder puntuación y recursos. El prototipo no tiene validaciones asociadas y no se encuentra disponible.

Happy (Ros-Morente, Cuenca, & Filella-Guiu, 2018) es un videojuego con 2 versiones, una dirigida a jugadores de 8 a 12 años y otra para 12 a 16 años. El objetivo del juego es enseñar técnicas de resolución de conflictos, mejorar las competencias emocionales y reducir la ansiedad, todos ellos elementos relacionados estrechamente con el acoso escolar. Ambos videojuegos constan de 25 conflictos donde el jugador debe elegir cómo responder y qué emociones le evoca la situación. 15 de estos escenarios son en un ámbito escolar y los otros 10 en uno familiar. Los estudios con 574 estudiantes de primaria y 903 de secundaria con grupos de control y cuestionarios pre-post muestran un efecto positivo en parte de las variables evaluadas relacionadas tanto con la

concienciación como con las competencias emocionales y con los niveles de ansiedad. Se puede solicitar acceso al juego en <http://www.ub.edu/grop/en/happy-videogame/>.

The Messenger (DeSmet et al., 2018) es un juego para jóvenes de 12 a 15 años desarrollado con la herramienta de autoría Friendly ATTAC. El juego tiene el objetivo de concienciar y sensibilizar sobre el ciberbullying, enfocándose en el rol del observador, pero permitiendo experimentar los tres roles. Los personajes del juego muestran diferentes comportamientos y reacciones según las elecciones del jugador. Un estudio con 249 usuarios en Bélgica, con grupo de control, cuestionarios pre-post y seguimiento posterior, muestra resultados positivos en comportamiento y en la calidad de vida. Sin embargo, el cuestionario de seguimiento no muestra una reducción de prevalencia del acoso escolar del grupo en ninguno de los roles (observador, víctima o acosador).

Adventures aboard the S.S. GRIN (Sanchez, Brown, Kocher, & DeRosier, 2017) es una aventura gráfica de ciencia ficción diseñada para mejorar las habilidades sociales y emocionales y la confianza en sí mismos de niños de 7 a 11 años. Está enfocado a personas que sufren problemas sociales como aislamiento, rechazo, bullying y ansiedad social. Dos estudios con un total de 100 niños de habla inglesa, con grupo de control y cuestionarios pre-post (online desde casa) muestran efectos positivos en aspectos de cultura social, satisfacción social, ansiedad social y victimización de bullying. El juego requiere el pago de una licencia, aunque ofrece una demo gratuita para probarlo (<https://www.centervention.com/adventures-aboard-the-s-s-grin/>).



Figura 15. Imágenes de los juegos Singularities (arriba izquierda), Monité (arriba derecha), PREVER (abajo izquierda) y Bullybook (abajo derecha).

Singularities, Monité y PREVER son otros 3 juegos cuyas mecánicas principales difieren más de los anteriores centrados en diálogos y preguntas y respuestas. Singularities (Coulter et al., 2019) es un RPG (juego de rol) con combates por turnos con el objetivo de reducir el uso de drogas, así como enseñar estrategias para afrontar el bullying y los problemas de salud mental. Está enfocado a jóvenes LGTBIQ+ y su estudio describe un experimento con 240 estudiantes LGTBIQ+ de EE.UU. usando grupo de control y cuestionarios pre-post y de seguimiento. Sin embargo, el estudio no presenta datos científicos sobre el efecto del juego en los estudiantes.

Monité (Guerra, 2017) es un juego de plataformas 3D con diálogos y exploración para niños de 6 a 11 años cuyo objetivo principal es enseñar estrategias de resolución de problemas y mejorar las competencias emocionales. Su estudio describe un experimento con 92 estudiantes de 10 a 12 años usando grupo de control y con cuestionarios pre-post. Los resultados fueron positivos en algunas de las variables medidas que representan la tendencia al peligro, las amenazas, las fobias y los miedos, mostrando así una reducción de las conductas de riesgo relativas al acoso escolar. Para usar Monité hay que comprar una licencia en su web. Además, proporciona diferentes recursos complementarios para usar en clase (<https://monite.org/>).

PREVER, acrónimo de *Prevention of Racial Stigma* (Álvarez-Bermejo, Belmonte-Ureña, Martos-Martínez, Barragán-Martín, & del Mar Simón-Marquez, 2016), es una aplicación móvil para concienciar sobre el bullying y para detectar casos de exclusión y racismo. El juego es multijugador, los estudiantes deben escanear los códigos QR de sus compañeros de clase, y de esta forma pueden proponerse retos y “atacarse” para ganar puntos. Además, la aplicación permite hacer grupos para ciertas actividades y los jugadores pueden aceptar o rechazar a otros compañeros. La aplicación genera así un sociograma con las interacciones y conciencia sobre el efecto en la realidad de las decisiones que toman los jugadores. El estudio realizado con 151 estudiantes de 7 a 16 años en Almería (España) sirvió para estudiar los grupos generados en varias clases y como interactuaban los jugadores con compañeros de su misma y distintas nacionalidades. Sin embargo, el estudio no evalúa la efectividad de la aplicación a la hora de concienciar.

BullyBook (Cebolledo & De Troyer, 2015) simula una red social donde el jugador puede ver sus publicaciones y las de otros personajes no jugables (NPCs). El jugador puede inspeccionar las interacciones de esos personajes, decidiendo cómo y cuándo intervenir. Por ejemplo, puede contestar a los personajes, escribir en su muro de perfil o usar el botón de “me gusta”. El jugador puede apoyar el acoso o defender a una víctima. El juego propone diferentes desafíos, como hacerse amigo de un determinado personaje

o defender a algunas víctimas. No tiene ningún estudio experimental de su efectividad como herramienta de prevención.

Por último, programas de prevención como el previamente mencionado Kiva (Hutchings & Clarkson, 2015) o SmartTalk (Bosworth, Espelage, & DuBay, 1998) disponen también de juegos serios como recursos complementarios. Sin embargo, estos juegos no han sido descritos con detalle en sus estudios, ni evaluados individualmente, y tampoco son accesibles de manera libre.

2.3.2. Estrategias y mecánicas

Al igual que con el resto de recursos, hay gran variedad en las estrategias y las mecánicas usadas por los diferentes videojuegos. El público objetivo de los videojuegos también varía: algunos están diseñados para alumnos de primaria y secundaria, otros van enfocados a profesores y unos pocos se centran en colectivos más específicos como los estudiantes LGTBIQ+. Los juegos serios también abordan el problema desde diferentes ángulos y estrategias que, en su mayoría, se corresponden con los de los recursos analizados en la sección 2.1.:

- Concienciar sobre el problema y darle visibilidad para que los jugadores entiendan las consecuencias de sus acciones y el efecto que pueden tener en los demás.
- Crear empatía con las víctimas.
- Enseñar estrategias para combatir el problema.
- Enseñar el uso seguro y responsable de Internet y de las redes sociales.
- Informar sobre el acoso, qué es, sus características y efectos, etc.
- Enseñar a identificar las situaciones de acoso.
- Cambiar el comportamiento de los jugadores ante ciertas situaciones.
- Detectar y evaluar el nivel de riesgo de estar implicado en un caso de (ciber)bullying.
- Practicar los conocimientos y las estrategias de prevención relacionados con el acoso y el ciberacoso.

- Desarrollar habilidades emocionales que disminuyan el riesgo de victimización y que traten alguno de los efectos de la victimización, como la ansiedad o el miedo.
- Desarrollar habilidades sociales que permitan a los jugadores relacionarse mejor con los otros, disminuyendo así el riesgo de victimización y agresión.

De estas estrategias, las más utilizadas entre los juegos revisados son la de enseñar formas de evitar y combatir el (ciber)bullying y la de concienciar a los jugadores. También hay videojuegos que trabajan con las habilidades sociales y las emociones de los jugadores para reducir la prevalencia del acoso escolar. La mayoría de estos juegos serios se enfocan únicamente en prevenir el bullying y solamente 5 de ellos llegan a abordar ambos problemas (bullying y ciberbullying) mostrando su estrecha relación en el ámbito escolar. Además, solo 3 de los juegos serios estudian la detección de situaciones de bullying o ciberbullying según las acciones de los jugadores. Dos de ellos son una adaptación de cuestionarios en papel ya validados (Cangas et al., 2013; Carmona et al., 2010) y el tercero estudia el clima social de una clase en base a la interacción en el juego con el resto de alumnos de la misma clase (Álvarez-Bermejo et al., 2016).

Para aplicar estas estrategias de prevención y detección, los juegos serios hacen uso de distintas mecánicas que les proporcionan el tipo de jugabilidad deseada para cumplir su objetivo. La mayoría de estos juegos muestran situaciones de acoso, mediante vídeos o diálogos entre varios personajes, en las que el jugador debe tomar algún tipo de decisión ante el problema, para luego mostrar las consecuencias que provocan estas decisiones. Las situaciones a veces se enmarcan en una historia narrativa a lo largo del juego, que puede tener rasgos de ciencia ficción, mientras que otras veces son escenarios independientes. Muchos de estos juegos presentan los efectos del bullying para concienciar a los jugadores de la gravedad del problema y crear empatía hacia las víctimas. En otros casos optan por proporcionar diversos escenarios donde el jugador pueda practicar y aprender distintas estrategias y maneras de actuar para prevenir y combatir el acoso. Por otro lado, en estos videojuegos para abordar el (ciber)bullying es muy habitual encontrar mecánicas que fomentan la sensación de control en el jugador, como las de proporcionar libertad de movimiento, la exploración al jugador, la edición de la apariencia de su avatar y las preguntas con respuestas correctas e incorrectas.

2.3.3. Público objetivo

La mayoría de juegos van dirigidos a estudiantes, siendo más abundantes aquellos dirigidos a últimos cursos de primaria y los cursos de secundaria, edades en las que la literatura describe que se concentran la mayoría de casos de bullying y ciberbullying en

la escuela. Tan solo hemos identificado cinco juegos que tengan al profesor como público objetivo (E. Bradley et al., 2019; E. G. Bradley & Kendall, 2019; Kalaitzis et al., 2010; Lievense et al., 2019; Stavroulia et al., 2016). Step In, Speak Up! y At-Risk for Middle School Educators son juegos de rol, Stavroulia usa la realidad virtual y Stop Bullying Now! utiliza preguntas sobre situaciones que se le muestran al jugador. Estos juegos se basan en mostrar diferentes situaciones de acoso escolar al profesor para que aprenda a identificarlas y estrategias de cómo actuar antes estas. Por otro lado, SimSafety proporciona un entorno para trabajar, contextualizar y concienciar sobre el ciberbullying tanto a profesores como a los estudiantes.

2.3.4. Experimentos y evidencias de efectividad

Todos los juegos descritos tienen asociada alguna publicación científica donde, en la mayoría de los casos, se describen experimentos con usuarios. Sin embargo, los diseños experimentales son muy diferentes y en algunos casos incluso discutibles. Sólo 15 de ellos tienen experimentos donde se demuestra cierto efecto cumpliendo uno o varios de los objetivos del juego en cuanto a la prevención o detección del (ciber)bullying. El resto, o bien no describe los resultados con suficiente rigor, o bien sus experimentos tienen otros objetivos como recoger la opinión sobre el juego, su uso en clase o a validar la aceptación de su diseño. Respecto a los métodos para evaluar estos juegos, el método más utilizado son los cuestionarios pre-post en el caso de los experimentos que buscan medir expresamente el efecto del juego, y de cuestionarios únicamente post en los demás casos. Este resultado es coincidente con lo descrito por otros autores que han realizado estudios sobre juegos serios en general (Boyle et al., 2016; Calderón & Ruiz, 2015). A esta escasez de casos en los que se demuestra la efectividad de los juegos hay que sumarle la habitualmente reducida muestra con los que se realizan dichos experimentos. En el caso de los juegos mencionados, la media de usuarios en los grupos de intervención es menor a 300 jugadores y en la mitad de ellos se usan menos de 100.

En cuanto a los datos recogidos y el uso de analíticas, si bien hay 6 juegos que recogen información sobre las interacciones de los jugadores (en concreto, en archivos de logs), únicamente dos de ellos comparan estos datos con los resultados de los cuestionarios realizados. Además, en estos casos únicamente comparan las decisiones tomadas en el juego con las respuestas en los cuestionarios para comprobar si el juego se puede utilizar como herramienta de detección al igual que los cuestionarios ya validados. Otro de los juegos realiza un sociograma en base a las interacciones entre los jugadores (Álvarez-Bermejo et al., 2016). Ninguno de los juegos que recoge información sobre las interacciones de los jugadores usa esta información para complementar los datos obtenidos de los cuestionarios y analizar el efecto del juego en función de la forma de

jugar de los usuarios. Por tanto, los datos recogidos no tienen una utilidad real (o es muy limitada), por lo que se puede afirmar que el uso de analíticas en el campo de los juegos serios para la prevención y detección del (ciber)bullying es incluso menor que en otros tipos de juegos. Uno de los motivos que podrían explicar este escaso uso de las analíticas es el propósito de los juegos, que en este caso no es incrementar el conocimiento teórico, sino incrementar concienciación y mostrar el problema y sus consecuencias de una forma que llegue a los alumnos.

2.3.5. Limitaciones

A pesar de existir varios estudios sobre el uso de juegos serios con objetivos de prevenir y detectar el (ciber)bullying, siguen existiendo numerosas limitaciones en el campo. Por un lado, sería de utilidad una mayor aplicación de analíticas para entender mejor el efecto del juego según las interacciones de los jugadores. También es necesario disponer de más evidencias sobre la efectividad de los juegos. Como se ha mencionado previamente, hay pocos juegos que tengan experimentos que evalúen sus efectos sobre grandes grupos de usuarios y, debido a la diversidad de estrategias y mecánicas que se utilizan, los resultados son poco generalizables. A esto hay que sumarle que la mayoría de juegos abordan únicamente el problema del bullying, sin tener en cuenta las características del ciberbullying.

Por último, destaca la falta de disponibilidad de dichos juegos. Únicamente 3 de ellos (Cooperative Cybereduca 2.0, Stop Bullying Now! y StopTheMob!) pueden descargarse de forma libre y gratuita. Para otros es necesario ponerse en contacto con sus investigadores (Happy y MySchool4Web) o implantar el programa de prevención como en el caso de Kiva. Para jugar a los videojuegos Step In, Speak Up!, Adventures Aboard The S.S Grin, At-Risk For Middle School Educators y Monité es necesario pagar una licencia por jugador. Esto pone en evidencia que muchos de los juegos serios desarrollados y validados científicamente tienen tiempos de vida muy cortos, no llegando a estar disponibles para el público o dejándolo de estar cuando termina la investigación. Hay pocas excepciones, generalmente juegos que se han comercializado y por tanto es necesario el pago de algún tipo de licencia. Aun así, muchos siguen teniendo un ciclo de vida corto desapareciendo la posibilidad de utilizar el recurso.

Capítulo 3. Objetivos y planteamiento de la tesis

Como se ha descrito en los capítulos anteriores, el objetivo principal de este trabajo de tesis es estudiar el uso de los juegos serios como herramientas educativas aplicadas en clase para la prevención del bullying y el ciberbullying. Además, este estudio propone aplicar técnicas de analíticas de aprendizaje para juegos (GLA) con el propósito de mejorar y simplificar las diferentes fases del ciclo de vida de los juegos serios. El objetivo se ha abordado a través de cuatro objetivos más específicos:

1. Estudio del dominio del acoso escolar y de los juegos serios como herramientas de prevención, así como de los estudios sobre la efectividad de dichos juegos.
2. Desarrollo de un videojuego serio abierto para la prevención del (ciber)bullying.
3. Desarrollo e integración de GLA para recoger información sobre las interacciones del juego serio desarrollado.
4. Validación del videojuego y de su uso en clase mediante experimentos controlados en entornos reales aplicando GLA.

En las subsecciones de este capítulo describimos más en detalle cada uno de estos objetivos y de qué manera se han llevado a cabo para la compleción de este trabajo de tesis.

3.1. Estudio del dominio

Este primer objetivo se ha abordado y desarrollado en el capítulo anterior. Incluye el estudio del marco teórico del acoso escolar y la revisión de estudios anteriores que han propuesto juegos serios como herramientas educativas para la prevención del (ciber)bullying. También analiza el uso de las analíticas de aprendizaje en los estudios asociados a estos juegos serios. El marco teórico de los problemas del bullying y el ciberbullying sirve para sistematizar los procesos posteriores y dirigir el diseño del videojuego desarrollado en esta tesis con el nombre de Conectado. De esta forma, se analizan y seleccionan las características del acoso que serán representadas en el videojuego y las estrategias con las que se abordarán. El estudio de las publicaciones realizadas en base a otros juegos serios y su uso de las analíticas permite determinar los aspectos en los que se habían señalado áreas de mejora, como la aplicación de GLA de formas no utilizadas en este campo hasta ahora.

Este estudio teórico del dominio abarca un amplio análisis de la literatura existente sobre el (ciber)bullying y el estudio de los diferentes tipos de recursos que existen y que

abordan este problema. Para estudiar los juegos serios que se han usado como herramientas educativas para tratar el problema del acoso escolar se realizó una revisión sistemática de la literatura. De esta revisión se obtuvieron aquellos juegos serios con publicaciones científicas asociadas que afrontan la prevención y detección del (ciber)bullying. Como describe el capítulo 2, el alcance de los juegos serios enfocados a la prevención y la detección tiene varias limitaciones: la falta de juegos serios que aborden ambos problemas, la falta de evidencias de su efectividad y la imposibilidad de acceder a muchos de estos recursos. Esta falta de acceso impide que otros investigadores realicen nuevas investigaciones sobre ellos, ya sea para probar su efecto en un ámbito diferente, mejorar el recurso, replicar la investigación, o realizar comparaciones entre recursos. Por otro lado, aunque algunos estudios mencionan la recogida de datos de interacción, los videojuegos son validados mediante cuestionarios auto-evaluados, sin hacer uso de analíticas para su validación. Todas estas limitaciones refuerzan la necesidad de abordar el segundo y cuarto objetivos mencionados en la sección 1.2: el desarrollo de un videojuego que sirva como herramienta de prevención del (ciber)bullying y su validación adecuada proporcionando evidencias de su efecto en los jugadores.

3.2. Desarrollo del juego serio

Tras el estudio del marco teórico y el análisis de los juegos serios existentes que abordan el acoso escolar, el siguiente objetivo ha sido el desarrollo del juego serio usado en este trabajo y denominado Conectado. Para hacer frente a este desarrollo, es importante definir un objetivo pedagógico claro e implementar mecánicas de aprendizaje y de juego que ayuden a cumplirlo. Además, se debe tener en cuenta el público al que va dirigido y el contexto en el que se va a utilizar. Los diferentes estudios y recursos analizados mostraban estrategias muy variadas para combatir el problema del (ciber)bullying.

La estrategia escogida para abordar la prevención del acoso escolar con el juego Conectado es la concienciación y la creación de empatía. Para ello, como recomiendan las publicaciones sobre el desarrollo de juegos serios, hemos diseñado entornos y situaciones realistas que representen de una forma creíble el problema tratado. Las mecánicas y decisiones de diseño buscan cumplir este objetivo. El juego muestra los dos problemas, bullying y cyberbullying, de forma conjunta, ya que es muy frecuente que aparezcan ambas situaciones en los colegios e institutos. En cuanto a la forma de uso, el propósito de Conectado es servir como herramienta para ser utilizada en clase por un profesor. Para poder aplicarlo en este contexto, se propuso que el juego tuviese una duración corta y proporcionase una experiencia común a todos los jugadores, aunque con ligeras variaciones y distintos finales, sobre la que el profesor pudiera plantear una reflexión con sus alumnos una vez que se ha jugado a Conectado.

Los pasos seguidos en el desarrollo de Conectado fueron: (1) la definición de requisitos a través del estudio de la literatura y de los objetivos de aprendizaje propuestos; (2) el diseño y el desarrollo de un primer prototipo; (3) el contraste del diseño con psicólogos y educadores expertos así como una evaluación formativa en colegios; (4) la integración de mejoras y correcciones obtenidas en la fase anterior para realizar una evaluación sumativa en colegios, tanto con alumnos como con profesores.

Para evitar una de las limitaciones identificadas en los recursos analizados en el capítulo 2, Conectado ha sido concebido como un proyecto de código y recursos abiertos disponible en <https://github.com/gorco/Conectado-CyberbullyingGame>.

3.3. Integración de analíticas

El siguiente objetivo de este trabajo de tesis es la aplicación de técnicas de GLA para mejorar los procesos de desarrollo, validación y aplicación en la clase del juego serio Conectado. Esto incluye la recogida de datos de interacción de los usuarios, el análisis de estos datos, tanto en tiempo real como a posteriori, y su visualización para simplificar su comprensión. Para llevar a cabo este objetivo es necesario un modelo que guíe el proceso e integre un sistema de analíticas con Conectado. El modelo de analíticas de aprendizaje a utilizar es el propuesto por (Chatti et al., 2014) que define: (1) qué información se quiere obtener de los jugadores; (2) con qué objetivo se recogen los datos; (3) cómo se van a recoger y analizar los datos; y (4) a quién se dirigen los datos y qué análisis se van a realizar.

Actualmente, en la mayoría de los estudios de juegos serios que utilizan las analíticas para evaluar a los usuarios el objetivo de dichos juegos es enseñar conocimiento de algún tipo. Sin embargo, en este trabajo se aplican las analíticas en un videojuego cuyo objetivo es el incremento de la concienciación sobre el problema del (ciber)bullying y la creación de empatía con las víctimas. Estos objetivos son muy ambiciosos de modo que es muy complejo medirlos únicamente con las acciones de los jugadores debido, entre otros aspectos, a la existencia de lo que se denomina *dark play* (Mortensen, Linderoth, & Brown, 2015). Los jugadores pueden jugar de forma exploratoria tomando decisiones distintas a las que elegirían en la vida real (por ejemplo, jugando a ser “malos”) o buscando maneras de saltarse las restricciones impuestas por el diseño del juego. Por ello, el uso de las analíticas en Conectado tiene otros objetivos diferentes a la simple evaluación del jugador y de sus acciones. Estos objetivos incluyen el uso de analíticas como ficheros de log para identificar posibles errores sutiles del juego o problemas en su diseño que no se han encontrado en las fases de depuración ni de prueba inicial con expertos o usuarios seleccionados. Otro objetivo es la combinación de estas evidencias objetivas con los resultados de los cuestionarios en la fase de validación para estudiar

mejor el efecto del juego serio en los usuarios. Además, las analíticas proporcionan un mayor control durante la aplicación del juego en el aula permitiendo conocer lo que realmente están haciendo los jugadores en tiempo real. Todo ello hace que las analíticas proporcionen un claro valor añadido en Conectado.

3.4. Validación del juego serio

El objetivo final de la tesis es la validación científica del videojuego Conectado mediante un diseño experimental completo que permita la adquisición de los datos necesarios para estudiar el efecto del juego mediante sesiones experimentales sobre un amplio conjunto de sujetos en entornos reales y diversos (es decir, en centros educativos con diferentes equipamientos y no solo en las condiciones controladas de un laboratorio). Esto implica llevar a cabo el conjunto de experimentos necesarios para: (1) recoger datos de interacción y realizar la validación de la efectividad, aceptación y aplicabilidad del videojuego Conectado; (2) proporcionar mayor evidencia sobre la utilidad de los juegos serios en clase permitiendo abordar el (ciber)bullying; y (3) evaluar el uso de analíticas de aprendizaje en juegos sobre concienciación y estudiar cómo éstas pueden mejorar las distintas fases de desarrollo, validación y aplicación de un videojuego en entornos reales.

Durante los experimentos se recogen los datos de las interacciones de los jugadores con el juego y los datos obtenidos de cuestionarios pre-post. Los cuestionarios pre-post permiten medir la concienciación sobre (ciber)bullying de los jugadores antes y después de jugar, además de recoger datos demográficos, opinión sobre el juego e, incluso, el uso de redes sociales (por si esta fuera una variable relevante). Los datos de las interacciones de los jugadores con Conectado permiten conocer de forma objetiva las acciones tomadas por los jugadores en el juego, el tiempo invertido en completarlo, etc. Los experimentos realizados tienen como público objetivo dos grupos de usuarios diferentes. En primer lugar, estudiantes de secundaria, cuyos datos permiten comprender el efecto del juego y estudiar si existen diferencias entre los usuarios según las edades, el género o las elecciones tomadas en el juego. En segundo lugar, profesores de secundaria y estudiantes de carreras de ciencias de la educación, cuya experiencia con el juego y las opiniones permiten evaluar la aplicabilidad del juego en entornos reales y su aceptación entre los profesionales de la educación. En las sesiones con estudiantes de secundaria también están presente docentes, esto permite obtener la opinión de los profesores sobre la sesión, el videojuego y sobre los análisis realizados, así como comprobar si las visualizaciones presentadas de la información recogida y analizada es comprensible.

Actualmente, la aplicación de analíticas en los diferentes estudios sobre juegos serios tiene como objetivos principales la evaluación del jugador y el estudio de su comportamiento durante el juego. Por tanto, este trabajo proporciona una mayor

evidencia de la utilidad de los juegos serios aplicados en la clase para concienciación y la prevención del acoso escolar y, a su vez, evidencias del valor añadido que proporcionan las analíticas en la vida útil de un juego serio de las características de Conectado.

Capítulo 4. Discusión integradora y contribuciones

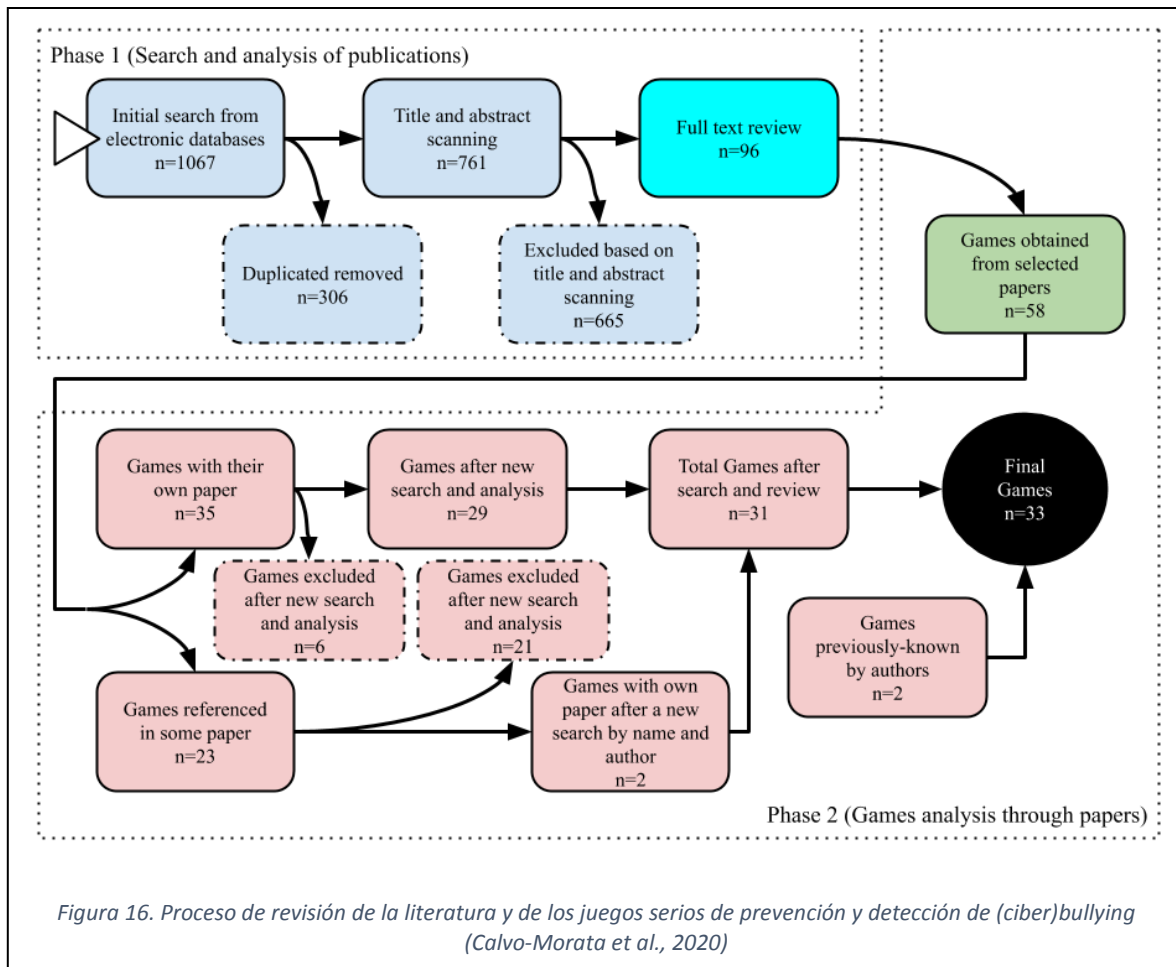
Este capítulo resume el trabajo realizado en función de los objetivos descritos en el capítulo 3. Al ser una tesis por compendio de publicaciones, los detalles completos del trabajo realizado y las contribuciones aparecen en los artículos que componen esta tesis. El capítulo está dividido en cinco secciones: la primera sección resume el estudio realizado sobre el dominio de los juegos serios como herramientas para la prevención del (ciber)bullying; la segunda sección aborda el diseño y desarrollo del juego serio Conectado; la tercera trata la integración de las analíticas de datos de interacción; la cuarta sección describe los experimentos que se han realizado para validar la efectividad y aplicabilidad de Conectado como herramienta educativa; por último, la quinta sección de este capítulo destaca la utilidad de aplicar las analíticas en el ciclo de vida de Conectado.

4.1. Estudio del dominio

Para realizar el diseño de Conectado, el primer paso ha sido estudiar el marco teórico del problema del bullying y del ciberbullying, así como el tipo de recursos y estrategias que se utilizan para abordarlos. Además, para contextualizar este trabajo y cubrir los aspectos menos tratados en esta área, se estudió en detalle otros juegos serios con la temática del (ciber)bullying, con publicaciones científicas que describieran su uso como herramienta educativa para la prevención y detección del (ciber)bullying. Este estudio del dominio se refleja en el resumen presentado en la sección 1.3, que introduce el problema del bullying en la escuela, y, sobre todo en el capítulo 2, que describe el estado del arte. El trabajo realizado de búsqueda, análisis crítico y síntesis sobre el estado actual de los juegos serios con objetivos de prevención y detección del (ciberbullying) ha sido descrito y publicado en *Computers & Education* con el título *Serious games to prevent and detect bullying and cyberbullying: a systematic serious games and literature review* (Calvo-Morata et al., 2020). Esta publicación, que forma parte de las contribuciones de este trabajo de tesis, proporciona una visión completa y detallada sobre el estado de la investigación en juegos serios para abordar el problema del acoso en la escuela. Los investigadores que quieran conocer el uso de los juegos serios en este ámbito, las mecánicas más utilizadas y las formas de evaluación aplicadas hasta ahora podrán recurrir a este trabajo. Para realizar este estudio del estado del arte sobre estos juegos se ha realizado una revisión sistemática de la literatura a partir de la siguiente consulta:

("bullying" OR "cyberbullying" OR "harassment") AND ("game" OR "gamification" OR "videogame" OR "virtual environment" OR "app" OR "simulation").

De las 1067 publicaciones que resultaron de aplicar la consulta anterior en las distintas fuentes de búsqueda, se analizaron a fondo las 96 publicaciones que cumplían



los criterios de inclusión para el campo de estudio. De ellas, se obtuvieron 58 recursos. En una segunda fase, se filtraron estos recursos según su propósito y características hasta finalmente obtener los 33 juegos que se analizan en el trabajo publicado. Entre ellos aparecía Conectado que, en la fecha en la que se realizó la búsqueda para este artículo, ya tenía publicaciones relacionadas. Este proceso se representa en la Figura 16.

La revisión de los juegos serios encontrados mediante la revisión sistemática muestra una gran variedad de mecánicas de juego utilizadas. Entre ellas, se identificaron las más comunes, como es el uso de vídeos, la toma de decisiones por parte de los jugadores y la representación realista de casos de acoso. Las estrategias a la hora de abordar el (ciber)bullying también son muy variadas y tratan diferentes aspectos (p. ej. concienciación, conocimiento, emociones, habilidades sociales, uso seguro de Internet, etc.). Los métodos utilizados para validar estos juegos son, en su gran mayoría, instrumentos externos al juego, como cuestionarios autoevaluados o grabación de vídeo y voz para su análisis posterior. En muchos casos, los juegos descritos en los estudios analizados no están disponibles y, por tanto, no es posible reproducir la investigación realizada ya que falta el elemento crítico (el juego) para que los investigadores puedan contrastarlos.

Hay que señalar que la mitad de los juegos con estudios asociados demuestran ser útiles para combatir el (ciber)bullying en mayor o menor medida. Por ello, sería deseable realizar un esfuerzo por mantener disponibles y accesibles este tipo de juegos ya que podrían tener un impacto muy positivo en la sociedad a medio y largo plazo. Esto podría lograrse fomentando la utilización de licencias abiertas tanto para el código y el juego como para los recursos gráficos (p. ej., *creative commons*). Además, el estudio de las mecánicas utilizadas en los videojuegos de (ciber)bullying puede ser útil y aplicable a otros problemas sociales que comparten algunas características como puede ser la discriminación y otros tipos de violencia. En particular, la inmersión del jugador en escenarios donde se muestran las agresiones, junto a un diseño adecuado en el que se enfatizan las consecuencias y los efectos negativos en las víctimas, permite fomentar la empatía, la concienciación, y los comportamientos de prevención y apoyo. Se aprovecha así el entorno seguro que proporciona el videojuego, y que permite al jugador experimentar las consecuencias de las diferentes elecciones que toma y aprender de su propia experiencia.

4.2. Diseño y desarrollo

Como ya hemos mencionado, el juego serio desarrollado como parte de este trabajo se llama Conectado. El diseño del videojuego parte de las ideas recogidas en el prototipo desarrollado durante el evento Hack For Good 2016, que abordaba el uso del videojuego serio como herramienta educativa para prevenir el acoso escolar (Calvo-Morata, 2017).

El videojuego se ha desarrollado siguiendo las recomendaciones de la literatura a la hora de diseñar juegos serios (Ravenscroft et al., 2012):

- Los objetivos pedagógicos. El objetivo pedagógico de Conectado es concienciar a los jugadores mostrándoles la realidad del (ciber)bullying desde el rol de víctima de las agresiones a través de todo el videojuego.



Figura 17. Imágenes del videojuego Conectado: título (izquierda) y selección de nombre y género (derecha).

- La simulación del dominio. Los escenarios deben representar de una manera creíble para el jugador el contexto en el que se desarrolla el dominio. El dominio abordado en Conectado es el del (ciber)acoso escolar, por ello los escenarios representados son los de un instituto de secundaria y la casa del protagonista. También aparecen dentro del videojuego dos escenarios con simulaciones de redes sociales que el jugador puede usar con ciertas limitaciones. Los casos de acoso y ciberacoso presentados en el juego se ubican en estos escenarios que representan espacios tanto físicos como virtuales.
- Las interacciones con el videojuego. Las interacciones diseñadas en Conectado permiten la exploración en los diferentes escenarios, en los que el jugador tiene que tomar decisiones mediante los diálogos con el resto de avatares o personajes NPCs (*Non-Player Characters*) a través de los que se construye la historia o narración del juego. El jugador tiene la sensación de que todas sus decisiones influyen en el desarrollo del videojuego (aunque no todas influyan realmente en la historia o no lo hagan en la misma medida debido a que se quiere crear una experiencia común independientemente de las elecciones del jugador).
- La progresión y los problemas con los que se va a encontrar el jugador. En Conectado, la progresión viene dada por el paso del tiempo dentro del juego. Las situaciones se presentan a lo largo de 5 días dentro del juego. Cada uno de estos días se divide en tres partes: una primera parte sucede durante la mañana en el instituto, la segunda transcurre por la tarde en la casa del jugador y, por último, la tercera parte se aborda por la noche mediante una pesadilla. Cada pesadilla consiste en un minijuego que el jugador no puede superar nunca satisfactoriamente. El acoso que sufre el jugador en el juego, que es llevado a cabo por el resto de personajes NPC que aparecen, es incremental y se intensifica según se progresa en el juego. El jugador puede tratar de disminuir el enfrentamiento para así evitar el acoso, pero en ningún caso tiene éxito completo, representando la idea principal de que para salir de una circunstancia de agresión hay que pedir ayuda externa (p. ej., familia, profesores).
- Una estética marcada que lo haga atractivo para el jugador. El videojuego tiene un estilo 2D y los recursos gráficos fueron creados por una diseñadora gráfica con experiencia en otros videojuegos¹⁰. Estos recursos dan un estilo propio a Conectado, haciéndolo un videojuego visualmente atractivo para los alumnos de la edad objetivo (12-17 años).

¹⁰ Los recursos gráficos de Conectado fueron creados por Ana Vallecillos (<https://nashek.artstation.com/>) y financiados parcialmente por la *Cátedra Telefónica-Complutense de Educación Digital y Juegos Serios*.

- Las condiciones de uso: cómo, cuándo, dónde y por quién va a ser utilizado el videojuego. Conectado está diseñado como herramienta para utilizar en clase con los estudiantes de manera individual. El público objetivo son alumnos de secundaria de 12 a 17 años. Pero si bien el juego tiene el objetivo de aumentar la concienciación del jugador, también es una herramienta que puede ser usada en clase por el profesor y maximizar su efecto mediante una sesión de debate o reflexión posterior, o con otras actividades y recursos complementarios.



Figura 18. Imágenes del videojuego Conectado: pesadilla (izquierda) e interacción con un personaje (derecha).

Entre las características del acoso que se representan en el juego se incluyen:

- El paso del tiempo. Una característica del acoso es que la agresión es continuada en un periodo de tiempo. Por eso, se presenta la división del juego en 5 días.
- La diferencia de poder, dejando al jugador sin opciones que le permitan evitar el acoso.
- Los diferentes roles que intervienen en los casos de (ciber)bullying: acosador, observador y víctima.
- La ubicuidad del ciberbullying, representada a través del acoso en las redes sociales cuando el jugador llega a casa.
- La situación de frustración, indefensión y ansiedad de las víctimas. En este videojuego se incluyen minijuegos representando agresiones en forma de pesadillas nocturnas en los que el jugador nunca puede ganar.
- La incapacidad de resolver el problema del acoso por uno mismo. Incluso si el jugador trata de evitar el enfrentamiento, habitualmente no es posible

evitar la agresión y la única forma de salir de dicha situación es pedir ayuda externa.

Como resultado de este diseño, Conectado es una aventura gráfica en 2D y en primera persona, del género *point&click*, donde los jugadores juegan en el rol de una víctima de (ciber)bullying. El juego tiene como objetivos aumentar la concienciación sobre el acoso escolar y crear empatía hacia las víctimas. Para ello muestra el (ciber)acoso en la escuela de manera realista y acerca al jugador a los sentimientos de frustración, impotencia, tristeza y rabia que suelen experimentar las víctimas. También transmite al jugador la idea clave de que el acoso sólo puede superarse pidiendo ayuda (por ejemplo, a la familia o a los profesores) y nunca permaneciendo en silencio.

El juego es en primera persona para facilitar que el jugador se identifique con su personaje, es decir, el jugador no aparece representado gráficamente por un avatar. El juego comienza con el protagonista llegando a una nueva escuela en la que tiene que integrarse y hacer amigos. Sin embargo, los personajes del juego, incluso alguno de los que parecen afables al principio, comenzarán a acosar al jugador de diferentes maneras y de una forma progresiva. El jugador puede tomar diferentes decisiones durante los diálogos con los diferentes personajes e intentar hacer frente al (ciber)bullying o tratar de evitar el enfrentamiento. Sin embargo, ninguna de estas decisiones permitirá al jugador resolver el problema antes del quinto y último día de la historia. La toma de decisiones y la libertad de movimiento a través de las diferentes escenas están diseñadas para que los jugadores sientan que tienen el control completo sobre lo que pasa dentro del juego. Sin embargo, sólo algunas de estas decisiones tienen impacto real en la historia. El objetivo de la mecánica de decisiones es dar una sensación de libertad y a la vez conseguir en el jugador un sentimiento de impotencia al no poder superar la situación de acoso independientemente de las decisiones tomadas. De esta forma también se asegura que todos los jugadores obtengan una misma experiencia compartida sobre la que el profesor

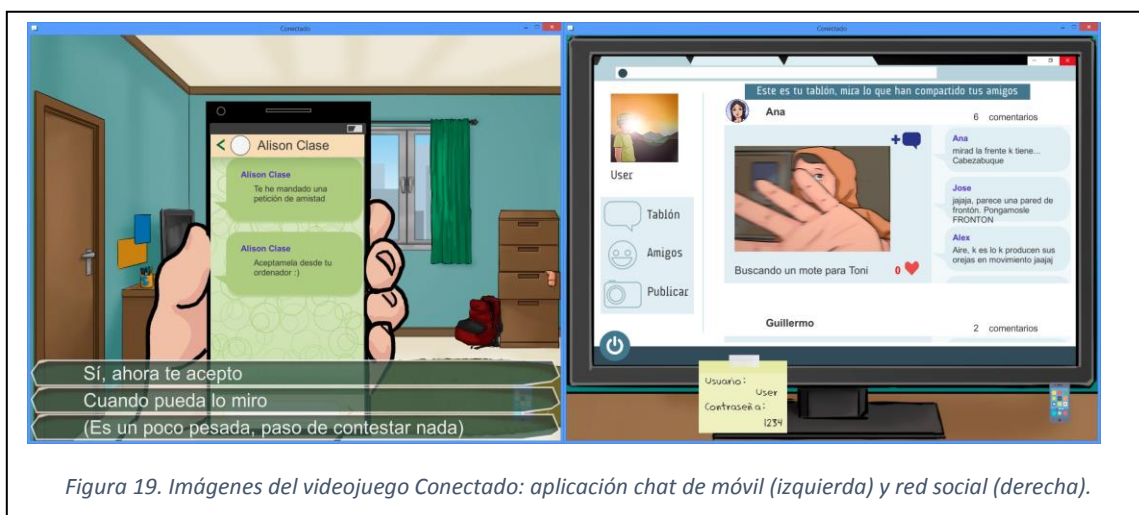


Figura 19. Imágenes del videojuego Conectado: aplicación chat de móvil (izquierda) y red social (derecha).

pueda construir una discusión con toda la clase sobre el problema del acoso (y además lo pueda particularizar o extender con situaciones pertinentes no recogidas en el juego). Conectado también incluye cuatro minijuegos, uno al final de cada uno de los primeros cuatro días. Estos minijuegos representan pesadillas relacionadas con la historia ocurrida en ese día del juego y están diseñadas para que los jugadores no puedan superarlas satisfactoriamente (minijuegos en los que el usuario siempre pierde). El objetivo de estos minijuegos es provocar impotencia y frustración en los jugadores, y transmitir que el acoso sufrido puede tener efectos que persiguen a la víctima las 24 horas del día.

4.3. Integración de analíticas

Para integrar las analíticas con el juego Conectado se reutilizó el sistema de analíticas de aprendizaje que se estaba desarrollando en el proyecto europeo H2020 RAGE (de hecho, Conectado fue uno de los casos de éxito de la prueba de dicha tecnología de analíticas para juegos en el proyecto RAGE). En el código del videojuego, se incluyó un Tracker (github.com/e-ucm/unity-tracker), que es una librería con la funcionalidad necesaria para enviar los datos de interacción del usuario con el juego (trazas) al servidor de analíticas de aprendizaje. El Tracker envía los datos siguiendo el formato estándar xAPI-SG Profile (Serrano-Laguna et al., 2017). El estándar xAPI, es un formato basado en el protocolo Activity Stream (Bowe, 2013) para seguimiento de usuarios en redes sociales, que permite recoger la experiencia del usuario en el juego mediante construcciones o frases que son trozos de información autocontenida. Estas

```
"statement" : {
  "actor" : {
    "account" : {
      "homePage" : "http://a2:3000/",
      "name" : "qnwh"
    },
    "name" : "qnwh"
  },
  "verb" : {
    "id" : "http://adlnet.gov/expapi/verbs/completed"
  },
  "object" : {
    "id" : "http://a2:3000/api/proxy/gleaner/games/gameID/sessionID/scene4",
    "definition" : {
      "type" : "https://w3id.org/xapi/seriousgames/activity-types/completable",
    }
  },
  "result" : {
    "success" : true
  },
  "extensions" : {
    "GameDay" : 1.0,
    "MariaFriendship" : 50.0,
    "sessionStarted" : "2019-09-19T12:08:26.875Z"
  },
  "timestamp" : "2019-09-19T12:13:13.280Z"
}
```

Figura 20. Ejemplo de una traza de Conectado en formato xAPI.

frases xAPI están compuestas por el sujeto o actor, el verbo de la acción realizada y el objeto de esta acción, y permite añadir extensiones con más información del contexto o resultado de la acción recogida.

xAPI-SG Profile es un perfil específico para juegos serios del estándar xAPI. Este perfil define unos verbos específicos para recoger la información de las acciones llevadas a cabo por los jugadores en un juego serio. En la Figura 20 podemos ver un ejemplo de este formato con las diferentes partes en color: el usuario con identificador “qnwh” (*actor*) completó (*verb*) la escena 4 de tipo completable (*object*) con resultado exitoso (*result*) y en el juego se encontraba en el día 1 habiendo empezado la sesión a las 12:08h y teniendo una amistad con el personaje de María de valor 50 (*extensions*). Esta traza se mandó a las 13:13h (*timestamp*).

Las interacciones recogidas durante el uso de Conectado según el verbo xAPI utilizado son:

- Interacted, este tipo de trazas recogen las interacciones con objetos (mochila, ordenador, móvil) y con los personajes.
- Accessed, representan los cambios entre habitaciones de una misma escena.
- Completed, señalan los cambios entre escenas. Estas indican la compleción de partes del día (la mañana en casa, la mañana en el colegio, la tarde en casa y el día completo).
- Selected, recogen las elecciones del jugador durante los diálogos. Estas trazas contienen la propia respuesta del jugador en el diálogo como objeto.

Además, todas las trazas, independientemente del verbo, contienen el *timestamp* y las extensiones para indicar la situación del jugador en cuanto al día de juego y el momento (mañana o tarde) y la amistad del jugador con los diferentes personajes, que varía entre 0 y 100. Es decir, las trazas xAPI capturan los eventos relevantes que suceden en el juego de modo que esté disponible para su análisis desde fuera de este.

Las trazas capturadas llegan en tiempo real al servidor de analíticas donde se pueden realizar distintos tipos de análisis y ver visualizaciones sobre los datos recogidos. Estas visualizaciones muestran, por ejemplo, el progreso de la clase en el juego. También, se pueden configurar alertas para notificar situaciones específicas que puedan ser relevantes para el profesor o para el investigador que está administrando el juego. Por ejemplo, que se genere una alerta en el caso de que no se reciban trazas de interacción de un jugador

durante tiempos largos. De media, por cada jugador que completa el juego, se recogen 430 interacciones.

4.4. Validación y aplicación en clase

Esta sección presenta el diseño experimental realizado en el estudio de la efectividad del videojuego Conectado para concienciar sobre el (ciber)bullying, su aceptación como herramienta en la clase, y la aplicación de las analíticas en sus diferentes experimentos. Los datos necesarios para este estudio se recogieron en diferentes experimentos, cada uno centrado en unos objetivos concretos. En primer lugar, se realizó un estudio piloto con el objetivo de realizar una evaluación formativa para comprobar, por un lado, si Conectado tenía efecto sobre los jugadores y, por otro lado, para analizar problemas en el diseño, o encontrar posibles errores que dificultaran su uso en clase. Otro de los experimentos buscaba recoger la opinión de los profesores y comprobar la aplicabilidad del juego en la clase. Dado que Conectado es un juego serio que debe implantar el profesor en su clase, es importante conocer si los profesores están realmente dispuestos a aplicarlo con sus alumnos y lo perciben como una herramienta útil. Además, se hicieron otros dos experimentos con el objetivo de medir la efectividad de Conectado y validar su diseño mediante datos de interacción y con una muestra mucho más numerosa. El último experimento fue puramente observacional para estudiar el uso del videojuego por los profesores en un entorno real no controlado.

Todos los experimentos, excepto el último observacional, tienen un diseño experimental similar en el que se recoge información de los jugadores mediante cuestionarios pre-post y, además, se recolectan los datos de interacción mediante trazas xAPI. Estos datos experimentales son pseudo-anonimizados en origen mediante un código aleatorio de 4 caracteres que permite relacionar ambos cuestionarios y los datos de interacción de un mismo usuario a la vez que permite mantener su anonimidad (sólo el profesor del centro conoce dicha asignación de código a alumno). Además, antes de cada uno de los experimentos se informó al centro sobre el objetivo y las características de la sesión, y los datos que iban a recogerse. Cada centro autorizaba el uso del juego como una actividad docente y un responsable de cada centro firmaba a continuación un consentimiento informado dando permiso para realizar el experimento y recoger los datos.

Los datos recogidos en los experimentos (cuestionarios y datos de interacción) tienen distintos objetivos en el estudio del juego. Como se ha mencionado, algunas de las elecciones del jugador en el juego causan cambios en diálogos, en algunas escenas y en el final del juego. Sin embargo, el jugador es víctima de (ciber)acoso hasta el final del juego donde puede llegar a la resolución del problema mediante la ayuda de otros

personajes. Si bien algunas acciones disminuyen el riesgo de ser acosado y otras lo aumentan, el juego no está diseñado para realizar la evaluación automática del jugador. Por ello, es necesario que el jugador rellene los cuestionarios para evaluar el efecto del juego. Los datos de interacción nos permiten entender mejor el efecto del juego, es decir los cambios que se producen en el jugador y hacer un seguimiento más detallado de esos jugadores/estudiantes durante las sesiones de juego.

Para facilitar la validación de Conectado y la gestión de los cuestionarios en los diferentes experimentos, se utilizó la herramienta *SurveyManager*¹¹, también desarrollada en el ámbito del grupo e-UCM, y precursora de la herramienta *SIMple VALidation (SIMVA)*¹².

4.4.1. Experimento piloto: evaluación formativa

La primera prueba piloto fue una evaluación formativa que se realizó con 257 estudiantes de secundaria de entre 12 y 17 años en tres institutos diferentes en Madrid, Zaragoza y en una escuela rural de Teruel. El experimento y sus resultados se describen en detalle en el artículo publicado en la revista *IEEE Transactions on Learning Technology* titulado *Validation of a Cyberbullying Serious Game Using Game Analytics* (Calvo-Morata, Rotaru, et al., 2018). Durante este experimento se utilizaron unos cuestionarios pre-post que incluían:

- Preguntas demográficas, para conocer la edad y el sexo de los jugadores. Esta información se utiliza para analizar la posible relación entre dichas variables y la concienciación previa y la posterior después de jugar (es decir, el efecto del juego) en los distintos jugadores.
- Cuestionario de concienciación sobre el acoso y el ciberacoso, que se ha obtenido mediante una adaptación y combinación de cuatro cuestionarios diferentes: CUVE3 (Álvarez-García, Nuñez-Pérez, & González, 2013), ECIP-Q, EBIP-Q (Ortega-Ruiz, Del Rey, & Casas, 2016) y Test de ciberacoso (Garaigordobil & Aliri, 2013). Esta adaptación presenta un Alfa de Cronbach de 0,95. El cuestionario se compone de 18 ítems evaluados en una escala tipo Likert de 1 (“Totalmente en desacuerdo”) a 7 (“Totalmente de acuerdo”). 11 de los ítems evalúan la conciencia del ciberacoso, y los 7 restantes evalúan la conciencia del acoso. Se interpreta que la puntuación media del cuestionario de cada jugador es el nivel de conciencia de ese jugador. Los jugadores completan

¹¹ Disponible en <https://github.com/synpheros/surveymanager>

¹² Disponible en <https://github.com/e-ucm/simva-infra>

este test antes y después de jugar, y la diferencia de ambas puntuaciones refleja el efecto del juego en el jugador.

- Prueba de ciberacoso, un cuestionario para medir el nivel de ciberacoso en el aula que considera los tres roles (observador, víctima y agresor). La prueba consta de un total de 45 ítems, 15 para cada uno de los roles, calificados en una escala de tipo Likert de 1 (“Nunca”) a 4 (“Diariamente”). Su objetivo es tener información sobre el clima social del colegio, es decir comprobar el grado de incidencia de estos roles en los diferentes centros en los que se lleva a cabo las sesiones de juego.
- Uso de las redes sociales, un cuestionario para conocer y medir la frecuencia de uso de 10 aplicaciones diferentes y la red social en una escala de tipo Likert de 1 (“No la conozco”) a 5 (“La uso todos los días”). También permite analizar si el uso de redes sociales tiene influencia en la concienciación del (ciber)bullying o el efecto del juego.
- Aceptación del videojuego, consistente en dos preguntas de texto libre para analizar cómo ven los estudiantes el juego: “¿Qué te pareció el videojuego y qué cambiarías?” y “¿Crees haber aprendido algo?”.

Con los resultados obtenidos, tanto de los cuestionarios como de las analíticas de aprendizaje, se demostró que Conectado cumplía su objetivo de incrementar la concienciación de los jugadores y de crear empatía con las víctimas. También se encontraron algunos problemas en el diseño del juego que no habían sido identificadas en las fases de testeo y validación anteriores. Además, a la mayoría de estudiantes les pareció interesante el juego y consideraron que habían aprendido cosas sobre el (ciber)bullying y cómo se podían sentir las víctimas. Por un lado, los cuestionarios mostraron que el juego aumenta la concienciación de los usuarios y que era bien recibido por la mayoría de estudiantes. Por otro lado, la recogida de los datos de interacción y el uso de técnicas de analíticas de aprendizaje permitió: (1) en tiempo real, hacer un seguimiento de los jugadores, permitiendo conocer en qué escena se encontraban o si dejaban de interactuar con el videojuego; y (2) después de las sesiones, descubrir que la duración del juego era mayor a la deseada por lo que se creó una segunda versión reduciendo algunas partes del juego y solventando algunos casos en los que el juego se cerraba o bloqueaba. Estos datos objetivos permitieron mejorar el diseño experimental respecto a los planes iniciales para los experimentos siguientes.

4.4.2. Experimento de aplicabilidad

Después del piloto, el siguiente paso fue comprobar que los profesionales en educación están dispuestos a usar Conectado como herramienta en sus clases y conocer su opinión sobre el juego y su diseño educativo. Para cubrir los distintos perfiles, se diseñaron experimentos con dos tipos de usuarios: profesores de cursos de secundaria en institutos de España y estudiantes de carreras de educación. Los profesores nos darían información sobre la aplicabilidad de Conectado como herramienta educativa en clase y la aceptación por parte de los profesores que están en activo. Por otro lado, los estudiantes universitarios de carreras de ciencias de la educación nos darían información sobre la aceptación de los juegos serios como herramientas educativas en los que próximamente serán los profesores. Estos experimentos de aplicabilidad y aceptación están descritos en el artículo publicado en la revista *IEEE Access* y con título *Applicability of a cyberbullying videogame as a teacher tool: comparing teachers and educational sciences students* (Calvo-Morata, Freire-Morán, Martínez-Ortiz, & Fernández-Manjón, 2019). El experimento se realizó con 93 profesores de secundaria y 113 estudiantes de carreras de ciencias de la educación.

Además de los cuestionarios anteriores, que en este caso pretendían mostrar el proceso experimental completo a los profesores de aquellos institutos donde se usaba el videojuego, se utilizaron otros dos cuestionarios al finalizar la sesión de juego:

- Cuestionario de aplicabilidad, un cuestionario compuesto por 6 preguntas en una escala Likert-4 con el objetivo de medir la aplicabilidad del videojuego como herramienta a usar en clase por parte del profesor.
- Cuestionario de aceptación, un cuestionario de 5 preguntas de texto libre para conocer la opinión de los profesores y estudiantes sobre el videojuego como herramienta educativa y expusieran cualquier mejora para facilitar su uso en clase.

Los resultados de los cuestionarios mostraron muy buena aceptación entre profesores y estudiantes (y futuros profesores), si bien fue algo mayor entre estos últimos. Uno de los resultados no esperados fue que en el cuestionario de concienciación sobre el (ciber)acoso, que inicialmente se incluía únicamente para que entendieran todo el proceso experimental, se encontró también un efecto positivo sobre profesores y estudiantes. Esto muestra que, incluso para jugadores fuera de su público objetivo, Conectado consiguió concienciar sobre aspectos del (ciber)acoso que no eran conocidos. Por ello, aún es necesario formar a los docentes y concienciarles de las características de estos problemas y de los efectos negativos que causan en los jóvenes. Con los datos de interacción

recogidos, además de comprobar que los jugadores terminaban el juego, se observó que la edad influía en el tiempo que tardaban en completarlo, tardando más los profesores de mayor edad.

4.4.3. Experimento con grupo de control y de evaluación sumativa

En el último artículo, de momento publicado únicamente como informe interno del departamento (pero enviado a revista para su posible publicación) se recogen los 3 experimentos realizados con estudiantes de secundaria: (1) el piloto descrito en la sección 4.4.1; (2) el experimento que incluía grupo de control; y (3) el experimento de la evaluación sumativa con una muestra elevada de participantes, que permitió estudiar en detalle el efecto del juego y su correlación con diferentes variables como el género de los jugadores, su edad o las decisiones tomadas durante la sesión de juego.

Todos estos experimentos sirvieron además como casos de estudio para evaluar el sistema de analíticas desarrollado en el proyecto H2020 RAGE y verificar su utilidad para que los profesores monitoricen la sesión mientras los estudiantes juegan a un juego serio. Las lecciones aprendidas de esta experiencia, proporcionando información a los profesores de lo que está ocurriendo mientras utilizan el juego en sus clases, están recogidas en el artículo publicado en el congreso *ICWL 2018* con título *Making Understandable Game Learning Analytics for Teachers* (Calvo-Morata, Alonso-Fernández, Freire, Martínez-Ortiz, & Fernández-Manjón, 2018).

En el experimento con grupo de control participaron 40 estudiantes de 14 y 15 años en una sesión realizada en la Facultad de Informática de la Universidad Complutense de Madrid. Los estudiantes se dividieron en dos grupos para comparar los resultados del test de concienciación en: (1) el grupo de intervención, que jugó a Conectado entre el pre-test y el post-test; y (2) el grupo de control, que jugó al juego serio First Aid Game. First Aid Game es un juego serio que enseña primeros auxilios (Marchiori et al., 2012), y no tiene contenido relacionado con el (ciber)acoso. Para proporcionar la misma experiencia global a todos los participantes, ambos grupos jugaron el juego contrario después de completar el cuestionario posterior a la sesión principal. El experimento sirvió para verificar que el cuestionario de concienciación no tenía efecto sobre el jugador y no se producía un efecto recuerdo (Lavrakas et al., 2019). En el grupo de intervención, los resultados mostraron un efecto similar al del resto de experimentos con Conectado, mientras que, en el grupo de control, como se esperaba, no se encontró mejora.

En el experimento sumativo participaron 1004 estudiantes de 12 a 17 años y de 8 institutos diferentes. Como ya mostró el experimento piloto y el grupo de intervención del experimento con grupo de control, los cuestionarios reflejaron el efecto positivo y

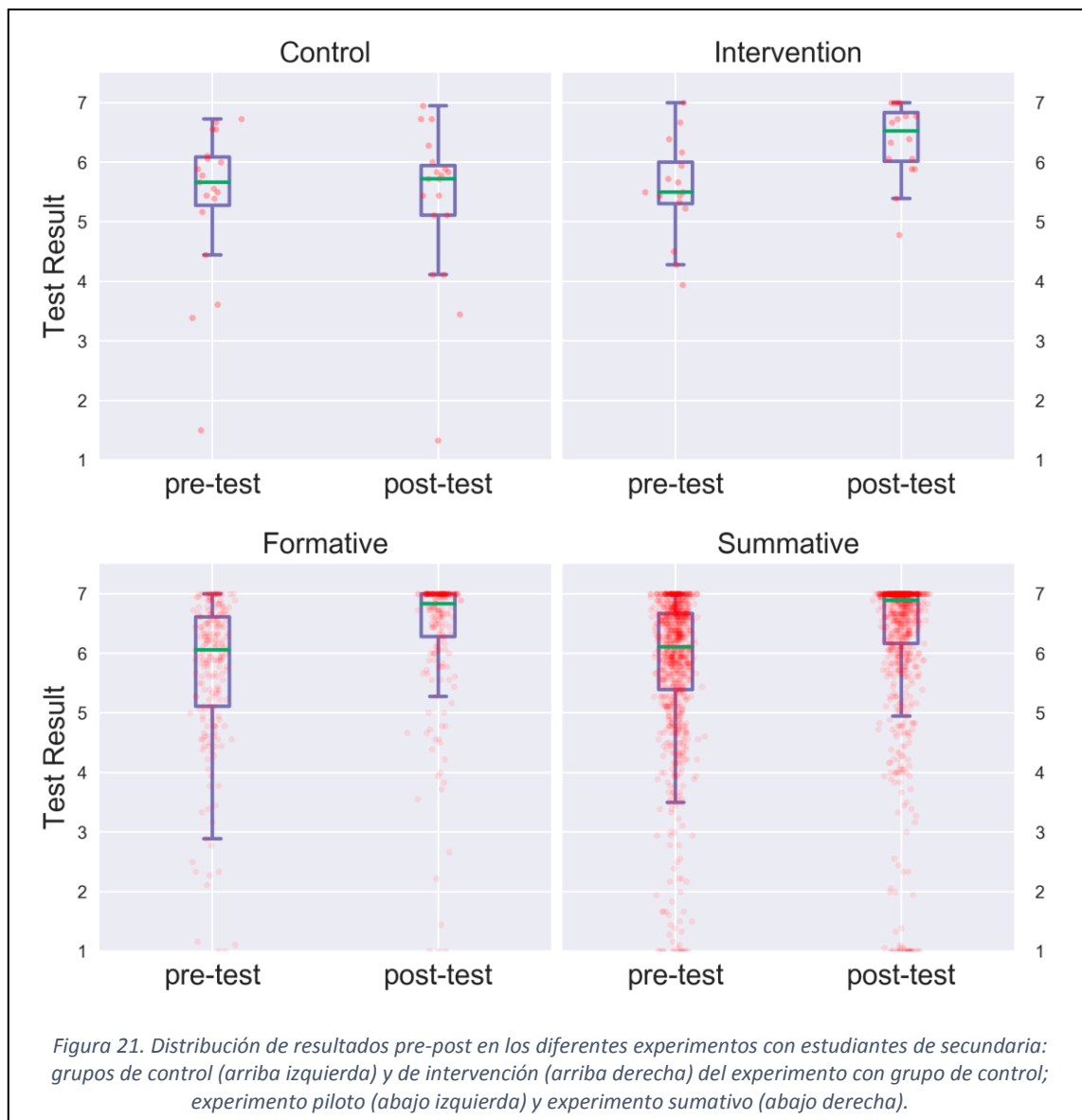


Figura 21. Distribución de resultados pre-post en los diferentes experimentos con estudiantes de secundaria: grupos de control (arriba izquierda) y de intervención (arriba derecha) del experimento con grupo de control; experimento piloto (abajo izquierda) y experimento sumativo (abajo derecha).

estadísticamente significativo del juego en la concienciación sobre el (ciber)bullying de los jugadores de Conectado. Con esta gran cantidad de datos pudo estudiarse la relación entre la forma de interactuar de los jugadores y sus resultados en los cuestionarios de concienciación.

Por un lado, las chicas mostraron estar más concienciadas tanto antes como después de jugar, siendo el efecto de Conectado similar en chicos y chicas, teniendo un efecto positivo en el 80% de los jugadores. En cuanto a la forma de jugar, comparando los datos de interacción con la concienciación, los jugadores con mayor concienciación inicial tomaban con mayor frecuencia decisiones mejores para resolver la situación de (ciber)acoso. Los datos de interacción y los cuestionarios también sirvieron para validar algunas decisiones de diseño. Por un lado, el diseño incremental del juego (en el que la situación se va agravando según pasan los días) se refleja en que la concienciación de los jugadores incrementa según avanzan en el juego. Este hecho se comprobó comparando el

efecto en aquellos jugadores que no completaron el juego según el día de juego en el que se habían quedado (un 20% de jugadores no completó el juego). Cuanto más habían avanzado en el juego, mayor era el incremento de concienciación. Por otro lado, también sirvió para validar que las elecciones del jugador no influyen en la eficacia del videojuego. Recordamos que el efecto de las decisiones es limitado y a corto plazo, y que independientemente de estas decisiones, los jugadores deben completar todas las situaciones mostradas en los cinco días de juego. De esta forma todos los jugadores obtienen una experiencia común equivalente y que puede ser usada por el profesor para motivar la conversación con los estudiantes después de la sesión de juego.

4.4.4. Ejemplo de uso real

El último experimento fue observacional y se realizó con cuatro clases de secundaria. El objetivo era estudiar el uso de Conectado en un instituto, en un entorno real no controlado y sin restricciones. El experimento se describe en un artículo presentado en el congreso internacional *ICERI 2019*, en Sevilla, y con título *Conectado in the classroom: applying a video game for the prevention of bullying at the school* (Calvo-Morata, García-Diego, Freire, Martínez-Ortiz, & Fernández-Manjón, 2019). Antes de realizar el experimento, se desarrolló una guía para el docente, que está publicada junto al juego serio Conectado en e-ucm.es/conectado. Esta guía se validó y mejoró con los comentarios de 20 profesores, que completaron un cuestionario sobre la utilidad de este recurso para entender el uso del videojuego y su contenido. Antes del experimento observacional, se proporcionó el videojuego a los profesores de las cuatro clases que participaban y se dio acceso a la guía docente únicamente a dos de ellos. Durante los experimentos se comprobó que los profesores que habían tenido acceso a la guía del docente eran capaces de desplegar el juego en clase y de resolver las dudas de los jugadores con soltura. En comparación, los profesores que no habían tenido acceso a la guía tuvieron problemas y requerían la ayuda del investigador de apoyo en el experimento. Después de las sesiones de juego, la orientadora del instituto realizó una sesión de reflexión y debate con cada una de las clases. En estas sesiones, la orientadora hizo uso de la experiencia obtenida durante el juego para que los estudiantes pusieran en común los sentimientos que el juego les había provocado y señalaran aquellas situaciones que aparecían y podían ser acoso. Los jugadores mencionaron impotencia, tristeza y enfado entre los sentimientos durante el juego, lo que la orientadora aprovechó para hacerles reflexionar sobre como esos sentimientos podían agravarse en situaciones reales.

La experiencia demostró que el juego puede ser utilizado en clase sin ayuda de los investigadores, siempre y cuando se den los recursos y las guías necesarias. Además, se pudo observar la utilidad de Conectado, además de por su efecto sobre los jugadores,

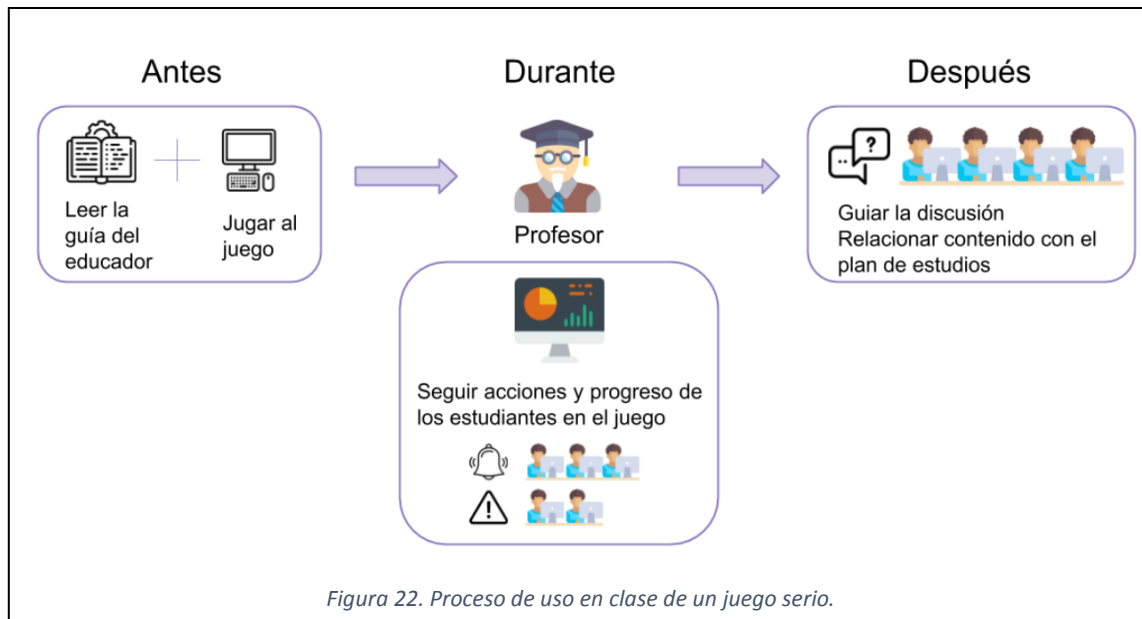
como herramienta para los educadores a la hora de abordar el tema del (ciber)acoso en clase.

4.5. Aplicación de analíticas de aprendizaje

La experiencia obtenida aplicando las analíticas de aprendizaje durante los experimentos está recogida en la publicación del congreso *EDUCON 2019* con título *Game Learning Analytics for Educators* (Calvo-Morata, Alonso-Fernandez, Freire, Martinez-Ortiz, & Fernandez-Manjon, 2019) y en su extensión publicada en la Revista *IEEE Iberoamericana de Tecnologías del Aprendizaje* con título *Game Learning Analytics, Facilitating the Use of Serious Games in the Class* (Calvo-Morata, Alonso-Fernandez, Freire-Moran, Martinez-Ortiz, & Fernandez-Manjon, 2019).

Una de las principales barreras a la hora de adoptar los juegos serios en clase es la dificultad para verificar que los jugadores realmente están jugando y para conocer qué acciones están realizando. Durante los experimentos en los diferentes institutos, se utilizó un sistema de analíticas para abordar este problema y así tener un mayor control sobre la clase. Este sistema de analíticas proporcionó un sistema de alertas y un conjunto de visualizaciones sobre algunas variables del juego. Dado que las trazas llegan al servidor con fecha y hora, el sistema de alertas permite mostrar un mensaje casi inmediato ante ciertas situaciones que pueden ser del interés de los profesores. Por ejemplo, permite notificar si alguno de los jugadores no realiza interacciones durante un tiempo específico. Por otro lado, las visualizaciones generadas a partir de los datos recogido permiten, entre otras, conocer el progreso de cada estudiante y las decisiones que toman durante el juego. Estas visualizaciones ayudan a conocer el porcentaje de jugadores que han completado el juego y permite ayudar a aquellos jugadores más lentos. También permiten, con un vistazo, saber qué decisiones son más comunes entre los jugadores (y utilizarlo posteriormente en la discusión con ellos sobre el tema).

Respecto a las visualizaciones desarrolladas para el seguimiento de la sesión, se comprobó la necesidad de simplificarlas y mejorarlas para aumentar su comprensibilidad por alguien no experto. Esto incluye aumentar su tamaño y usar títulos descriptivos, también la necesidad de añadir información al lado de cada visualización para facilitar que los profesores interpretaran correctamente dichas visualizaciones. Sin embargo, mostrar mucha información en pantalla o visualizaciones puede ser contraproducente. En el caso de Conectado, la parte que resultó más útil para los profesores fue el sistema de alertas en base a las acciones de cada usuario, mientras que el resto de gráficas para conocer el estado de juego de cada estudiante fue más útil para el investigador a la hora de controlar el tiempo de la sesión.



Las analíticas tienen un papel muy importante a la hora de facilitar el uso de los juegos serios en clase mejorando el proceso de aplicación y permitiendo entender mejor el proceso de aprendizaje. Pero consideramos que el uso del *Game Learning Analytics* tiene mucho más que aportar en el ciclo de vida de estos videojuegos. Incorporar las analíticas de manera temprana en las fases de diseño permite beneficiarse de la recogida de los datos de interacción de los usuarios y de su análisis y visualización en las fases de desarrollo y mejora del videojuego, en la validación y en la aplicación del juego en la clase. De esta forma, las analíticas proporcionan un valor añadido tanto a desarrolladores de juegos serios como a investigadores y profesores. Esto permite que juegos serios que no están pensados para realizar una validación del conocimiento del jugador puedan beneficiarse también del uso de las técnicas de analíticas de aprendizaje. Por un lado, en el desarrollo, las analíticas permiten analizar el comportamiento de los jugadores y facilitan encontrar errores en el diseño del juego (por ejemplo, encontrar estados de juego que sean inalcanzables). Además, podemos analizar el tiempo de juego y el porcentaje de completitud para facilitar su uso en el tiempo limitado de las sesiones de clase. En los experimentos de validación o despliegue a mayor escala, la información de las analíticas da un mayor control al investigador y le permite hacer un mejor seguimiento de los jugadores. También aportan un valor añadido en aquellos experimentos que utilizan cuestionarios tradicionales permitiendo comparar los resultados con la forma de interactuar de los jugadores, validando así decisiones de diseño o comprendiendo mejor los efectos del juego. Por último, las analíticas pueden proporcionar a los profesores información sencilla pero completa e incluso de forma visual (mediante un sistema de alertas o visualizaciones), les permite entender mejor lo que está pasando durante las sesiones de juego y ser más efectivos en su labor docente.

Capítulo 5. Conclusiones y trabajo futuro

Este capítulo describe las principales conclusiones y aportaciones del trabajo realizado. Además, propone como trabajo futuro las líneas de investigación que quedan abiertas.

5.1. Conclusiones

En este trabajo de tesis hemos planteado el uso de un juego serio para resolver un problema social de gran relevancia. En concreto se ha creado el juego Conectado como herramienta educativa aplicada en clase para abordar el (ciber)bullying. Además, se han utilizado técnicas de analíticas para mejorar el ciclo de vida de los juegos serios, es decir, los procesos de desarrollo, validación y aplicación de este juego. Durante la investigación, se ha comprobado que:

- El juego serio Conectado aumenta la concienciación sobre el (ciber)bullying y la empatía de los jugadores hacia las víctimas. Además, es una herramienta aceptada por los profesores y que puede usarse en clase para proporcionar a todos los alumnos una experiencia común previa a una sesión de reflexión. Estos resultados, en línea con otras investigaciones sobre juegos serios, proporcionan una mayor evidencia de la efectividad y la utilidad de los juegos serios como herramientas de prevención del acoso escolar.
- Las analíticas son una herramienta que complementa y hace más robustos los procesos tradicionales de validación de juegos serios como son los cuestionarios pre-post. La combinación de ambos métodos proporciona una evaluación más precisa y basada en evidencias ya que tiene en cuenta las acciones de los jugadores. Esto permite, por ejemplo, detectar usuarios que no realizan los cuestionarios de forma adecuada, entender cómo afecta el juego a los usuarios según su porcentaje de completitud o tiempo de juego, o incluso estudiar cómo se relacionan las interacciones de los jugadores con su aprendizaje final.
- Las analíticas mejoran y simplifican los procesos de desarrollo, validación y aplicación de un juego serio como Conectado. Este enfoque puede ser utilizado en otros juegos serios diseñados para el uso en clase con objetivos diferentes del aprendizaje de conocimiento. Entre otros para: mejorar la depuración en fases de desarrollo; complementar otros métodos de validación permitiendo estudiar el efecto de los juegos en base a las interacciones de los jugadores; mejorar el control durante la experimentación en entornos reales o simplificar la aplicación en la clase permitiendo un mayor control durante las sesiones de juego.

5.2. Principales contribuciones

La principal aportación de esta tesis es el estudio realizado sobre el uso de Conectado y su eficacia para prevenir el bullying. El estudio abarca desde el desarrollo del videojuego hasta su validación y aplicación en entornos reales no controlados. Además, en todas estas fases se han usado las analíticas como medio para facilitar y mejorar el ciclo de vida del videojuego. Las contribuciones específicas de este trabajo son:

1. El amplio estudio realizado sobre el dominio del uso de juegos serios para abordar los problemas del bullying y el ciberbullying, que aparece en la sección 2.3 de este documento. El proceso seguido y los resultados han sido publicados en la revista de alto impacto *Computers & Education*. Este estudio del dominio proporciona una perspectiva de la efectividad de los juegos serios como herramientas de prevención y también de las carencias que aún existen en el campo. Entre estas limitaciones encontramos: falta de experimentos que validen la efectividad de muchos de los juegos encontrados; la escasez en el tamaño de muestra de los experimentos realizados con ellos; la falta de accesibilidad a los juegos debido a tiempos de vida muy cortos; y la escasez de estudios que hagan uso de los datos de interacción de los jugadores para validar el videojuego y su diseño.
2. El diseño y desarrollo del videojuego Conectado como herramienta educativa para ser usada en clase por los profesores. Conectado es un juego desarrollado en la plataforma Unity como un proyecto de código y recursos abiertos que está publicado en GitHub (<https://github.com/gorco/Conectado-CyberbullyingGame>) y puede descargarse un ejecutable desde la URL e-ucm.es/conectado. Junto con el juego se proporciona una guía de uso, validada por profesores, que permite a cualquier persona interesada hacer uso de este recurso, siendo así una contribución para la sociedad y más concretamente para la comunidad educativa. Además, hay que señalar la repercusión mediática de Conectado, que ha sido protagonista de numerosas noticias en prensa, radio y televisión. La repercusión obtenida aparece en el apéndice A de esta tesis.
3. La evidencia científica de la efectividad de los juegos serios a la hora de incrementar la concienciación de los jugadores y crear empatía hacia las víctimas de bullying y ciberbullying. Esta evidencia refuerza los resultados positivos de otros estudios científicos sobre la prevención del acoso escolar mediante los juegos serios. Los resultados obtenidos de la efectividad y la

aplicabilidad de Conectado han sido publicados en revistas de alto impacto como *IEEE-Transactions-Learning-Technologies* e *IEEE Access*.

4. El estudio sobre el uso de las analíticas en las distintas etapas del ciclo de vida de Conectado: desarrollo, validación y aplicación. Los diferentes experimentos y la experiencia obtenida han mostrado cómo pueden integrarse técnicas de analíticas para simplificar y mejorar estos procesos. En el desarrollo, el uso de analíticas nos ha permitido estudiar el tiempo de juego y ajustarlo a la duración de una sesión de instituto dejando tiempo para realizar los diferentes cuestionarios en los experimentos. Las interacciones también permitieron detectar errores no encontrados en las fases de depuración. A la hora de validar el videojuego, las analíticas permitieron validar decisiones de diseño y estudiar el efecto del juego según las acciones de los jugadores, el progreso del jugador, o características demográficas como el género. En este aspecto, cuestionarios y analíticas se complementan para permitir una mejor validación basada en evidencias. Por último, las analíticas también han ayudado a aplicar el videojuego en las clases, tanto al investigador en las sesiones experimentales como a los profesores. Las visualizaciones y alertas permitieron un mayor control sobre las sesiones por parte de los profesores ya que era posible conocer, en tiempo real, qué jugadores no estaban jugando y cuál era el progreso de la clase sin tener que ir puesto por puesto observando las interacciones.
5. Los datos recogidos en los experimentos realizados. Estos datos pertenecen a las interacciones de juego y a los cuestionarios de más de 1000 estudiantes de secundaria, y permiten a otros investigadores realizar estudios relacionados con las analíticas de aprendizaje. Por un lado, se utilizaron para validar el sistema de analíticas en el proyecto europeo RAGE¹³ y algunas de las conclusiones obtenidas en el proceso de validación y aplicación están sirviendo para desarrollar la herramienta SIMVA (Perez-Colado et al., 2019), que tiene el objetivo de simplificar el despliegue en la validación y en la aplicación de juegos serios. Por otro lado, los datos recogidos se están utilizando para estudiar el uso de las analíticas de aprendizaje como herramienta de validación y evaluación mediante la predicción, lo que permitiría prescindir parcialmente de los cuestionarios.

¹³ La información del proyecto puede encontrarse en <https://cordis.europa.eu/project/id/644187>

5.3. Trabajo futuro

Tanto en el ámbito de los juegos serios para la prevención y detección del (ciber)bullying como en el de las analíticas todavía queda mucho trabajo por hacer. Además, aún hay formas de mejorar Conectado y otros estudios que podrían realizarse a partir de este juego serio. Como trabajo futuro destacamos:

- Traducción de Conectado a otros idiomas. Actualmente, el juego está disponible en español y existe una versión inicial en inglés (no validada ni contrastada) y una versión en francés que está siendo validada desde el punto de vista de aceptación lingüística y adecuación cultural (localización). Junto al videojuego es necesario traducir la guía de uso publicada en la misma página de e-UCM. La traducción permitirá probar la efectividad en otros países y comparar los resultados con los obtenidos en España.
- Comprobación del efecto de Conectado a largo plazo. Hay algunos aspectos que dificultan este punto. En primer lugar, es difícil encontrar centros educativos donde probar el software desarrollado, además poder realizar más de una sesión de juego en estos centros es aún más complejo, ya que implica cambiar la planificación de los centros, coordinando profesores y el espacio de las aulas con ordenadores. Además, muchos centros ya tienen programas y otros recursos para tratar el acoso escolar y el ciberbullying. Esto hace que las variables que se miden pueden estar influenciadas por otras intervenciones si no se toman los datos justo antes y después de aplicar el juego.
- Integrar y estudiar el uso de dispositivos que permitan recoger datos biométricos (por ejemplo, ritmo cardíaco y actividad cerebral) para combinarlos con los datos de interacción. El principal problema en este punto es el coste de los dispositivos biométricos y su precisión. Además, se dificulta el uso en entornos reales con grupos grandes de usuarios debido a su complejidad y recursos necesarios. También hay que añadir el importe asociado a la calibración y análisis de los datos para ser capaz de interpretar los datos obtenidos.
- Comparar Conectado con otros juegos serios con un objetivo similar. Actualmente hay pocos recursos disponibles que hayan sido validados, que tengan el mismo objetivo (concienciar), que estén dirigidos a un público de la misma edad (12-17 años) y que además sean de acceso libre. La comparación de distintos recursos también tiene la dificultad ya mencionada para conseguir sesiones más largas en los institutos para hacer experimentos. Se recomienda a futuros investigadores que desarrollen juegos serios para la prevención del

(ciber)bullying, que utilicen Conectado para poder seguir mejorando este campo y estudiar que mecánicas de aprendizaje y de juego funcionan mejor o peor si buscan el objetivo de concienciar.

- Mejorar las analíticas para el profesor con el objetivo de obtener un mayor control sobre la clase. Incluir más datos de interacción sobre el juego puede dar una información más precisa que ayude a los profesores durante las sesiones de juego. Por ejemplo, una de las observaciones realizada en los experimentos es que con los datos de interacción podríamos medir el tiempo que los jugadores emplean en los diálogos del juego. Esto permitiría conocer qué jugadores no prestan atención en el juego de una forma mucho más precisa. Para ello, sería necesario modificar el código del juego para que mande también datos al terminar un diálogo. Además, con esta modificación podría añadirse una alerta en el sistema de analíticas que avisara cuando los jugadores se salten los diálogos.
- Mejorar la combinación de cuestionarios y de las evidencias de interacción para lograr una mejor evaluación. Aunque se considera que la forma estándar de evaluar los juegos son los cuestionarios pre-post, las analíticas detalladas (p. ej., tiempo empleado en los diálogos) se permiten filtrar las respuestas de aquellos usuarios que realmente no han jugado al juego y que, aun así, rellenan dichos formularios de manera que introducen ruido que es muy difícil de filtrar. Esta es una de las limitaciones que ha originado el desarrollo de la herramienta SIMVA.

Además de estos puntos, también queda como trabajo futuro integrar GLA a otros juegos similares aplicando lo aprendido durante el estudio realizado para mejorar sus procesos de validación y aplicación en el aula. Como hemos visto, la integración y recogida de datos de interacción puede servir en las diversas fases para complementar y dar un valor añadido al ciclo de vida de un juego serio.

Capítulo 6. Artículos presentados

En este capítulo se incluyen los artículos aportados como parte fundamental de esta tesis doctoral.

6.1. Serious games to prevent and detect bullying and cyberbullying: a systematic serious games and literature review

6.1.1. Cita completa

A. Calvo-Morata, C. Alonso-Fernández, M. Freire-Morán, I. Martínez-Ortiz and B. Fernández-Manjón, **Serious games to prevent and detect bullying and cyberbullying: a systematic serious games and literature review** in *Computers & Education*, vol. 157, November 2020, doi: 10.1016/j.compedu.2020.103958

6.1.2. Resumen original de la publicación

Serious games are an effective and highly motivational educational tool that has proved to be capable of changing users' attitudes and raising awareness in a great variety of fields, including mental health. A couple of decades ago, new technologies in general, and serious games, in particular, started to be incorporated into prevention programs, serving as both prevention and detection tools. This article presents a review of the serious games found through a systematic literature review focused on the use of video games as tools for the prevention and detection of bullying and cyberbullying. With this review, we aim to determine: (1) the benefits of using video games as tools against bullying; (2) the mechanics and types of games used to address it; (3) the type of users on which they focus; (4) the type of studies and the number of users with which these games are evaluated; and (5) the availability of these tools, to determine to what degree society can benefit from their potential. The results show a wide variety of video games, using in turn very different strategies to deal with (cyber)bullying; and also that most of these games are not currently available. The different initiatives found confirm that serious games can be used effectively to raise awareness, create empathy, and teach new strategies to address both bullying and cyberbullying.



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Serious games to prevent and detect bullying and cyberbullying: A systematic serious games and literature review

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ABSTRACT

Serious games are an effective and highly motivational educational tool that has proved to be capable of changing users' attitudes and raising awareness in a great variety of fields, including mental health. A couple of decades ago, new technologies in general, and serious games, in particular, started to be incorporated into prevention programs, serving as both prevention and detection tools. This article presents a review of the serious games found through a systematic literature review focused on the use of video games as tools for the prevention and detection of bullying and cyberbullying. With this review, we aim to determine: (1) the benefits of using video games as tools against bullying; (2) the mechanics and types of games used to address it; (3) the type of users on which they focus; (4) the type of studies and the number of users with which these games are evaluated; and (5) the availability of these tools, to determine to what degree society can benefit from their potential. The results show a wide variety of video games, using in turn very different strategies to deal with (cyber)bullying; and also that most of these games are not currently available. The different initiatives found confirm that serious games can be used effectively to raise awareness, create empathy, and teach new strategies to address both bullying and cyberbullying.

1. Introduction

Bullying is a social problem that affects many people all around the world, regardless of culture and nationality (Menesini & Salmivalli, 2017). Victims of bullying can suffer from numerous psychological and behavioral problems (Austin & Joseph, 1996; Salmon, James, & Smith, 1998). These bullying consequences can accompany children and teenagers in most or all of their adult life (Takizawa, Maughan, & Arseneault, 2014). The widespread use of new technologies has led to a rapid emergence of cases of cyberbullying, bullying that is carried out through electronic devices. Both problems share characteristics such as the continuity in time, the difference in power between victims and aggressors, and even the psychological effects and sequels that can appear in the victims (Foody, Samara, & Carlbring, 2015; Iranzo, Buelga, Cava, & Ortega-Barón, 2019). Bullying and cyberbullying both usually begin at an early age and are highly prevalent in schools (Monks & Smith, 2006), which often lack the resources or strategies to act (Moneios, Mendiri, & García-Fuentes, 2015).

Although cyberbullying is carried out through new technologies and electronic devices, we consider that these same devices can

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also be turned, through appropriate video games, into prevention tools that address both the problem of cyberbullying and that of bullying. Serious games have proved to be effective and highly motivational educational tools capable of increasing awareness, teaching knowledge, changing behavior, and even improving skills (Calderón & Ruiz, 2015). Not only have they been used in the educational field, but they have also demonstrated beneficial effects in the field of health, both mental and physical (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012).

This article presents a serious games review of the games found in a systematic literature review focused on video games as tools for the prevention and detection of bullying and cyberbullying. The present work aims to (1) collect and list existing video games (from this point on we will refer to these simply as games) with their main characteristics and the available evidence regarding their effectiveness; (2) inform about the current state of the art to those interested in designing or evaluating new or existing games; and (3) allow designers to apply their most effective mechanics and techniques to other social problems that share similarities with bullying and cyberbullying. The rest of the paper is structured as follows: Section 2 provides a summary of the related work; Section 3 describes the methodology used for the systematic serious games and literature review; Section 4 presents the results obtained; finally, Section 5 discusses the results, Section 6 describes limitations, and Section 7 presents the conclusions of the review.

2. Related work

Numerous literature reviews have studied the fields of bullying, cyberbullying, and serious games; however, we have not found any studies focusing specifically on serious games for the prevention and detection of bullying and cyberbullying, and this study aims to fill this gap.

The work of (Boyle et al., 2016) presents a literature review on serious games and focuses on the potential positive impact of gaming concerning learning, skill enhancement, and engagements, finding that the most frequently occurring outcomes and impacts were knowledge acquisition/content understanding, and affective and motivational outcomes. The literature review of (Nocentini, Zambuto, & Menesini, 2015) examines anti-bullying programs that use Information and Communication Technologies in general; they can use technology and apps but do not consider games within the program.

The only literature review that we have found similar to our proposal, focusing on serious games for bullying prevention and detection, is (Pecorini, Nocentini, & Menesini, 2016), which is in the Italian language and analyses only six game-based anti-bullying

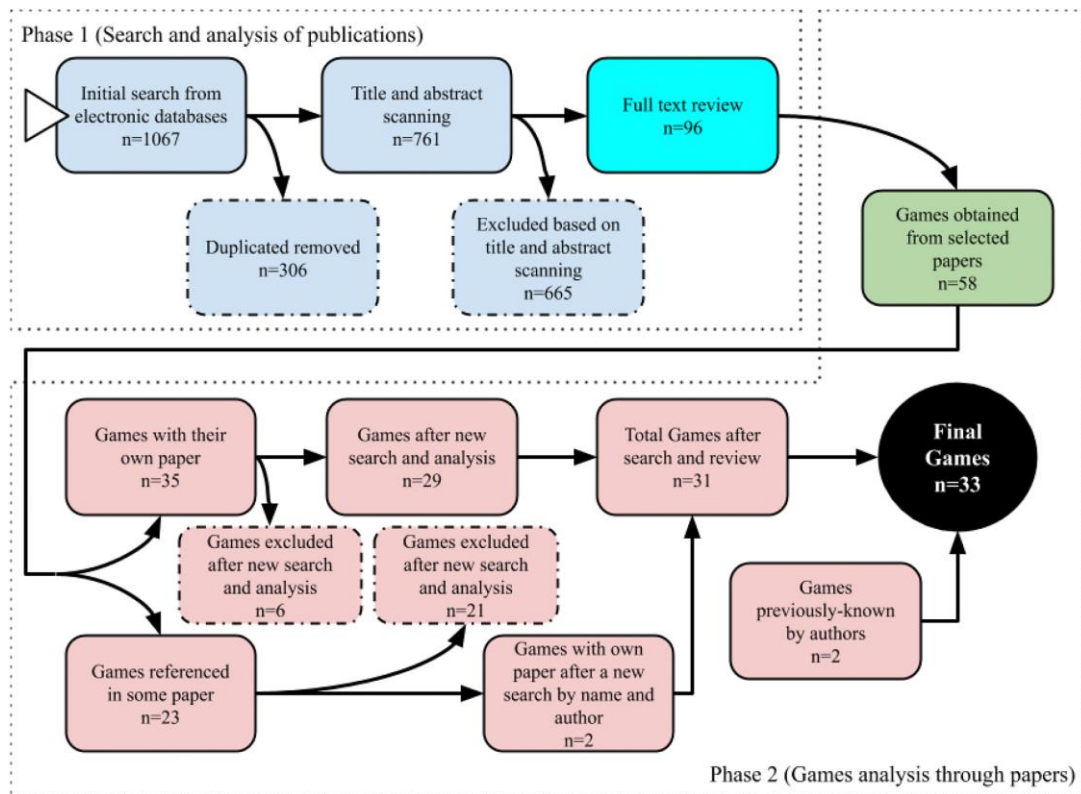


Fig. 1. Two phases review process (structure and tasks are described through section 2).

programs. There are other initiatives about using technology focused on bullying or cyberbullying such as (1) serious games and others technologies used to study the behaviour of the users in front of the problem (Feng, Jeong, Krämer, Miller, & Marsella, 2017), (2) technologies used as firewall that control and limit the use of social networks and other applications at school (Tulasi, 2018), and (3) simple videos where the users do not interact (Lister et al., 2013) but we focus our review in games designed for the purpose of preventing and/or detecting bullying and cyberbullying.

Moreover, there are some other publications related to games and/or technology for other purposes such as to deal with inappropriate user behaviour in social networks and online games; to study whether and how certain type of video games may be related with bullying behaviours; or to study bullying models using game theory. All those publications as were not related with the use of video games as tools for the prevention and detection of bullying and cyberbullying were considered outside of the scope of this review.

3. Method

The main objective of this review is to explore the serious games that have been (and are being) developed to prevent and detect bullying, their characteristics, and the degree to which their effectiveness has been demonstrated. To do so, we have proposed the following main research questions:

- RQ0. What serious games have been developed to tackle the problem of bullying and/or cyberbullying?
- RQ1. Which serious game genres and mechanics are used to prevent and detect bullying and cyberbullying?
- RQ2. What approaches do serious games take to help tackle bullying and cyberbullying?
- RQ3. What target users are serious games that tackle bullying and cyberbullying developed for?
- RQ4. What evaluation studies have been carried out with those serious games?
- RQ5. How, if at all, are the analysed serious games made available?

In addition to answering these research questions, we also compile other complementary information that, in our opinion, provides a deeper understanding of how games were developed or evaluated:

- The technology used to develop the serious games, and the platform or platforms on which they can be played.
- Whether Learning Analytics or the collection of interaction data is being used to conduct the studies.

The review of the serious games was carried out with a search divided into two phases (Fig. 1). The goal of the first phase was to obtain a list of publications about games designed and developed to address bullying and cyberbullying to analyze, and to do so we followed a standard methodology for systematic literature reviews: queries for specific combinations of terms in several well-known databases, together with clear inclusion/exclusion criteria. The second phase focused on finding the actual publications related to the videogames identified in the previous phase and, from these publications, analyzing the games and their supporting evidence in the literature. In the following sections, we describe the process followed in greater detail.

3.1. Phase 1: search and analysis of publications

3.1.1. Databases searched

We queried 11 databases, including some of the main databases for education, computer science, and general scientific research. The databases were: The Association for Computing Machinery (ACM) Digital Library, the Education Resources Information Center (ERIC), ProQuest, SAGE, Taylor & Francis, the Wiley Online Library, Springer, Science Direct (Elsevier), IEEE Xplore, Frontiers, and Mary Ann Liebert.

3.1.2. Search terms

The search was carried out by concatenation of two sets of words addressing two aspects:

- **Problem to address:** represented by the terms “bullying”, “cyberbullying”, or “harassment”.
- **Type of tool used:** which could be either “game”, “gamification”, “videogame”, “virtual environment”, “app”, or “simulation”.

Yielding to the following search query:

- ("bullying" OR "cyberbullying" OR "harassment") AND ("game" OR "gamification" OR "videogame" OR "virtual environment" OR "app" OR "simulation").

We restricted the search to the title and abstract of articles published in conferences or journals indexed in the 11 databases mentioned. This was only possible in some of the databases, as others lacked the necessary filters in their integrated query system. No further filters have been applied to, for example, impact factor or journal/conference scope.

3.1.3. Study selection

After removing duplicates, we scanned the title and abstract of all unique papers, comparing them against the inclusion and exclusion criteria below.

In this first search, publications that did not deal specifically with bullying and video games to combat this problem were directly excluded. We then fully read all non-excluded publications, taking special note of names of video games related to bullying and cyberbullying mentioned in each paper, for use during phase 2. We differentiated between games that were the focus of the paper and those that were simply mentioned as part of a previous study or related work (top and bottom rows of phase 2, at the bottom of Fig. 1). When games did not have an explicit name, they were labeled as “*NN –1st author's last name*”. Therefore, these are the inclusion and exclusion criteria for the publications:

3.1.3.1. Inclusion criteria.

- Publications containing a study of the design, development or evaluation of a game with the aim of preventing or detecting bullying and/or cyberbullying.
- Publications about serious games as tools for prevention or detection of bullying and/or cyberbullying but without a study of evaluation, design, or development of the game.

3.1.3.2. Exclusion criteria.

- Publications where the full text was not available.
- Publications about the bullying that can be found in online games.
- Publications about the relationship between video games and bullying.
- Publications not found in journals or scientific conferences.

These inclusion and exclusion criteria were applied by the first author of this study. The remaining co-authors reviewed those publications included, as well as the video games selected in phase 2 of the process, in order to validate this selection.

3.2. Phase 2: analysis of games described in papers

3.2.1. Selection of games

From the list of publications that met the inclusion criteria, a list of serious games was obtained, separating those that were the main contribution in a specific article from those that only were just mentioned in the state of the art or related work section. Because a single game can be mentioned in several publications, only 58 unique games were found in the final set of 96 publications that remained at the end of the first phase.

3.2.2. Analysis of games

With the list of selected games, we proceeded to make a deeper analysis of all the publications available about each of these video games, as well as their official website, if available. In this analysis, we carried out the following steps for each of the videogames:

1. Google search using as query the name of the video game and the word “*game*” or “*simulation*”.
2. Google Scholar search using as query the name of the video game and the word “*game*” or “*simulation*”.
3. Google search using the first and second authors’ names as a query.
4. Google Scholar search based on the profile of the first and/or second author.

Note that steps 1 and 2 were only possible for games that were given a name by their developers. Steps 3 and 4 were carried out for all games, regardless of whether the games were named or not.

From the results of these searches, we selected all publications related to each game. We also searched for publications on the websites of each game, websites of each author, or official download sites, as found through the above searches. Author websites were most often academic profiles in their research institutions, but we also checked in Research Gate profiles where available. Relevant publications were sometimes also found in press releases that were returned as results. In all cases, we excluded publications that were not available as full text, or that were not published in journals or conferences.

We are only interested in video games designed and developed with the aim of preventing and/or detecting bullying and cyberbullying and which have related scientific publications. For each of the games that meet both criteria, we collected the following data:

- Game characteristics
 - Name

- Type of game, such as video game, prevention program that use games, or simulation
- Year of the first related publication or press appearance
- Type of audience and target age
- Problem addressed
- Specific purpose or purposes of the video game, such as changing behaviour, teaching knowledge, or increasing awareness
- Game mechanics
- Deployment platform, such as web, iOS, Android, Windows, Linux, or MacOS X
- Development platform, engine or language
- Website
- Complementary resources, such as a teacher's guide
- Availability and cost
- Information on how it was evaluated
 - Type of evaluation, based on what was evaluated; this can include effectiveness, design, applicability, features, ...
 - Number of users
 - Use of a control group
 - Age and country of users
 - Time of play and evaluation
 - Evaluation method, such as learning analytics, surveys and/or questionnaires
 - Results and conclusions
- Publications

4. Results

4.1. Papers identified by search terms

Papers were retrieved in August/September 2019 using the search terms described in Section 3.1.2. In the first search, 1067 candidate papers were found throughout all databases.

4.2. Papers selected using inclusion criteria

After scanning the titles and abstracts of the initial 1067 candidates, only 96 papers were retained, while 306 were discarded as duplicates, and another 665 because they failed to satisfy the inclusion criteria. Most of the discarded non-duplicate publications dealt with user behaviour in social networks and online games; studied whether and how a certain type of video games may be related to bullying behaviours; or studied bullying models using game theory.

In preparation for phase 2, we read the 96 retained papers to extract the list of games to analyze. 62 papers focused on validation or development of video games about bullying, while the other 34 did not focus on specific games about bullying but nevertheless mentioned one or more of them. For example, some publications describe tools to create video games about bullying or contain proposals regarding the creation of video games about bullying; or describe prevention programs that use multimedia technologies.

As can be seen in Fig. 2, the number of publications returned by the search and those that meet the inclusion criteria has been growing over the last few years.

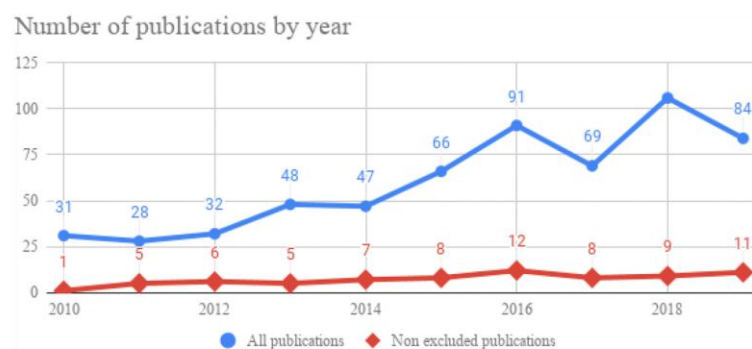


Fig. 2. The figure include two line graphs showing both the increasing number of publications returned by search and publications that met the inclusion criteria (2010–2019 period).

4.3. Games selected using inclusion criteria

Reading the 96 publications retained in phase 1 yielded a list of games to be analysed in phase 2. A total of 58 unique games were obtained from these publications, 35 of which appeared at least once as the object of study of publications that met the inclusion criteria. The other 23 games appeared as part of the introduction or state of the art of some of the publications but were not the subject of direct study of any of the publications reviewed in phase 1.

For the final set of 58 videogames, a new search was made through Google and Google Scholar for publications using the names of the videogame and those of the first authors. We carried out the analysis of games of phase 2 with all the publications obtained, including this new additional search. Table 1 shows the total number of studies identified in phase 1 as meeting inclusion criteria from each database considered, and the number of games found during phase 2 in these studies.

Of the 35 games that were objects of study in at least one of the publications selected in phase 1, we discarded 6 because they were not actual games designed to prevent or detect bullying and/or cyberbullying: three because their goal was to study the player's behaviour in the face of bullying; another because its goal was to make a system of agents more human; another because it consisted of recorded interactions on an existing leisure-oriented commercial virtual environment – and since there was no in-game player input, it could not be considered an actual game; and a final chat-bot system that offered emotional support to victims, but did not address bullying or cyberbullying directly. Therefore, 29 games made it to the final analysis.

Of the other 23 games which were only referenced in studies, 19 were excluded because we did not find any scientific publications associated with them; 1 was discarded for not having accessible publications; and another for not using video games. Therefore, only 2 of these 23 games were included in the final analysis, for a running total of 31 games.

Finally, two video games that did not appear in the searches were also added, as the authors of this study knew them from previous research, and both had at least one related publication. Therefore, the final sample for this study on serious games designed to prevent and detect bullying and cyberbullying contained 33 games. This allows us to use the games listed in Tables 2a and 2b to answer the first of the research questions, RQ0: What serious games have been developed to tackle the problem of bullying and/or cyberbullying?

4.4. Mechanics of bullying games

This section analyses the types of applications that have been found and the mechanics used in video games designed to prevent and detect bullying and cyberbullying. First, we attempt to answer RQ1:

RQ1. Which serious game genres and mechanics are used to prevent and detect bullying and cyberbullying?

Table 2a and Table 2b show the 33 resources obtained from phase 2, grouped by their main characteristics. We have classified them into 5 broad categories:

- **Videogames (20)**: serious games with very diverse characteristics and that use mechanics such as scores, exploration, narrative, or multiple scenarios; or which are built by aggregating several games or mini-games. All are directed at prevention.
- **Simulations (7)**: games focused on showing players situations and their outcomes depending on the reaction of the different people involved. Although they have similar characteristics to games from the previous group, simulations are usually less interactive, lack scoring, and are limited to the use of text, videos, and decision making.
- **Prevention programs (3)**: comprehensive bullying prevention programs that have appeared in the search because they use video games as part of the program.

Table 1

Number of studies and games per database identified in search and meeting inclusion criteria.

| Database | Phase 1: Studies | | | Phase 2: Games | | |
|------------------------------|------------------------|------------|------------------------------|--------------------------------------|---------------------|----------------------------|
| | # Identified in search | # Repeated | # Meeting inclusion criteria | # With their own study | | # Referenced in some study |
| | | | | Total different in the same database | New (Unseen before) | New (Unseen before) |
| ACM | 48 | 12 | 8 | 5 | 5 | 6 |
| ERIC | 24 | 0 | 3 | 2 | 1 | 0 |
| SAGE | 27 | 0 | 0 | 0 | 0 | 0 |
| Taylor & Francis | 28 | 2 | 3 | 3 | 2 | 0 |
| IEEE Xplore | 64 | 14 | 14 | 7 | 5 | 1 |
| Frontiers | 4 | 0 | 3 | 3 | 3 | 0 |
| Science Direct (Elsevier) | 73 | 2 | 11 | 7 | 5 | 14 |
| Wiley Online Library | 45 | 11 | 1 | 1 | 1 | 0 |
| Mary Ann Liebert | 7 | 0 | 4 | 4 | 3 | 0 |
| ProQuest | 407 | 254 | 8 | 6 | 3 | 0 |
| Springer Link | 340 | 11 | 41 | 13 | 7 | 2 |
| Total | 1067 | 306 | 96 | - | 35 | 23 |

Table 2a
Resources found during phase 2: non-game resources.

| Type | Resource name | Year | Availability | Platform | Targeted player age | Problem | Main purpose |
|---------------------|-------------------------------------|------|--------------|------------|----------------------------|---------------------------------|--------------|
| Simulations | Mii-School | 2010 | No | PC | Teenagers | Bullying/Drugs/Eating disorders | Detection |
| | My School 4 Web | 2013 | Restricted | Web | Teenagers | Bullying/Drugs/Mental disorders | Detection |
| | NN - Stavroulia | 2016 | No | PC | Teachers | Bullying | Prevention |
| | NN - McVoy | 2016 | No | PC | >18 | Bullying | Prevention |
| | NN - Inoue | 2017 | No | PC/Mobile | >12 | Cyberbullying | Prevention |
| | Step In, Speak Up! | 2018 | Pay | Web | Teachers | Bullying | Prevention |
| | At-Risk for Middle School Educators | 2019 | Pay | Web | Teachers | Bullying | Prevention |
| Prevention Programs | SMART Talk | 1996 | No | PC | Teenagers | Bullying | Prevention |
| | KiVa | 2006 | Restricted | Web/Mobile | 3–16 | Bullying | Prevention |
| Virtual Env. | Anti-Bullying Village | 2014 | No | PC | Teenagers | Bullying/Cyberbullying | Prevention |
| | TheSimSafetyPark | 2010 | No | PC | 9–11, teachers and parents | Cyberbullying | Prevention |
| Apps | SchoolLife | 2013 | No | Web | Teenagers | Bullying | Prevention |
| | #StopBully | 2018 | No | Mobile | - | Bullying/Cyberbullying | Prevention |

Table 2b
Resources found during phase 2: game-like resources.

| Type | Resource name | Year | Availability | Platform | Targeted player age | Problem | Main purpose |
|------------|--------------------------------|------|--------------|-----------|---------------------|------------------------------|--------------|
| Videogames | FearNot! | 2004 | No | PC | 8–12 | Bullying | Prevention |
| | Singularities | 2006 | No | PC | Teenager | Bullying/Mental health/Drugs | Prevention |
| | Cyberhero Mobile Safety | 2009 | No | PC | 8–12 | Cyberbullying | Prevention |
| | Quest for The Golden Rule | 2011 | No | Web | 6–11 | Bullying | Prevention |
| | NN - Tsai | 2011 | No | - | 12–15 | Bullying | Prevention |
| | NN - Rodrigues | 2013 | No | - | 10–13 | Bullying | Prevention |
| | Adventures Aboard The S.S Grin | 2014 | Pay | Web | 8–12 | Bullying | Prevention |
| | Happy | 2014 | Restricted | PC | 8–16 | Bullying | Prevention |
| | Stop the Mob! | 2015 | Free | PC/Mobile | Child and Teenager | Bullying | Prevention |
| | StopBully | 2015 | No | PC/Mobile | 10–12 | Bullying | Prevention |
| | Bully Book | 2015 | No | - | 18–34 | Cyberbullying | Prevention |
| | Monité | 2015 | Pay | PC | 6–11 | Bullying/Cyberbullying | Prevention |
| | The Messenger (Friendly ATTAC) | 2016 | No | PC | 12–15 | Cyberbullying | Prevention |
| | Cooperative Cybereduca 2.0 | 2016 | Free | Web | 11–15 | Bullying/Cyberbullying | Prevention |
| | PREVER | 2016 | No | Mobile | >12 | Bullying | Detection |
| | Conectado | 2017 | Free | PC | 12–17 | Bullying/Cyberbullying | Prevention |
| | CyberBullet | 2018 | No | PC/Mobile | - | Cyberbullying | Prevention |
| | Stop Bullying Now! | 2019 | Free | Web | Teachers | Bullying | Prevention |
| | NN - Ioannou | 2019 | No | Mobile | Child | Bullying | Prevention |
| | NN - Lazarinis | 2019 | No | Web | 6–12 | Cyberbullying | Prevention |

- **Virtual Environments (2):** games that provide a space where different players can interact with each other via chat and with other NPCs (Non- Playable Characters).
- **Apps (1):** resources that are neither comprehensive prevention programs nor just video games, but which include several tools, at least one of which is a game.

Among these resources, which we will collectively term as *games* for short, the most commonly used mechanic is that of presenting situations where players must choose among several options. Fig. 3 illustrates the popularity of different mechanics for each game. In addition to this, most games present the player with bullying situations, either in an isolated situation or through a story or adventure. Situations are frequently introduced to players through videos or parts of the game where the player cannot interact. Many of the games that do not present decision-making use simple questions that the player must answer with a correct selection, and in some, the player can score points for such choices.

Another frequent mechanic is the customization (or selection) of the character, especially in the case of third-person games where

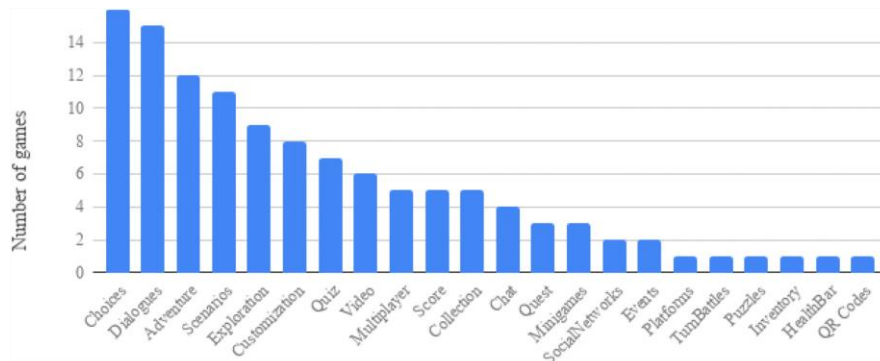


Fig. 3. Bars graph showing the number of games that included a specific game mechanic. In descending order: choices, dialogues, adventure, scenarios, exploration, customization, quiz, video, multiplayer, score, collection, chat, quest, minigames, social networks, events, platforms, turn battles, puzzles, inventory, healthbar, QR codes.

the player is represented by, and controls, an in-game avatar. Other mechanics such as the use of platforms (*Monité*), battles (*Singularities*), puzzles (*NN - Ioannou*), inventory (*NN - Rodrigues*), a health bar throughout the game (*NN Rodrigues*), and use of QR codes (*PREVER*), are found in only one of the analysed games. When tallying mechanics, we have not counted those in mini-games because mini-games are generally both very short and, to a large extent, not fully connected with the main game. Interestingly, several games are collections of multiple not fully integrated games – they are labeled as “Collection” in Fig. 3.

Regarding graphics, while resources classified as video games tend more to use 2D graphics in 2D or 2.5D perspectives, simulations and virtual environments generally make heavy use of 3D graphics and virtual reality.

In terms of deployment platforms, most video games were designed for PCs. Only 21% have a version for mobile devices, while 30% were developed for use via web browsers. In the case of web-based games, it should be possible to play them on mobile devices; however, their corresponding publications do not always clearly state the platforms where they were tested.

4.5. The main purpose of bullying games

This subsection addresses RQ2:

RQ2. What approaches do serious games take to help tackle bullying and cyberbullying?

As shown in Tables 2a and 2b, 61% of the resources analysed focus on the problem of bullying, while only 21% focus on cyberbullying. The remaining 18% deals with both problems.

Fig. 4 presents the goals of these resources, which we describe in the following list. Each item in the list describes a label in the horizontal axis of Fig. 4, from left to right; the actual text of each label is highlighted in italics:

1. Teaching *strategies* to combat the problem or to help students tackle and/or overcome it.
2. Raising *awareness* of the problem so that players understand the consequences of their actions and the effect they may have on others.

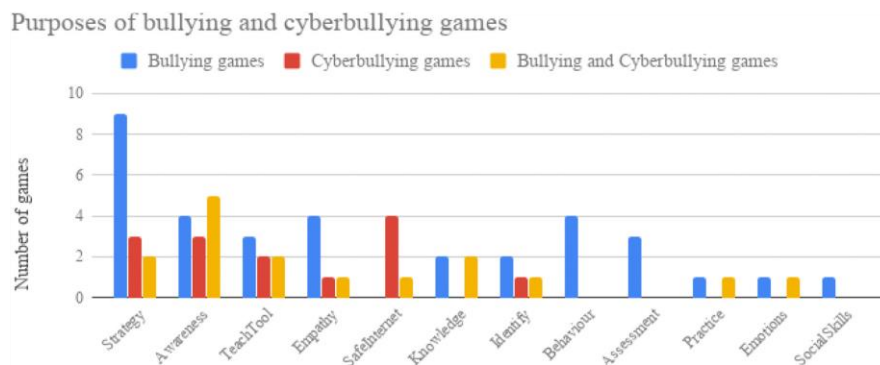


Fig. 4. Bars graph showing the puposes of games. In descending order: strategy, awareness, teach tool, empathy, safe internet, knoledge, identify, behaviour, assessment, practice, emotions, social skills.

3. Helping teachers deal with the subject in class as a *teaching tool*.
4. Creating *empathy* for victims.
5. Teaching *safe* and responsible use of the *Internet* and social networks.
6. Teaching *knowledge* about bullying, what it is, its characteristics and effects, etc.
7. Teaching how to *identify* bullying situations.
8. Changing the *behaviour* of players.
9. *Assessing* the level of bullying within a group or the level of victimization and/or aggression of an individual.
10. *Practicing* knowledge related to bullying and cyberbullying.
11. Developing *emotional* skills that decrease the risk of victimization and deal with the effects of victimization, such as anxiety or fear.
12. Developing *social skills* that allow players to relate to others, thus decreasing the risk of victimization and aggression.

However, not all these resources have been formally validated or scientifically proven to be effective in preventing or detecting bullying and cyberbullying, after searching for supporting papers as outlined in Section 3.2.2. Indeed, of the 33 resources, only 48% had associated publications that described experiments and results, addressing their effectiveness in achieving one or more of the objectives listed in this subsection. For example, we found no experimental or evidence-based support of the effectiveness of games addressing the goals *SafeInternet*, *Practice*, or *SocialSkills*.

4.6. Stakeholders

This subsection addresses RQ3:

RQ3. What target users are serious games that tackle bullying and cyberbullying developed for?

The six stakeholders considered in the studies are: children (6–12 years old), teenagers (12–18 years old), young adults (18–25 years old), adults (more than 25 years old), parents, and education professionals such as teachers. Fig. 5 shows the number of studies that focus on each of these stakeholders. Some games cover more than one stakeholder. Most of the video games analysed focus on children and adolescents between the ages of 8 and 16.

In addition to the age aspect of the players, 5 of the games focus on some specific group of people: teachers with LGBTQ students (*Step In, Speak Up!*); teachers of students with disabilities (*Stop Bullying Now!*); children at social risk or with social skills deficit (*Adventures Aboard The S.S. Grin*); LGBTQ teenagers (*Singularities*); and children with special needs (*NN – Inoue*).

4.7. Evaluation of games

Although all the analysed resources have at least one associated scientific publication, not all of them have publications describing how they were validated or proving their effectiveness with experimental data. This subsection analyses the characteristics of existing experiments, addressing RQ4:

RQ4. What evaluation studies have been carried out with those serious games?

We found five categories of experiments. The most frequent category encompasses experiments that test the effectiveness of games towards a particular goal (21 different games) or measure the extent to which users like it (16 games). Yet other experiments test the degree to which teachers can use the game in class; or test whether its design and characteristics are adequate from an educational point of view; or, finally, collect data and samples to inform the actual development of the game (i.e., formative evaluation of the game to improve it).

Only seven games had no associated experiments in their publications. From the remaining 26 games, we identified a total of 42 experiments, 40 of which described their details and methodology. Analysing these 40 experiments, we found the use of:

- A single questionnaire, after the intervention with the game (40%)

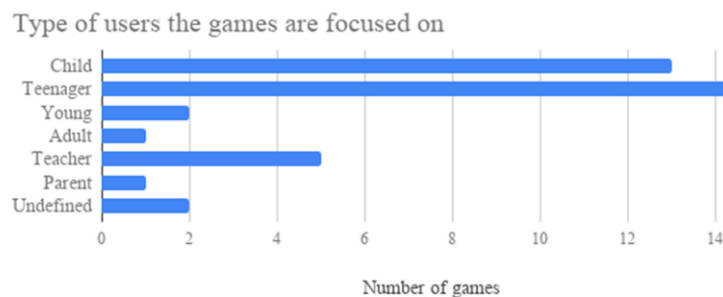


Fig. 5. Bars graph showing the type of users the games were developed for. In descending order: child, teenager, young, adult, teacher, parent, undefined.

- Questionnaires before and after the intervention with the game (35%)
- Questionnaires before, the intervention with the game, and a follow-up questionnaire (10%)
- Comparison of in-game behaviour to an external questionnaire (10%)
- Single questionnaire from interview, voice and/or video recording (5%)

In 90% of the experiments, the video game was played in a single session. There are 11 video games that have at least one experiment where a control group is used, accounting for 42% of the 26 games for which we found experiments.

Table 3 summarizes, for each game, whether or not it was backed by an experiment and, if applicable, the type of questionnaires used. Readers should note that some resources have more than one associated experiment. In addition, some studies evaluate the game acceptance and players' opinion together with the game effectiveness, while others use experiments with separate questionnaires. *SMART Talk*, *KiVa* and *Anti-Bullying Village* present studies with evaluations of an entire prevention program, but provide no details about the videogames used or about their effectiveness or acceptance. *Cooperative Cybereduca 2.0* is a game made within the prevention program *Cyberprogram 2.0*, and its publications evaluate the complete program together with a non-digital version of *Cybereduca 2.0*: the videogame was developed later. *The Sim Safety Park* studies and *NN Tsai* do not provide enough details about the effectiveness evaluation.

The number of users with which the experiments with games were carried out is very variable, and goes from 5 to 2500, also depending on the purpose and instruments used in the experiment. If we take all experiments into account and include control groups, the average is 329 users per experiment (N = 42, SD = 496.24). In this case, we can consider the experiment with 2500 users an outlier, and we must take into account that the usual is to have below 1000 users.

If we look only at those experiments focused on finding evidence of effectiveness in the games, we find that serious games focused on preventing and detecting bullying and cyberbullying use a mean of 479 total users (N = 21; SD = 530.14), while the median number

Table 3
Type of experiments by resource.

| | Effectiveness experiments | | | Design and/or Acceptance Experiment | | Others |
|-------------------------------------|---------------------------|----------------------------------|----------------|-------------------------------------|----------------------------------|---------|
| | Detailed results? | Experiment type by questionnaire | Control group? | Detailed results? | Experiment type by questionnaire | |
| FearNot! | Yes | Pre-Post and Follow | Yes | Yes | Post | - |
| Singularities | Yes | Pre-Post and Follow | Yes | Yes | Pre-Post and Follow | - |
| Cyberhero Mobile Safety | Yes | Post | No | Yes | Post | - |
| Quest for The Golden Rule | Yes | Pre-Post | No | - | - | - |
| NN - Tsai | Yes | ? | No | - | - | - |
| NN - Rodrigues | - | - | - | - | - | - |
| Adventures Aboard The S.S Grin | Yes | Pre-Post | Yes | Yes | Pre-Post | - |
| Happy | Yes | Pre-Post | Yes | - | - | - |
| Stop the Mob! | - | - | - | - | - | - |
| StopBully | No | Pre-Post | No | Yes | Post | - |
| Bully Book | - | - | - | Yes | Post | - |
| Monité | Yes | Pre-Post | Yes | - | - | - |
| The Messenger (Friendly ATTAC) | Yes | Pre-Post and Follow | Yes | Yes | Post | - |
| Cooperative Cybereduca 2.0 | - | - | - | - | - | Program |
| PREVER | Yes | Pre-Post | No | Yes | Post | - |
| Conectado | Yes | Pre-Post | No | Yes | Pre-Post | - |
| CyberBullet | - | - | - | - | - | - |
| Stop Bullying Now! | Yes | Pre-Post and Follow | Yes | - | - | - |
| NN - Ioannou | Yes | Record | No | Yes | Record | - |
| NN - Lazarinis | Yes | Post | No | Yes | Post | - |
| Mii-School | Yes | Compare test with game choices | Yes | - | - | - |
| My School 4 Web | Yes | Compare test with game choices | No | Yes | Post | - |
| NN - Stavroulia | - | - | - | Yes | Post | - |
| NN - McVoy | Yes | Post | Yes | Yes | Post | - |
| NN - Inoue | - | - | - | Yes | Post | - |
| Step In, Speak Up! | Yes | Pre-Post | Yes | Yes | Pre-Post | - |
| At-Risk for Middle School Educators | Yes | Pre-Post | No | - | - | - |
| SMART Talk | - | - | - | - | - | Program |
| KiVa | - | - | - | - | - | Program |
| Anti-Bullying Village | - | - | - | - | - | Program |
| TheSimSafetyPark | No | ? | ? | Yes | Record | - |
| SchoolLife | Yes | Post | Yes | - | - | - |
| #StopBully | Yes | Pre-Post | No | Yes | Pre-Post | - |

of users in these games is 223. If we only consider the intervention groups, these numbers drop even further ($N = 21$; $M = 296$; $SD = 341.69$; $MED = 108$), as illustrated in Fig. 6.

The literature reports gender differences in the style of play, in the preferences of the kind of video games, in the prevalence of bullying and cyberbullying and even in the behaviour towards bullying and cyberbullying in different roles. However, of the 16 resources with studies that experimentally demonstrate their effectiveness in some aspect and describe the results obtained, only 6 compare the results between boys and girls. *StopBully* and *Adventures Aboard the S.S. Grin* found no significant differences between boys and girls. The other 4 found differences: *Fear Not!* and *Conectado* found statistically significant differences in the questionnaires and in the interaction with the game when comparing boys and girls. *Fear Not!* found that more girls are involved in relational bullying and more boys are involved in direct bullying. Girls show the highest empathy scores after play. *Conectado* found that girls have more awareness and take more time to complete the game; *Quest For The Golden Rule* found differences in knowledge in one of the three games that compound it. In this case, girls have more knowledge to identify bullying and about strategies to respond when faced with bullying, also other of three games shows a greater effect on girls. *Monité* also found differences in the results of the questionnaires carried out. Boys score higher in some variables, such as making unforgivable mistakes and having a hard time at school.

In addition to the questionnaires, only 7 of the video games analysed claim to collect traces of user interaction (movements, choices, etc.). However, only one game uses the term Learning Analytics and provides details regarding the traces collected (*Conectado*). Two other games use the user interaction traces to compare player choices with their responses to evaluation questionnaires, using the comparison to validate the effectiveness of the game to assess the level of bullying (*Mii-School* and *My School 4 Web*).

4.8. Availability and cost

Regarding availability:

RQ5. How, if at all, are the analysed serious games made available?

Throughout this study, we have also tried to test all games by playing them. Although we found 33 video games for the prevention or detection of bullying or cyberbullying, only 8 are accessible, 4 of them for free and the other 4 through the payment of different types of licenses, ranging from 10€ to 400€ at the time of writing – with 2 of them offering free demo versions. A further 3 games are only available upon request. The remaining 67% of games are, to our best knowledge, no longer available.

As previously mentioned, most of the games have been developed to be played on desktop or laptop computers, with several being web-based, and therefore at least in theory also playable on portable devices such as tablets. We were able to identify the technology used to develop 16 of the games, which is roughly half of the total. In these 16 games, 56% were developed with Unity3D, a popular multiplatform game authoring environment. We have only found the source code for two of the games online – both of which use open-source licences (*Conectado* and *FearNot!*).

5. Discussion

5.1. Properties and mechanics

Research both into serious games as into bullying and cyberbullying has experienced a steady growth in the last years. This is also true of the intersection of these fields, with increasing numbers of serious games designed to address bullying and cyberbullying. The most frequent approach of these games is focused on placing the player in a bullying situation. Players must then typically decide how their representing avatar should act, dealing with successive bullying situations presented in different scenarios or levels, or as events within a story that the player must complete. The games then usually show the negative effects of behaviours such as ignoring the problem or engaging in verbal or physical violence, as opposed to the positive effects of behaviours such as supporting victims or asking for outside help. Many of the games feature dialogues between different characters, with which the player can also interact by

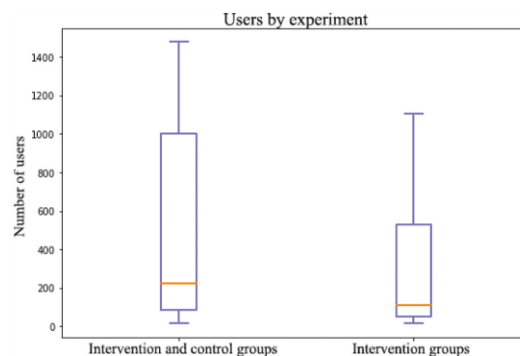


Fig. 6. Box plot of users by experiment, showing a whisker graph for each the intervention group and the aggregated (intervention and control groups).

using the usual game mechanics present in the game genres of graphic adventures, role-playing, simulation, and question-answer games. This type of game is common in the area of serious games in general. Besides, the mechanics found are already included in some proposed frameworks for the design of serious games (Arnab et al., 2014; Suttie et al., 2012).

5.2. Validation

Not all the games found in this study have associated experiments that formally demonstrate their effectiveness. Only 48% of games had associated experiments with statistical results regarding their effectiveness, while 18% described experiments without providing evidence-based details that would allow the game's effectiveness to be considered scientifically demonstrated. Well-validated games tend to focus on teaching strategies for dealing with bullying and/or on increasing awareness about the consequences of certain behaviours and actions that are interpreted as (cyber)bullying. On the other hand, only three of the games include, among their stated goals, the detection of bullying – and none of them addresses detection of cyberbullying. In the literature we find that many of these objectives, such as increasing awareness, changing behaviour or increasing empathy have also been successfully explored in serious games focused on problems other than bullying and cyberbullying (Boyle et al., 2016; Calderón & Ruiz, 2015; Lau, Smit, Fleming, & Riper, 2017).

In addition to the lack of experimental validation of many games, we also observe (1) a great variety of questionnaires used to demonstrate the effectiveness of games; (2) that many of these games are not available; and (3) a large variety of objectives, such as increasing awareness, teaching strategies, creating empathy, teaching how to identify cases of bullying, and others listed in Section 4.5. This variety in goals, approaches, availability and experimental validation makes it difficult to compare different games and draw conclusions on the merits of different game types, mechanics or platforms.

When performing experiments, the methodology preferred by researchers was clearly the use of questionnaires, which were present in all experiments that we analysed. In most cases, a single questionnaire was used after playing; slightly less popular overall was the use of a questionnaire before playing, followed by another one afterwards. In experiments for validating game effectiveness, two-questionnaire (pre-post) setups are more prevalent, and, in some cases, they are complemented with a follow-up questionnaire some weeks after playing. The use of simple post-game questionnaires and pre-post questionnaires is also the most common evaluation method for other serious games (Boyle et al., 2016; Calderón & Ruiz, 2015).

Regarding more recent evidence-based techniques, such as the use of learning analytics or the collection of interaction traces, their use is very limited, being nearly non-existent in the revised games.

From the point of view of participants in experiments designed to measure the effectiveness of serious games, 67% had less than 500 users (70% if only taking into account intervention groups), with a median of 223 users (108 when considering only intervention groups). These values are similar to other reviews on the evaluation of serious games, where about 30% of validations are done with less than 100 users and 65% with less than 1000 (Alonso-Fernández, Calvo-Morata, Freire, Martínez-Ortiz, & Fernández-Manjón, 2019).

5.3. Effectiveness

The results of these studies show that half of the analysed games have proven their effectiveness in a wide variety of aspects related to bullying and cyberbullying such as: teaching strategies to act when faced with bullying, increasing awareness, creating empathy in players, helping teachers to deal with and address the issue in class, teaching to identify cases of bullying, changing behaviour, detecting bullying, and improving certain emotional skills.

On the other hand, despite the fact that there are gender differences in the field of video games (Lucas, Sherry, & Sherry, 2004; Procci, Bohnsack, & Bowers, 2011) and in that of bullying and cyberbullying (Waasdorp & Bradshaw, 2015; Zych, Ortega-Ruiz, & Del Rey, 2015), few studies report studying whether there are differences in the results of the questionnaires, in how players of different genders interact with the resource, and/or differences in game effectiveness. Therefore, more research is needed to further study the effects of video games according to demographic variables such as gender.

5.4. Stakeholders

Most of the games analysed were aimed at students between the ages of 6 and 12 and users between the ages of 12 and 16. Some were also focused on teachers to help them to identify and deal with cases of bullying among their students. We found only one game for adults (*BullyBook*), which is aimed at people between the ages of 18 and 34. This is related to the fact that bullying and cyberbullying are mostly studied within these ages (8–16 years) and in school settings; and that these ages are also the main targets for prevention campaigns and programs (Zych et al., 2015).

5.5. Availability

It is necessary to highlight that very few of the serious games analysed are currently available. Although most of them have been tested in schools and high schools, as we have seen, only eight of them are available online, with half of them being free and the other half requiring the purchase of a license. This makes it very difficult to compare new games and mechanics with others that have already been developed and validated.

Most importantly, research into effectiveness of unavailable games cannot be replicated due to the lack of the intervention resource

(i.e., the actual game). This lack of availability also indicates a short lifecycle for the games analysed, suggesting that many now-unavailable games were only used and available for the duration of their corresponding research, limiting the benefit that society can get from these existing tools as soon as they have proven their usefulness.

Existing video game literature reviews focus primarily on the validations and demonstrated effects of the studies reviewed, with little or no emphasis on the availability of the resources of those studies (Boyle et al., 2016; Calderón & Ruiz, 2015; Lau et al., 2017). The results obtained suggest that, in general, the life cycles of serious games that appear in scientific studies are very short or non-existent once the study is completed. This life cycle is longer in those games that also have commercial objectives.

6. Limitations

The current review has several limitations. First, as all systematic reviews, it is limited by the search terms used, the databases included, and the temporal window during which the actual searches for papers were carried out. However, this study provides a snapshot of empirical research on outcomes and impacts of digital games focused on preventing and detecting bullying and cyberbullying, and is representative of the state of the art at the time. Note that, as previously stated in the related work, we have purposefully excluded several games that focused on the study of player behaviour in cases of bullying and/or cyberbullying, because we chose to specialize only on those geared towards prevention and detection.

7. Conclusions

We consider that this review can greatly help and inform new research initiatives on the topic of using serious games for addressing bullying and cyberbullying. Our review shows a large variety of game mechanics used and identifies the most common ones. It also provides an overview of the methods used when validating the corresponding games, which are far from standardized, varying greatly even for serious games that share similar subjects and approaches. Indeed, among the analysed games that dealt with the prevention of bullying and cyberbullying, there was also a considerable variety of approaches and target audiences.

In many cases, we encountered that the games were no longer available, making the research that supported them no longer reproducible and removing critical context (the game) for researchers that access those papers. We encourage authors of current and upcoming serious games to take steps to avoid this fate for their games. For example, by arranging to release their games as open-source when they cease to be maintained or, at least, by sharing their game design documents so that other researchers can build on top them and/or learn from those efforts. Beyond research, this review shows that several serious games have proven useful to combat both the issues of bullying and cyberbullying: keeping effective games available has a positive impact on society.

Finally, we expect that techniques used in serious games found in this review could also be effective in addressing social problems that share characteristics with bullying and cyberbullying, such as discrimination, public health and lifestyle choices, domestic violence, or environmental issues, among others. In particular, immersing players in problems within the safety of game environments, and allowing them to experience the consequences of different in-game choices appears to be a powerful approach to promote empathy, awareness, and constructive behaviour.

CRedit authorship contribution statement

Antonio Calvo-Morata: Conceptualization, Investigation, Methodology, Data curation, Writing - original draft. **Cristina Alonso-Fernández:** Conceptualization, Validation, Data curation, Writing - original draft. **Manuel Freire:** Validation, Data curation, Writing - review & editing. **Iván Martínez-Ortiz:** Validation, Data curation, Writing - review & editing. **Baltasar Fernández-Manjón:** Conceptualization, Validation, Supervision, Project administration, Data curation, Writing - review & editing.

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6.2. Validation of a cyberbullying serious game: using game analytics

6.2.1. Cita completa

A. Calvo-Morata, D. C. Rotaru, C. Alonso-Fernández, M. Freire-Morán, I. Martínez-Ortiz and B. Fernández-Manjón, **Validation of a Cyberbullying Serious Game Using Game Analytics** in *IEEE Transactions on Learning Technologies*, vol. 13, no. 1, pp. 186-197, 1 Jan.-March 2020, doi: 10.1109/TLT.2018.2879354

6.2.2. Resumen original de la publicación

Bullying is a serious social problem at schools, very prevalent independently of culture and country, and particularly acute for teenagers. With the irruption of always-on communications technology, the problem, now termed cyberbullying, is no longer restricted to school premises and hours. There are many different approaches to address cyberbullying, such as school buddies, educational videos, or involving police in counselling; however, awareness continues to be insufficient. We have developed Conectado, a serious game to be used in the classroom to increase awareness on bullying and cyberbullying in schools. While playing the game, students gain a first-hand immersive experience of the problem and the associated emotions, fostering awareness and empathy with victims. This paper describes Conectado and presents its validation with actual students using game analytics.

Validation of a Cyberbullying Serious Game Using Game Analytics

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Abstract— Bullying is a serious social problem at schools, very prevalent independently of culture and country, and particularly acute for teenagers. With the irruption of always-on communications technology, the problem, now termed cyberbullying, is no longer restricted to school premises and hours. There are many different approaches to address cyberbullying, such as school buddies, educational videos, or involving police in counseling; however, awareness continues to be insufficient. We have developed *Conectado*, a serious game to be used in the classroom to increase awareness on bullying and cyberbullying in schools. While playing the game, students gain a first-hand immersive experience of the problem and the associated emotions, fostering awareness and empathy with victims. This paper describes *Conectado* and presents its validation with actual students using game analytics.

Index Terms— Serious games, game learning analytics, bullying, cyberbullying, awareness

1 INTRODUCTION

BULLYING is a serious social problem, and it is present in all countries to a greater or lesser extent [1][2]. Approximately 40% to 55% of students around the world are involved in some form of bullying and/or cyberbullying, either as a victims, aggressors or observers; and 20% to 50% of them say that they have been victimized [3]–[5]. The prevalence of bullying and cyberbullying varies significantly between countries, for example some studies indicate that the percentage of victimization in the United States and Asia is 55%, compared to other Central and South American countries (22%), Canada (25%), Oceania (25%) and Europe (30%) [3].

In the last few years, the problem of bullying has grown significantly. The emergence of new technologies, and particularly the expansion of Internet access and social networks, together with the early use of these technologies by children and young adults, has led to the appearance of another form of bullying known as cyberbullying. Cyberbullying is not restricted to school hours and premises and can occur at any time and place [5]–[7].

Bullying victims can be defined as those that are targets of: a) aggressive behaviors, both physical and verbal and both direct and indirect; b) behaviors that isolate the individual from the group and/or; c) behaviors that create feelings such as powerlessness and fear [8]–[11]. Cyberbullying appears when bullying is carried out through new technologies such as the Internet, mobile phones or different media: e-mail, forums, social networks, text messages, chat rooms, or online video games [1], [12], [13].

Among the most common effects of bullying and cyberbullying are problems associated with attention, behavior, and emotional regulation, which usually interfere

with the victims' ability to learn and adapt in schools [5], [14], [15]. Important psychological disorders and even suicides have also been documented [3], [13]. Bullying is a complex problem that requires multiple perspectives and initiatives to deal with, and many educational centers do not know how to handle it effectively. There are many different approaches and tools to address this problem, including school buddies [16], awareness campaigns, training talks, educational videos, and video games, among others. However, more research is needed on the topic, as not all approaches are readily available, and many of them are not scalable due to different factors such as cost or specific requirements; in particular, some require one or more specialists to carry out the intervention or to train teachers. In addition, most of the interventions do not consider the parents, who also need to be provided with resources to better educate their children at home and to provide them with strategies to identify and address bullying.

In this paper we present *Conectado*, a serious game designed for use in school classrooms to increase awareness on bullying and cyberbullying. By playing this game, we give the player the opportunity to experience the problem of bullying and cyberbullying and associated emotions from the perspective of the victim, in a safe environment, increasing empathy with the victim and learning strategies to defend against harassment. We also describe the experimental validation of *Conectado* at schools using game analytics techniques.

The rest of the paper is structured as follows: Section 2 reviews the current solutions against bullying and cyberbullying; Section 3 presents the game *Conectado*; Section 4 describes the use of game analytics to validate serious games; Section 5 describes the methodology used; the results of which are presented in Section 6; and finally, Section 7 summarizes the main conclusions and outlines future work.

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2 CURRENT APPROACHES

Bullying and cyberbullying are problems that affect a significant percentage of students and their families. Parents, teachers and students often do not know how to act or even how to clearly identify the problem. We briefly review below some of the current approaches, projects and tools that focus on preventing and acting on bullying and cyberbullying.

There are numerous projects and web platforms focused on increasing awareness about this social problem, its consequences and what signals help to identify it. These approaches provide resources and help to prevent both bullying and cyberbullying. Some of the most relevant initiatives and projects addressing these problems include the

1. Cyberbullying Research Center (cyberbullying.org) is a U.S.-based website dedicated to providing up-to-date information on the nature, extent, causes and consequences of cyberbullying among adolescents. The platform also explores and addresses other risky behaviors among adolescents such as malpractice in social networks, sexting and other issues related to digital citizenship.
2. Pantallas Amigas (www.pantallasamigas.net) is a Spanish and Portuguese-language initiative whose main mission is to promote the safe and healthy use of new technologies as well as the promotion of responsible digital citizenship in childhood and adolescence by having carried out different interventions and campaigns in collaboration with different entities.
3. StopBullying (www.stopbullying.gov), administered by the U.S. Department of Health and Human Services, is a website that provides information about harassment, cyberbullying, its risks and how to prevent and respond to these problems

The most common way to combat bullying is through campaigns and projects organized by associations, foundations and, as in the case of Spain, by regional governments, such as:

1. Cibermentores (www.cibermentores.com) is an educational program of learning and service solidarity created and developed in 2010 in which last-year secondary school students are coached and tutored to give support and training to younger students. The program uses video games, videos and other animations to help students identify, reflect and react to the various risks posed by information technology.
2. Ciberexperto (www.ciberexperto.org) is a project created by the Spanish National Police, with the support of Telefónica and the collaboration of Fundación Cibervoluntarios, aiming to improve the digital education of families. The program consists of training talks on the use of the Internet with police officers as counselors and experts.
3. Ditchthelabel (www.ditchthelabel.org) is a charity working in the UK, the U.S. and Mexico. It focuses on promoting equality and empowering people

aged 12-25 to overcome harassment. It participates in various campaigns regarding anti-harassment, anti-homophobia and social networking awareness.

4. I am a Witness (iwitnessbullying.org) is an anti-bullying campaign in the U.S. that focuses on the role of the witness, encouraging people not to take a passive position on harassment, encouraging actively helping victims instead.

Moreover, several existing videogames and other software focus on bullying/cyberbullying prevention and detection [17], [18]:

1. Be Internet Awesome, a Google project (beinternetawesome.withgoogle.com/en), teaches younger children about the dangers of the Internet. This is done through a browser-based video game that takes them to the world of Interland, where puzzles teach safe and unsafe Internet practices, and provide advice and guidance.
2. Clear Cyber Bullying (www.clearcyberbullying.eu) is an Erasmus European project with a web videogame with the same name that is available for the iOS and Android platforms. The video game includes two questionnaires to identify students' sensitivity to cyberbullying, and four mini-games that address the issue of sending photographs, grooming (in the sense of adults luring and interacting with minors for sexual purposes), bullying with offensive messages, and sharing of private information and passwords.
3. Cybereduca (www.cybereduca.com), is a web video game that belongs to the psychoeducational program Cyberprogram 2.0 [19] to prevent and reduce cyberbullying. The video game comprises 6 blocks, focused on cyberbullying and harassment definitions, their consequences, computer concepts such as antivirus, firewalls, pop-ups, etc. The blocks of content are presented mainly as multiple-choice questions.
4. SchoolLife (www.giantotter.com/schoollife/) is a video game designed to reduce bullying in the classroom. The video game presents a 3D scenario where the user can take the role of victim or observer. SchoolLife is designed to work in groups, where several people participate directly and the rest can give their opinion on what is happening in a chat provided by the game. While free, the premium version can also generate reports.

After studying current existing resources, we found that none of them focus on the student's emotions to encourage passive observers (and potential bully accomplices) to take active roles and help the victim. Most of the prevention resources that exist so far focus on teaching what the problem is, its consequences, and how to proceed in these cases – but do not provide a simulated first-hand experience. In addition, there is a lack of studies to validate the impact of these projects. Of the videogames mentioned, we have only found studies with users for the Cybereduca project,

where 176 young people participated in the experiments, with 83 being part of the control group. The results were positive and the intervention yielded both a significant decrease in victimization behaviours (0.6 points out of 7 between pre and post) and significant increase in various positive social behaviours in the experimental group (0.57 points out of 7), as compared to the control group.

In response, we have developed *Conectado*, a serious game to increase awareness on bullying and cyberbullying in schools through experience and emotion. The game places players in the role of a victim, creating a common experience in the class and focusing on conveying feelings such as helplessness and frustration.

In *Conectado*, the player plays the role of victim, while in many other games the player is an observer of the bullying or cyberbullying situation. It is focused on conveying feelings and increasing empathy with the victims, while many other resources focus on imparting knowledge through definitions and in-game lessons, which are less attractive to learners. There are already studies on how video games can increase empathy and affect players' motivation and attention [20], [21].

Another advantage is that *Conectado* is made with Unity, which allows the game to be deployed to many platforms and run in any of the devices commonly found in high schools. Our experiments were carried out on Linux and Windows computers (as found in the computer labs of the participating schools); but tablets and other devices are also supported.

This paper focuses on testing the effectiveness of the game in changing the player's awareness and feelings, through data collection in experiments with real students, and analysis of the data that is generated during the game and in pre- and post-tests.

3 CONECTADO, A SERIOUS GAME AGAINST BULLYING

Conectado is a video game that has been designed and developed with the goal of raising awareness on bullying and cyberbullying through experience and emotions. As a tool, it is intended to help educational professionals to increase the interactivity and emotional engagement of their classes. Its vocabulary and conversations are targeted at students between 12 and 17 years old. Within the videogame, players are placed in the role of a student suffering cyberbullying by schoolmates (see Figure 1a and Figure 1c).

The game provides a safe environment that allows players to experience firsthand some of the feelings experienced by victims of bullying and cyberbullying, as well as to reflect on the consequences of bullying-related action and inaction by increasing player's awareness of the problem. The game follows the classical adventure videogame structure where the primary means of interaction with the game is to choose dialogue options, which alter the story and can lead to different endings.

In the video game, the player lives the life of a high-school student arriving at a new school. During the 5 days in the game, more and more classmates turn against and



Figure 1a. *Conectado* game: the player's view of the class. A dialogue line from the bully/antagonist is also visible.

harass the player, following the lead of the classroom bully (pictured in Figure 1). Each of these game-days, the player-protagonist moves from home to school; spends the day at school; and returns home with the protagonist's parents. At the end of each day the protagonist experiences a nightmare, a mini-game that is designed to be impossible to overcome and is intended to frustrate and stress the player, echoing the feelings of their character.

Through the different scenarios, players can talk to the characters in the game, such as classmates. Conversations are navigated by choosing between different dialogue options. Each player's choices can alter the flow of the story, decreasing the level of confrontation and affecting future dialogues and events, as well as the ending that is reached on the 5th day. However, the bullying situation cannot be totally avoided or resolved until the actual ending. The three different endings vary according to the protagonists' level of friendship with classmates, whether players have asked the teacher for help or not, and the relationship between the protagonist and the in-game parents. The videogame is designed so that players feel powerless because they cannot solve the problem; and seeks to make them understand that they need to ask for help, because they will otherwise be unable to solve the (cyber)bullying situation on their own.

A secondary goal of the game is to teach strategies that reduce the risk of becoming a victim, an abuser or an enabling bystander. For example, by informing players about the risks and consequences of mocking or making derogatory comments on social networks; or uploading images that can be easily accessed by anyone (see Figure 1b and Figure 1c). Another advantage of the video game is that it reflects on the social aspect of the problem, since cyberbullying affects not only those directly involved, but also the degree of bullying-awareness of the social environment [3], [22]; and this social aspect can be effectively represented in a language and channel that teenagers understand as their own.

The game provides a common experience for all students that can be used to initiate later discussions under



Figure 1b. Screenshot of the simulated social network included in the Conectado game: Login screen.

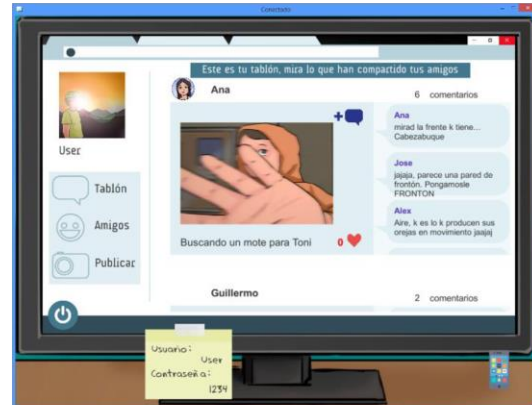


Figure 1c. Screenshot of the simulated social network in the Conectado game: Classmates post harrasing comments.

the supervision of a professional such as a teacher or guidance counselor. The aim is to make players reflect on their common game experience and better understand the ultimate consequences of their actions. In addition, the game sheds light on important aspects such as asking for help (presented as an act of courage as opposed to snitching), communicating with parents [14], or avoiding being an observer/collaborator who looks the other way; since passive bystanders are often involuntary but necessary participants in harassment processes.

As depicted in Figure 1a, the game is currently in Spanish, although it has been designed to be easy to translate into other languages. The design of the game and the simulated scenarios is based on different multiple experiences, projects and studies [23], [24] which should be common across multiple countries and cultures. The game is played in first-person mode, so that the player is not represented in the game by an avatar which facilitates feeling identified with the protagonist. The game also considers the player's gender, which the user is requested to select at the very start. Dialogues and small parts of the plot change according to the chosen gender (Spanish grammar is more gender-aware than English), increasing the players' sense of identification.

The video game works by engaging the player's empathy, confronting the player with feelings such as impotence, inferiority, frustration and loneliness. This is done through mini-games in the form of nightmares that cannot be overcome; and through dialogues where the player must choose among multiple answers, none of which include violent responses or lead to a lasting solution. Only at the end of the game can such a solution be reached; and, depending on player choices, it may be far from satisfactory. This gameplay is designed to persuade players that bullying and cyberbullying can only be effectively stopped by asking for help and, importantly, offering help, as these are serious social problems that victims cannot solve alone.

The implementation of the game is based on an educational design that encompasses the key points of serious game design as described in [25]:

1. The pedagogical objectives must have clear instructional objectives.

2. The simulation of the domain must represent it reliably in the gameplay, in order to teach and raise awareness at the true target domain.
3. The progression and problems the player will encounter must be defined.
4. The game must exhibit marked aesthetics that make it attractive for the player.
5. The interactions of the player with the simulation must be clearly defined.
6. The conditions of use, how, when, where and by whom the video game will be used, must be clearly specified.

The most common duration of a Spanish high school lecture is 55 minutes, so the game is designed to last from 30 to 40 minutes depending on the speed and reading comprehension of the players. This leaves at least 15 minutes remaining that teachers can use to start a discussion as mentioned earlier in this section.

4 GAME ANALYTICS, VALIDATING AND IMPROVING SERIOUS GAMES

For instructors, it is important that educational tools provide control and situational awareness of the classroom; generally, such tools should allow professionals to view student progress and understand if the tools are serving their purpose. In the case of serious games, the necessary data collection and analysis is part of Game Learning Analytics, which can be defined as the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs, in particular applied to games [26]–[28].

Collected data from players' interactions with the game provide insights not only regarding players' improvement and learning, but also into the actual use of the game, including those parts that do not achieve their intended goals; and information on where players have problems with game mechanics or educational objectives. This allows developers to improve the serious game as an educational tool, and enables instructors to better adapt it

for classroom use.

In this project, data is collected via a tracker module within the game which tracks in-game player actions and sends them to a server for storage and analysis. The actions that are being tracked are referred to as *traces*, and are analyzed in real time by the server, which then generates visualization dashboards that provide overviews to stakeholders such as teachers and instructors. The dashboards can then be queried for further details on particular students [27]. The data traces are formatted using the xAPI (Experience API) format, and in particular the xAPI application profile for serious games [29]. Use of this standard is intended to facilitate the development and the combination of tools required to build analytics systems; and to comply both with data portability and with an adequate experimental design with the privacy data requirements imposed by the EU GDPR [30].

For this game, the visualizations generated for the teacher display the in-game locations of players, their relationship with classmates, their in-story decisions, and, for players that have finished the game, the specific ending that has been reached. In addition, data provide the information needed to understand how players are interacting with the game, including, for example, how much time they have spent in each scene. This can be useful to know if, when and where players are getting stuck in the game. This information is also useful for developers, which can use it to locate difficulties for players, and to improve the adaptation of the video game as an educational tool within the classroom. For example, it allows gameplay time to be adjusted to fit within a specific class slot.

To organize and guide our analysis, we pose the following research questions: Is the serious game an appropriate learning tool for creating a change in cyberbullying and bullying awareness among early teenagers? Does the video game fit the typical duration of a class? Does the game have different effects depending on the gender of the student? Is the game valid for the entire target age range? Is the video game perceived as engaging? Does the video game create empathy towards victims?

To address these questions, the following research hypothesis are established, and will be tested and analyzed in Section 5:

1. H1: The video game fits within the duration of a standard 1-hour class slot, leaving at least 15 minutes for guided reflection with the tutor.
2. H2: The intervention with the videogame increases awareness.
3. H3: The video game creates empathy towards victims.
4. H4: The video game is perceived as such and players like it even though it is not intended to be enjoyable.

5 METHODOLOGY

The effectiveness of the video game *Conectado* has been experimentally validated in three different educational centers in Spain, where a total of 257 students aged between

12 and 17 years old have participated. In one-hour sessions, students were asked to complete pre-post questionnaires and, between both, play the game.

The use of the *Conectado* videogame has been evaluated and accepted by participating schools' educational boards as a complementary and voluntary educational activity. All three highschools have signed the corresponding informed-consent forms, which specified that all collected data would be pseudonymized and not traceable back to individual students. Students were assigned random tokens, and only schools could, if they chose, retain a correspondence between tokens and students [31].

The single group pre- and post-test design without a control group was chosen for several reasons:

1. Feasibility in actual schools: This evaluation has been done on schools and finding educational centers that agree to participate in the validation is difficult as schools must be willing to modify their planning and must have the required infrastructure for deployment to perform these tests.
2. Choice of control treatment: schools that have participated used other resources and prevention programs such as mentors and professional talks (e.g. police program). Therefore, it was difficult to find an additional resource that brings something new and can be used in all centers, constituting a control group against which the *Conectado* video game can be compared. Additionally, the possibility that the control group would not use any tool was ruled out by schools. From an experimental point of view, such an experiment would also introduce risks, as control-group students would object to being left out.
3. Fairness and time constraints: schools are reluctant to divide their courses into two to use one part as a control group. Instead, they prefer to apply the resource, in this case the *Conectado* video game, to all their students in a class equally and at the same time. The obvious alternative, counter-balanced groups, requires significant additional time.

There are some limitations associated with the single group pre- and post-test design [32], [33]. We have carried out experiments in 3 different schools, at different times, and with different staff, classrooms and previous interventions. There was no free time between the tests and the gameplay, and users neither leave the classroom nor comment about the intervention with each other. The previous characteristics of the different sessions minimize some of the problems of this kind of experiments (e.g. history, maturation). In relation to the test effects, we added other indicators of the usefulness of the intervention: in the free-text part of the post-test, a question asks players whether they considered that they had learned anything by playing. The answers to this question were compared with the increase in awareness assessed by the pre-post. Therefore, if data showed an increase in awareness in the pre-post and players explicitly mentioned that they had learned

new aspects about cyberbullying, then it appears reasonable to state that the increase was not only due to the questionnaire.

5.1 Materials

The pre-test questionnaire, prior to students playing the video game, consists of two parts. The first part asks for the player's age and gender. The second part consists of 18 items in which each player is asked if they consider a certain action as bullying or cyberbullying, rating it on a 7-point Likert scale with responses ranging from low (rated as 1) to high awareness (7).

The 18 questions about what actions respondents consider to be harassment or cyberbullying are drawn from the adaptation of different questionnaires such as CUVE3 [34], ECIP-Q, EBIP-Q [35] and the Cyberbullying Test [36], which are used to assess violence and different types of bullying and cyberbullying within schools. These tests have been previously validated both for bullying and cyberbullying and adapted to Spain demography.

The aim of these 18 adapted questions is to assess the player's perception of what actions they consider bullying or cyberbullying before they play the video game. The effectiveness of the game is valued as the increase of the awareness based on the changes between both tests.

The post-test is performed by each user when the game is over, or when the time set to play is over, i.e. some players may not finish the game before the post-test. This post-game questionnaire consists of several sections:

1. The first section is identical to the second part of the pre-game questionnaire. The analysis of the data compares the pre- and post-test results, to determine if there is a change in the perception of students regarding acts that can be considered harassment and/or cyberbullying.
2. The second section is the Cyberbullying Test, which is used to assess the level of cyberbullying within each class. It is composed of 45 items: 15 to assess the observer level, 15 to assess the offender level and 15 to assess the victimization level.
3. The third and final section tries to evaluate what social networks students use and how often.
4. In addition, the questionnaire contains three free-text questions about the video game: whether the player has felt identified with a game character, the player's opinion about the game (and any suggestions for future versions), and the whether the player believes to have learnt anything about bullying or cyberbullying from playing the video game.

The data collected from both questionnaires and traces of game interactions are only identified by the aforementioned random four-letter tokens. Before a session starts, a list of valid random tokens is generated and stored in the server, linked to the session where they will be considered valid. This ensures that the game and questionnaires cannot be used without entering a valid session-specific token; while linking each game-play session with its pre-post questionnaires.



Figure 2. Students playing the game Conectado in a session of the experiment at the La Inmaculada School (Madrid, Spain).

5.2 Sessions

We initially ran a formative evaluation with 64 students in two high-schools to elicit initial feedback and check the applicability of the initial version of the game in one hour. With that initial feedback we produced a new version of the game that was shorter but had the same educational approach – specifically, we removed the repetition of one of the school days which was considered as reiterative by students. We consider this as only a minor change from the educational design, and therefore all educational game outputs have been considered together, regardless of version (short or long) being played.

Experiments have been carried out in different sessions of around 15 to 25 students, depending on the size of the computer classrooms in the different educational centers. Students were informed that they were going to play a video game about school life at the time of the session, but received no additional explanations on educational details or intent.

At the beginning of each session, students are provided with the token printed on a piece of paper, and use it to enter the game. Once the token is entered and validated, the game launches the pre-test that players must fill in, and does not allow playing until pre-test answers have been received. Once the game finishes, players are requested to fill in the post-test.

6 RESULTS

Data gathered in the different sessions, as we will see below, are not only used to evaluate the effectiveness of the game, but also to improve it and to provide near real-time information to the teacher who uses the tool during the class.

We analyze data from three points of view: finding possible points of improvement, identifying the most common errors, and assessing the degree to which the game is adapted to the typical 1-hour duration of classes in Spanish educational centers. The purpose of evaluating the data from several viewpoints is to prove the usefulness of using game analytics techniques for game validation, improvement, and enhancing teacher awareness. With the data from player interactions with the game (traces) sent by the tracker to the server, and the age and gender of the players,

TABLE 1
AGE AND GENDER OF PLAYERS

| Age | All | | | Males | | | Females | | |
|-----|-----|-------|------|-------|-------|-------|---------|-------|------|
| | N | M | SD | N | M | SD | N | M | SD |
| 12 | 11 | 38.17 | 6.20 | 4 | 34.02 | 1.53 | 7 | 40.53 | 6.69 |
| 13 | 36 | 33.93 | 6.82 | 15 | 30.12 | 8.28 | 21 | 36.63 | 3.84 |
| 14 | 47 | 33.19 | 4.78 | 31 | 31.80 | 4.37 | 16 | 35.81 | 4.51 |
| 15 | 21 | 32.75 | 4.78 | 13 | 31.34 | 3.04 | 8 | 35.05 | 6.30 |
| 16 | 11 | 28.44 | 4.21 | 10 | 27.86 | 3.94 | 1 | 34.31 | |
| 17 | 6 | 25.21 | 9.74 | 3 | 21.34 | 11.37 | 3 | 29.08 | 7.94 |
| All | 132 | 32.97 | 6.23 | 76 | 30.58 | 5.76 | 56 | 36.22 | 5.36 |

*N = number of users; M = mean; SD = standard deviation

we evaluate the in-class use of the game and how the information provided to the teachers through visualizations helps them to understand the development of each session, for example to locate players that may need help. Finally, with the results obtained from the pre-post questionnaires, we check the effect of the game on its players.

6.1 Improving the game

We begin this analysis with a short overview of collected analytics. Out of the original 257 data sets, each corresponding to a play-through by a student, 27 data sets did not reach the server, and 36 resulted from students running the game multiple times, either because they closed the game in the middle of the session or because of errors within the game. We therefore discarded 63 data sets when analyzing the time that takes to complete the game. Analyzing the first valid collected sets from the first sessions (64 players), we found that the 35 players who finished the game took longer than expected ($n=35$, $M=41.07$ min, $SD=5.68$ min). A consequence of this high duration is that, within this subgroup, a quarter of those players who had no problems with the game did not finish it. To prevent excessive game duration, we created a slightly shorter version to be used in the following sessions: version 2. With this new version, in the remaining 193 data sets, the server

received 147 play-throughs and 90% of the players completed the game, and required shorter average times to do so ($n=132$, $M=32.97$ min, $SD=6.23$ min) than those that used the first version.

The first version of the game therefore did not satisfy hypothesis "H1: The video game fits within the duration of a standard 1-hour class slot, leaving at least 15 minutes for guided reflection with the tutor". This was solved in version 2 of the game, which was shortened to fit into the available time. The difference between playing times for both versions can be seen in Figure 3a.

It is also observed that the younger the player, the longer the time needed to complete the game. This may be caused by the player's reading speed. Women also take longer to complete the game than men. This can be seen in Table 1 for the short version of the videogame.

The traces helped to easily find various game problems, which we missed during beta-testing. For instance, when the game was used in window mode, users often closed the entire game when attempting to close the in-built "social network" window, mistaking the game's controls for those of the internal window (see top-right corners of Figures 1.b and 1.c). We also found that several sequences of in-game decisions could prevent players from reaching the very end of the game. Another observation is that most players who finished the game (74.4%) arrived at the best possible end, while only 8.9% arrived at a bad end and 16.7% reached a neutral end.

6.2 Gaining insights from analysis

In this case the use of analytics allows session supervisors, such as teachers, to monitor the deployment of the game in the classroom and receive information on the actions of players within the game. For example, they can see the scenes accessed by the players, know whether they have completed the game, access the level of friendship of players with the different in-game characters, and check the in-game progress at any moment. Analytics also provide a built-in inactivity indicator, where a player is considered to be inactive when no game traces are received after 30 seconds, alerting the supervisors.

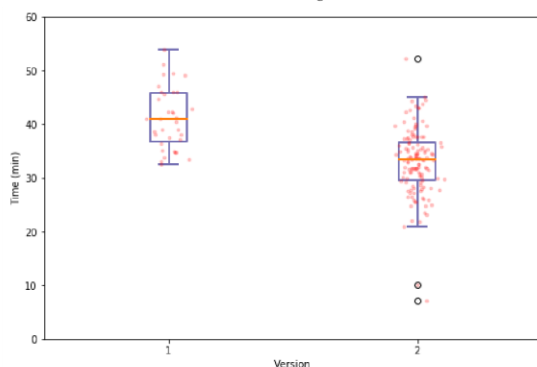


Figure 3a. Time used to complete versions 1 and 2 of the game for players that finished them.

6.3 Validating the game

To check the effect of the game on the players, 223 data sets were used. 27 data sets did not reach the server and other 7 users did not complete the post-test, and were therefore excluded from this validation. The average age of the remaining data sets was 14.20 (N=223, SD=1.26), where 121 were women (45.7%) and 102 men (54.3%). The age distributions is depicted in Table 2, where we can see that most of the players were between 13 and 15 years old.

The result from pre- and post-test is the mean of the means of each of the 18 common items of pre-post test. The average of the 18 7-point Likert items that have been used to validate the game in the pre-test was 5.72 (N=223, SD=1.26) compared to 6.38 (N=223, SD=1.11) in the post-test (see Figure 3b). A paired Wilcoxon test yields a statistically-significant effect (p-value < 0.001).

We also note that female generally present greater awareness values both before and after playing the game. The awareness value increases in both genders (see Figure 3c). However, when segmenting by age and gender groups, we observe that the game is not effective with 17-year-olds, and has a less pronounced effect in 16-year-olds (see Table 2).

The difference of 0.66 points over 7 of the 18 common pre-post questions indicates that the game increases awareness in those players aged 12 to 16, fulfilling hypothesis “H2: The intervention with the videogame increases awareness”. Although we found that it is not suitable for players aged 17.

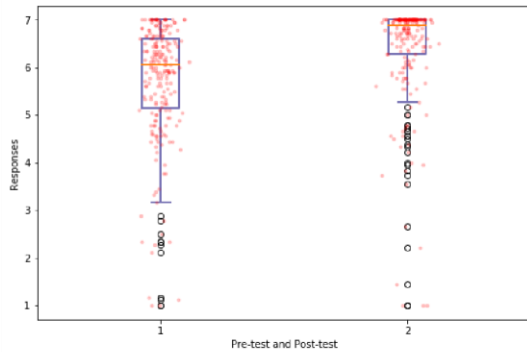


Figure 3b. Pre-post bullying/cyberbullying awareness results.

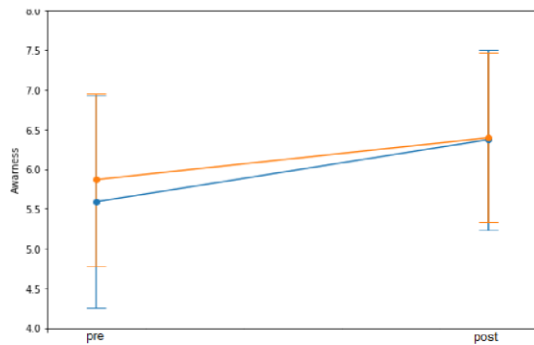


Figure 3c. Awareness differences by gender.

TABLE 2
AWARENESS RESULTS BY AGE AND GENDER.

| Age | All | Males | Females | |
|-----|------|-------|---------|-------|
| 12 | N | 15 | 5 | 10 |
| | Pre | 5.24 | 5.32 | 5.20 |
| | Post | 6.22 | 6.10 | 6.28 |
| | Diff | 0.98 | 0.78 | 1.08 |
| 13 | N | 56 | 25 | 31 |
| | Pre | 5.57 | 5.04 | 6.01 |
| | Post | 6.51 | 6.40 | 6.61 |
| | Diff | 0.94 | 1.37 | 0.59 |
| 14 | N | 70 | 42 | 28 |
| | Pre | 5.84 | 5.76 | 5.98 |
| | Post | 6.53 | 6.41 | 6.71 |
| | Diff | 0.68 | 0.65 | 0.73 |
| 15 | N | 43 | 22 | 21 |
| | Pre | 5.37 | 5.24 | 5.49 |
| | Post | 6.47 | 6.21 | 6.74 |
| | Diff | 1.10 | 0.96 | 1.25 |
| 16 | N | 30 | 22 | 8 |
| | Pre | 6.21 | 6.16 | 6.36 |
| | Post | 5.57 | 6.48 | 6.80 |
| | Diff | 0.36 | 0.33 | 0.44 |
| 17 | N | 9 | 5 | 4 |
| | Pre | 6.49 | 6.30 | 6.72 |
| | Post | 5.97 | 5.47 | 6.58 |
| | Diff | -0.52 | -0.83 | -0.14 |
| All | N | 223 | 121 | 102 |
| | Pre | 5.72 | 5.59 | 5.87 |
| | Post | 6.38 | 6.37 | 6.40 |
| | Diff | 0.66 | 0.78 | 0.53 |

*N = number of users;

Pre and Post = mean awareness score before and after playing;

Diff = Difference between Pre and Post values

It is necessary to emphasize the high level of awareness of the players at the beginning of the experiment, this is because the centers where it has been tested had already undertaken previous anti-bullying interventions, including awareness talks (but not using games) as described in the Methodology section.

6.4 Player reflection and feedback

The last part of the post-test contains three optional free-text questions that request the players' opinion about the game as described in Section 5.1, including what they would change for future versions, and whether they identify themselves with any character of the game. Responses for these free-text questions were coded using a key based on preliminary analysis, initially composed of ~25 binary categories. Many of the categories only made sense for specific questions, while others were generic (for example, “TooLong” was a question-specific category, while “PositiveSentiment” is generic). Two of the authors coded all 223 response rows independently, and then compared the codings, measuring agreement for each of the 3 questions using the average of the Jaccard Index over all responses. Initial agreement

was 0.96 for Q1, 0.72 for Q2, and 0.75 for Q3. A single consensus encoding was then generated by both encoders by agreeing on classifications for only those answers that were initially encoded differently. All results in this section are based on the consensus encoding. Finally, the encoded answers were analyzed as binary vectors (with a 0 or 1 for each possible category), and explored using both spreadsheets and the R statistics and analysis platform.

As a first observation, there are 150 responses to the question “Do you feel identified with any of the characters that appear in the game (main character, Maria, Guille, Jose, Ana, Alex, Alison)?”, 183 to the question “What did you think of the game’s look, and what would you change?”, and 180 to the question “Do you think you have learned something?”; that is, most users wrote a free-text response to at least one of these optional questions.

In general, most students reported not feeling represented by the characters: 87.89% replied “no” or equivalent, or left an empty answer, and only 12.11% of all students mentioned actual game characters. From those that did mention a character, only 1 mentioned the bully, and the rest is divided between the victim (18.52%) and the surrounding classmates (77.78%).

When asked whether they liked the game, and what, if anything, they would like to change, answers were mostly positive (65.47%), while 17.94% left the answer empty, only 2.24% answered that they did not like the game, and the remaining 14.35% of comments were neither positive nor negative. 21% of those answering that they liked the game mentioned that they found it interesting, fun and/or entertaining. 19.13% of those that answered wrote that they would not change anything in the game, while 10.93% would make changes in the plot, and 8.74% would add or modify the choices in player dialogues. Only 4.93% of those who answered considered the game monotonous, and less than 3% considered its duration to be either too long or too short. In view of these comments, the video game has been positively received by a large majority of players; few have been bored, although there are things to improve; and in general, the game has been entertaining and liked, in addition to getting players to reflect on the feelings of victims of bullying and cyberbullying.

Analyzing the answers to the question “What did you think of the game’s look, and what would you change?”, we conclude that “H4: The video game is perceived as such, and players like it even though it is not intended to be enjoyable” is satisfied as 80% of the opinions about the game are positive and 22% of these mentioned that the game is fun or interesting. There are, however, users who did not like the game (less than 10%).

The last free-text question asked students whether they had learnt anything from the game, and if so, what. 63.23% said that they had learnt something, 19.28% left the question blank, and 10.31% answered that they had not learnt anything. From those that left non-empty answers, 9.23% mentioned already knowing about the problem and how to approach it. 17.95% mentioned that the game helped them to empathize more with the victim. Multiple responses describe player emotions, even though they were not explicitly requested in the questions. For example, 5.38% of players which

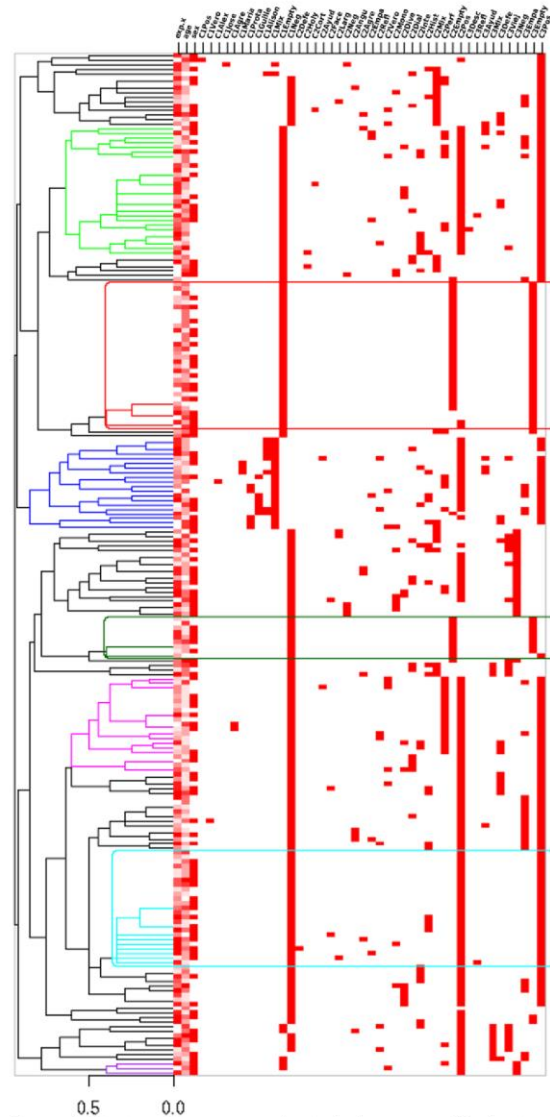


Figure 4. Clusters of users according to their answers. The heatmap displays actual responses; the first 3 rows were not used during clustering, and are intended to reveal gender or age patterns in response clusters.

did not leave all answers blank freely mentioned that they found the game to be believable/realistic in its plot, while 3.59% express desire to have an option to physically confront the bully (this option was deliberately excluded in the educational game design). These positive comments add even more value to what has already been statistically proven: the video game fulfils its main objective by helping to raise awareness among players, making sure that, within a safe environment, they are temporarily put in the place of victims of bullying and cyberbullying. In addition, the comments also reflect the player’s understanding of the importance of not ignoring victims (i.e., neutral observer, bystanders), helping them, and talking to parents and professionals in education. Many users

comment that the game helps to better understand victims and their feelings. These results validate hypothesis "H3: Video game creates empathy towards victims".

By considering responses as binary vectors and performing complete-linkage hierarchical clustering based on their Jaccard distances [37], we can isolate a few interesting clusters of answers:

- 32 (14%) of students did not fill in any answer, or only answered with a single positive comment in the question on whether they liked the game. This cluster is marked in red in Figure 4. A further 8 (4%) replied "no" to the first question, and then left the other answers empty. The cluster is marked in dark green in Figure 4.
- 28 (13%) replied that they liked the game, had learnt something, and did not feel explicitly represented by any character. Some of them make additional comments regarding small improvements or things that they have learnt, but their answers tend to be short. This cluster is marked in green in Figure 4. A very similar cluster of 25 (11%) students is marked in cyan in Figure 4, with the only significant difference being the difference between answering "no" in the 1st question versus leaving it empty.
- 20 (9%) felt represented by one or more characters. Most of this cluster feels positively about the game itself, and all of them report having learnt something, although only 5 explicitly mention what (mostly reporting empathy, the importance of helping bullied colleagues, and how to react if bullied). The cluster is marked in blue in Figure 4.
- 21 (9%) did not feel represented, but liked both the game and outcome, and reported that they would either not change anything or only minor changes in some dialogues. The cluster is marked in magenta in Figure 4.
- 3 (1%) of users simply did not like the game and considered not to have learnt anything. However, 13 (6%) of those that reported not having learnt anything did like the game, and indeed often offered multiple suggestions on how to improve it. This cluster is marked in purple in Figure 4.

7. DISCUSSION AND FUTURE WORK

This article describes the goals, methodology and main results of a set of experiments to validate the video game *Conectado*. From our analysis of the data and results, there is evidence that the video game fulfills its main objective, that is, to raise awareness about cyberbullying and to make players empathize with the victims (the videogame will be used by teachers to promote active discussion with the students in the classroom). Players also consider the tool as a video game that they enjoyed playing. Results also suggest that the ages at which it is most effective are 12 to 15 years.

During analysis, we quickly observed that the first version of the game was too long, and after releasing an updated version, we concluded that the use of analytics

certainly helped to refine the game, as well as to validate its effects on players. The players themselves say that the video game helped them to better understand the victims. Furthermore, the experiments have also shown that video games are a valuable complement to other solutions that currently exist, with positive results even in centers that have already undertaken other interventions and campaigns to prevent bullying and cyberbullying.

Analysing the data from each school separately, we still obtained a positive difference between the results of the pre-test and the post-test for every school. There is no significant difference between schools, even though each has different conditions, and had used different previous interventions on bullying and cyberbullying. This proves that cyberbullying awareness is still increased with the intervention, even when external variables change such as researchers, classrooms, teams, times, schedules and even previous intervention programs used in the schools.

We consider the game to be effective as 63% of players mention that the game has taught them new aspects of bullying, and about 20% of them mention that the videogame has made them reflect and be aware of the importance of helping the victims or identify themselves with the victims. There is also a positive difference between the pre and post-test results that assess the awareness level (0.66 points out of 7).

We have developed a tool that helps young people aged 12 to 16 to empathize with victims of bullying and cyberbullying, and helps them reflect on their feelings and problems (H2 and H3). This tool is a video game that entertains and is positively received by most players (H4); and that fits within the time constraints of a typical class, to be used as a common experience for the group (H1).

Future lines of work are discussed below. A first line involves designing and executing experiments with teachers and students of Education Sciences, asking them to play the game and provide detailed feedback. The goal of these experiments will be to improve the game's value as a "classroom tool" to motivate classroom discussion on cyberbullying, from the teacher's point of view. We are interested in knowing how useful the video game is perceived by teachers, whether they would apply it in their class, and why and how to improve the game as an educational tool for classroom deployment.

Also, with the data collected, for later experiments, and since we now know the average time that players spend in each game scene, alerts can be displayed in real-time to indicate when players spend, for example, more than 20% of the average time in any scene. This allows us to alert teachers in the classroom about players that are getting stuck in the game, and potentially help them before the end of the gameplay session.

A second line is to carry out large-scale experiments in educational institutions. Although we consider that the current sample of students is representative, especially given the difficulty in finding centers equipped with the

necessary material and availability, the aim is to make an experiment involving even more students to check whether classroom use of *Conectado* is feasible even in only modestly-equipped centers. This would provide a better model of acceptance among schools, teachers and educators.

Although the results obtained are considered as very satisfactory, there are aspects in which the game can be improved to create a better final version. We are interested in improving the videogame itself, including both its game mechanics and ease of translation into other languages. For example, we plan to create a tool to modify the story that the students will play, by selecting among different pre-built scenes, or from a larger set of situations, so that the teacher can adapt it to the context of the class and what has been experienced in the center related to situations of harassment and cyberbullying. The decision-making also can be improved by providing a larger number of options, together with suitable in-game consequences of choosing them.

Finally, we intend to study the possibility of adding a mechanism to estimate player affinity to the different roles (victim, witness and bully) without explicitly asking the players, making the tool not only useful to raise awareness, but also to automatically infer player attitudes towards bullying and cyberbullying.

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6.3. Applicability of a cyberbullying videogame as a teacher tool: comparing teachers and educational sciences students

6.3.1. Cita completa

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Conectado is a serious game designed to increase the awareness of young people on bullying and cyberbullying in schools. It is designed as an educational tool for teachers to be used in classrooms with their students to provide a common experience in class about bullying and cyberbullying. When playing the game, students are placed in the role of victims, making them reflect on the problems, consequences, and strategies that do and do not work. In addition, by making students role-play as victims, the game increases empathy with actual victims. After a game-play session, teachers can start an open conversation about bullying and cyberbullying with students based on their shared in-game experiences. Since the game is designed to be used in the classroom as an educational tool, it is not only important that it is effective, but also the current and future educators find it potentially applicable to their classrooms. This article presents the results of how the serious game Conectado, previously validated with students, has been tested with 93 actual teachers in eight schools and with 113 educational sciences students in two university centers. Conectado has been well accepted, and both teachers and students of educational sciences see it as a useful tool for classroom use, which can help to promote empathy with victims and raise bullying awareness among their students.

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Applicability of a Cyberbullying Videogame as a Teacher Tool: Comparing Teachers and Educational Sciences Students

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ABSTRACT *Conectado* is a serious game designed to increase the awareness of young people on bullying and cyberbullying in schools. It is designed as an educational tool for teachers to be used in classrooms with their students to provide a common experience in class about bullying and cyberbullying. When playing the game, students are placed in the role of victims, making them reflect on the problems, consequences, and strategies that do and do not work. In addition, by making students role-play as victims, the game increases empathy with actual victims. After a game-play session, teachers can start an open conversation about bullying and cyberbullying with students based on their shared in-game experiences. Since the game is designed to be used in the classroom as an educational tool, it is not only important that it is effective, but also the current and future educators find it potentially applicable to their classrooms. This article presents the results of how the serious game *Conectado*, previously validated with students, has been tested with 93 actual teachers in eight schools and with 113 educational sciences students in two university centers. *Conectado* has been well accepted, and both teachers and students of educational sciences see it as a useful tool for classroom use, which can help to promote empathy with victims and raise bullying awareness among their students.

INDEX TERMS Serious games, bullying, cyberbullying, game-based learning.

I. INTRODUCTION

An increasing number of schools have classrooms equipped with computers, tablets, whiteboards and/or other electronic devices that are used by teachers in their lessons. Along with these new devices there is an increase in the use of new educational media (e.g., videos, interactive presentations, virtual classrooms), and even in the use of educational games (a.k.a. serious games) in the classroom to provide a more interactive and authentic learning [1]. Serious games have been effectively used in different domains such as medicine [2], [3] or business education [4]; and for different purposes [5], such as increasing knowledge [6] or changing user attitudes [7]. Serious games can provide authentic learning environments that help to break the student 10-minute limit of attention to traditional lectures [8], while providing immersion, and a free

and safe exploration of simulated domains where students can test and apply their knowledge, and can experience the results of their actions with very short feedback cycles [9], [10]. However, use of serious games is still not generalized [11], due to a wide variety of problems [12], [13], including among others, the following issues:

1. Lack of scientifically validated serious games aligned with the curriculum, or that fit in the allotted times for lessons.
2. Use of new technologies that teachers do not master or feel at ease with, and of time to train those teachers to familiarize them with use of video games.
3. Shortage of devices, as many institutions do not have enough computers or tablets to provide one per student in the class.
4. Game deployment issues, including platform compatibility, network issues, and the complexity of installing and maintaining the games at the classroom.

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On one hand, many of these issues are technical, and can be addressed by improving the infrastructure and its maintenance, making the use of games more straightforward for teachers. Nevertheless, teachers also need to be better trained in the use of technologies, instead of relying on self-training, to make them feel more comfortable not only to use technology more effectively in their classrooms, but also to gain a greater sense of agency while doing so. Increasing numbers of subjects and specializations within educational sciences studies already cover the use of new technologies within the classroom, for example as part of teaching methods, virtual classrooms, or even serious games [14]. On the other hand, regarding the topics addressed by the games and their applicability to classrooms, while there are a significant number of educational games focused on specific domains (e.g. physics), the number of serious games that focus on social problems to raise awareness is still very limited when compared to these. Games can be especially helpful to address social problems, as they allow students to better understand a problem by actively experiencing stressful situations within the safe game environment. For example, [15] can help players to have a better idea about the extreme difficulties of life in a refugee camp. By having to make in-game decisions to deal with the problems that arise from such situations, and then experiencing the consequences of those in-game decisions, students playing serious games are both immersed and engaged, and afterwards exhibit greater empathy towards those that suffer similar problems in real life [16].

This paper focuses on the use of a serious game to address peer aggression in school (i.e. bullying, cyberbullying), a serious social problem. Bullying is a global problem [17] that has historically been frequently and wrongly considered as a normal rite of passage for children and adolescents [18]. It was not until the 1990s that bullying began to be considered as a serious risk to the mental and physical health of young people [19]. Now, bullying is globally recognized as a serious problem due to its high impact and long-term effects on the life of the victims [20]. Among its most common effects, there are problems associated with attention, behavior and emotional regulation, which can not only interfere with students' ability to learn and adapt in schools [21]–[23] but also with students' life, as both psychological disorders and even suicides have been documented [24].

With the generalization of new technologies in our society, the pervasive use of mobile devices and social networks, and the early age at which young people begin to use these technologies, other form of harassment has emerged, termed cyberbullying: "repeated verbal or psychological harassment carried out by an individual or a group against others through online services and mobile phones or bullying taking place on the internet" [25]. This phenomenon is even more complex because it makes young people vulnerable both at school and at home, especially because they are not fully aware of the effects and consequences that may be triggered by their online

actions [26]. Cyberbullying can occur at any time, and the consequences for victims are just as serious and important as for victims of traditional bullying [21]. It should not be forgotten that both bullying and cyberbullying are universal problems which affect all countries to a greater or lesser extent, regardless of the culture and country of origin of victims and aggressors [17].

Conectado is a videogame developed within the e-UCM Research Group, designed to increase awareness on bullying and cyberbullying in schools among young people between 12 and 17 years old. The game itself has been tested in actual classroom settings and initially validated through experiments with students [27]. However, the game is not intended to be used in isolation. Instead, it has been designed as an educational tool to help teachers: once students have played Conectado, teachers can conduct a controlled discussion with their students based on the experience they have just shared. To ensure Conectado's fitness as a classroom tool that elicits productive discussion, the acceptance and feedback from teachers who would use it is a vital second half of the validation.

This work presents the results of evaluating Conectado through different experiments with actual full-time teachers and with students pursuing degrees in educational sciences. The goal is to evaluate the complexity and the perceived usefulness, for both current and future teachers, of applying the game and using it in class as a tool to create a fruitful discussion based on a common game experience. In general, current teachers, who have been teaching with traditional materials for years, can be expected to be less technologically up-to-date than aspiring teachers. Using both groups in experiments provides a greater robustness to our results, and partially accounts for the rapid pace of technological change.

The rest of this paper is structured as follows: Section 2 details the methods and materials used in this study. Results of the analysis of the data collected with both teachers and students of educational science studies are presented in Section 3. Finally, Section 4 summarizes the main conclusions of the work, and describes future lines of work.

II. METHODS AND MATERIALS

The *Conectado* game has been deployed in 8 different schools with at least one researcher present in every session. Experimental sessions have also been carried out with teachers and students of educational sciences, to test whether the game is perceived as applicable by current and future educational professionals and whether they see it as a useful and practical tool; and to study possible differences between these two groups.

This game was previously tested only with students to validate that it increases student awareness and that they consider it as a game. Results with 250 students showed, on a 7-point scale of cyberbullying awareness, an increase statistically significant of 0.66 points between a 5.72 point average on the initial questionnaire (pre-test) and a 6.38 point average

on the final questionnaire (post-test), answered immediately after having played the video game [27]. The effect was also found to be significant for each gender, and when considering each school in isolation, even if those schools had previously carried out one or more awareness-raising actions on bullying (e.g. with the collaboration of the police).

In this article, we focus on the experiments and results obtained in the sessions carried out with 206 users, 93 of them in-service teachers and 113 educational sciences students (ESS). The 93 teachers are a representative sample from 8 schools all around Spain both in large cities and in rural areas, which in turn are representative of the actual mix of private, charter and public schools found in Spain [28]. Educational sciences students are from 2 different educational centers in Madrid: Complutense University and Escuni. All sessions, both with teachers and ESS, lasted one and a half hours, and were composed of the following activities:

1. Pre-test: the initial questionnaire that users were asked to complete before the start of the game, containing questions to assess cyberbullying awareness.
2. Game session: users played the game *Conectado* for about 40 minutes, or until completing the game.
3. Post-test: after playing the game users were asked to fill out a questionnaire, assessing post-game cyberbullying awareness, their use of social networks, their opinion of the game, and what they consider they have learned.
4. Applicability Questionnaire: users completed this questionnaire to evaluate the degree to which they find the game useful, applicable in their classes, and to which extent they would use it with their students.
5. Discussion: for half an hour, users and the researcher in charge of the experiments talked about the game, its design decisions and what each part of the game represents; as well as how teachers can use the common experience it builds with players as a starting point for a more in-depth discussion about bullying and cyberbullying in schools.

Activities 1-3 overlap with the previous experiment to validate the applicability of the game with actual K-12 students. This allows teachers to know exactly what their students are going to do, since in the schools where the game was used, sessions were also held with young people to collect data to assess the game's effectiveness for students. Activities 4 and 5 were specifically designed for the experiment that is presented in this paper.

The common part of the pre- and post-test is a set of 18 statements that were adapted from other questionnaires, including CUVE3 [29], ECIP-Q [30], EBIP-Q [30] and the Cyberbullying Test [31], which are used to assess violence and different types of bullying and cyberbullying within schools. These pre-existing tests have been previously validated both for bullying and cyberbullying with students in the target age-groups in Spain. Users indicate their level of agreement with the different statements using a 7-point Likert scale, with 1 being the lowest agreement and 7 the highest

agreement. The 18 statements have one of the following forms:

- X action is bullying.
- Y action is cyberbullying.

The effect of the game on players is measured by comparing the mean of the 18 responses in the pre-test with the mean of the responses in the post-test. On the post-test part, the Test of Cyberbullying is only relevant for the students, but was also included in these experiments so teachers and ESS could see the exact pre-test and post-test that their students would fill in. The questions on social networks are intended to study whether differences in awareness are related to social network use.

In these experiments, the Applicability Questionnaire is the new and essential part, as we want to know if education professionals perceive the game as a useful tool for their classrooms. This questionnaire focuses on the opinion of the videogame as a tool and its applicability. The questionnaire's 6 questions were answered on a 4-value scale, with 1 = Yes; 2 = Maybe; 3 = Not usually; and 4 = No:

- Q1. Do you think this game is applicable in classrooms to raise awareness about bullying in school?
- Q2. Would you use this game in your classroom?
- Q3. Would you use other video games in your classroom?
- Q4. Do you see the game as an effective tool to motivate a guided discussion in class?
- Q5. Do you think the game gives students a realistic view of bullying and cyberbullying?
- Q6. Do you think that students who are bullied can identify with the main character?

Additionally, there were 5 open-ended questions:

- Q7. How do you think that this game can improve classes?
- Q8. What would you change and/or improve in the game to improve its use as an educational tool for classrooms?
- Q9. What do you think of this video game?
- Q10. What did you like best about this videogame and why?
- Q11. What did you like the least and why?

Q1, Q4 and Q6 focus on whether the user considers the game to be useful and applicable in the classroom, as a tool to help teachers deal with the problem of bullying. Q2 and Q3 are designed to find out if users would use the game in classroom, and their general stance on using games in school. These two questions check if users would use *Conectado* in class, but not other games; or vice-versa. Q5 is intended to find out if participants consider the events depicted in the game to be both plausible and realistically described.

The open-ended questions part of the questionnaire focuses on how professionals would use the game as a tool in their classrooms. It therefore explores how they think that it can be useful, and whether there is something about the game that they would change or improve. To avoid influencing the views reflected in the questionnaires, participants in these experiments (both teachers and education science students) were minimally briefed on the exact nature and goals of *Conectado*, and were asked not to talk with each other

about their experiences until after completing the game and feedback questionnaires.

Finally, once the questionnaires had been completed, a discussion was held with all participants. In this discussion, the researcher explained how the game is intended to be used in class, the intended meaning of some of the events that occur in the game, and how the shared experience was intended to elicit in-class discussions for the students to participate in.

The videogame includes a game analytics module that tracks player actions inside the game. All in-game user interactions are captured, anonymized and sent as traces to a game analytics server. Those traces are used to build a real-time dashboard that displays the number of active players, how long they have been playing, what part of the game they are in, and their friendship level with the characters of the game, among other visualizations [32]. Interaction data allows us to check that the users have actually played the game, and are later analyzed further, to look for relationships between in-game interactions and questionnaire responses. This is possible because both interactions and the responses to the questionnaires, while anonymous, are related to each other with unique 4-character identifiers, which are randomly generated and handed out to participants at the start of the experiment; with the request that they use the same identifier in all their questionnaires and play-throughs. All high schools and the two educational centers have signed the corresponding informed-consent forms, which specified that all collected data would be pseudonymized and not traceable back to individual students.

Based on questionnaire responses and player interaction data, we want to test the following hypotheses:

- H1: Players can finish the game without getting stuck, and within 50 minutes.
- H2: There is no variation in awareness between before and after playing.
- H3: *Conectado* is seen as a useful and applicable tool in a class.

We chose a single group pre- and post-test design without a control group over other alternatives for several reasons:

1. Choice of control treatment: participating schools used other resources and prevention programs such as mentors and professional talks (e.g. police program). Finding an additional resource to use as a control which would be both comparable to *Conectado* and new to all centers would have been extremely difficult.
2. Feasibility: finding educational centers that agree to participate is already difficult, as schools must modify their planning accordingly, and not all of them have the required infrastructure for deployment to perform the tests. Requesting additional teacher time and resources to accommodate a control would have made it harder to find participants.
3. Cost/benefit analysis for schools: participating schools expressed interest in having a maximum number of teachers receiving the training with the game, in order to be able to use it in their classes.

To address the effect of questions on participants' perceptions and responses (test effects), we added additional indicators, and compared related responses in different parts of the questionnaires. In particular, in the open-ended questions part of the post-test, a question asks players whether they considered that they had learned anything by playing. Answers to this question were compared with the increase in awareness as assessed by the pre-post. The open-ended questions on applicability were also analyzed to be contrasted with the applicability questionnaire.

III. RESULTS

The main goal of the experiments with educational sciences students (ESS) and with actual in-service school teachers is to verify that the game is applicable in class by a teacher, that it is both easy and useful to do so, and that it is perceived as such. Using both in-service teachers and the ESS that will be the next teachers-in-training tests whether these requirements are met, both for the current generation of teachers and for the next one. Due to quick technological changes, we expect a different technology literacy and adoption between both participant profiles, particularly in relation to social networks and games. In this section, we describe the results obtained from the questionnaires carried out during the experiments. The results are evaluated both globally and segmented by age and profile to locate and analyze possible differences.

A total of 206 people participated in these sessions, of whom 93 were teachers and 113 were ESS. 8 teachers have been excluded from this data set as they did not send any of the questionnaires; and the server did not receive any interaction traces from 1 teacher and 9 ESS, indicating either that these 10 users did not actually play the game or a network problem. Therefore, the total sample is composed of 188 users, with 84 teachers and 104 ESS. A total of 76.6% were women and 23.4% were men, which is in line with observed gender distributions in Spanish education [33], where ~70% of in Secondary Education teachers are women. Figure 1 depicts the distribution of age and gender of all users.

A. TIME AND COMPLETION

To allow teachers to adequately use the game in class, it is important that the length of the game is adequate and that teachers can complete it without problems, so that they can help students who may get stuck. If teachers do not understand their tools, they will not be able to use them effectively or be able to help students to do so.

Of the 188 users, only 4 (3 teachers and 1 ESS) failed to finish the game in less than one hour. Analyzing completion times, we find that the average time spent by the teachers in finishing the game was 43.23 minutes (SD = 6.25 minutes) while the ESS average time was 34.65 minutes (SD = 4.73 minutes.) The distribution of times according to user profile can be seen in Figure 2. Analyzing these times by age, we can see that age strongly influences the time it takes to complete the game, and in general the older the player, the longer the time to finish (see Figure 3).

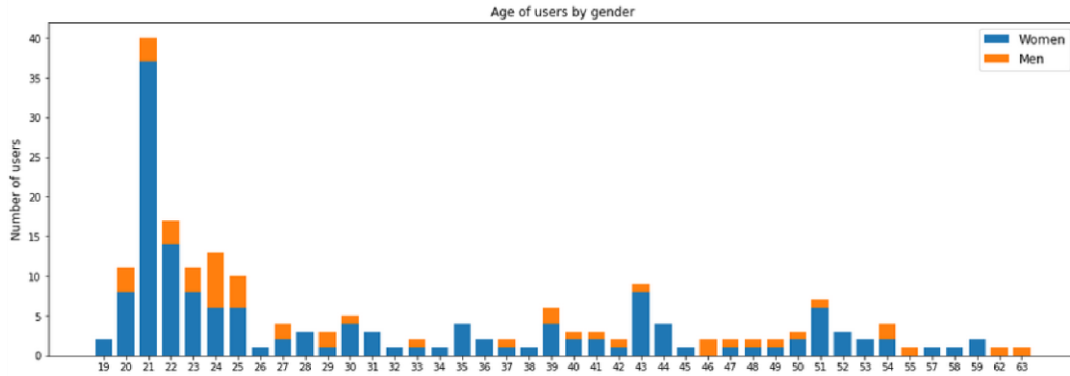


FIGURE 1. Age of users by gender.

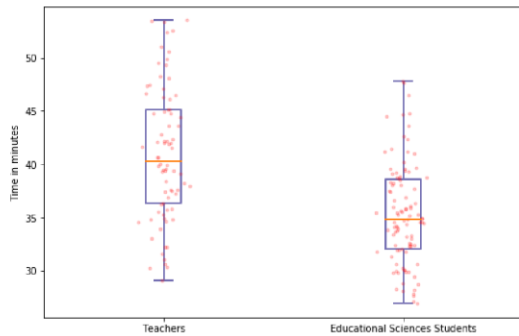


FIGURE 2. Time to complete game by users' profile.

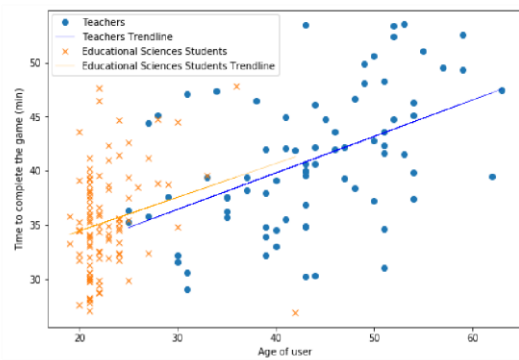


FIGURE 3. Time to complete game vs participant age.

Only 7 of the players took more than 50 minutes to finish, and most of the 124 players took less than 40 minutes. That is, 87% of the teachers and ESS managed to complete the game without problems in less time than the typical duration of a class in Spain. The outlier in Figure 3 corresponds to a very fast 42-year-old user, which finished the game in under

30 minutes. According to the data, H1 is therefore satisfied: players in general have been able to complete the game without complications within the time class of 50 minutes.

In addition, both variables (age and duration) follow a normal distribution; and a t-student significance test shows that both variables are dependent with $p < 0.01$.

B. AWARENESS

Teachers and ESS filled out the same pre- and post-test questionnaires that their students would be asked to fill in if the game were to be applied in their classrooms. Although the main goal of these sessions was not to check if there was a change in awareness, our data found such a change. Results show an increase of 0.44 points over 7, where 6.28 (SD = 1.10) points were obtained in the initial questionnaire and 6.72 (SD = 0.72) points in the final questionnaire, after having played the video game. There are no significant differences between teachers and ESS (see Table 1). H2 is therefore not satisfied: contrary to what we expected, the game creates a positive change in awareness in both teachers and ESS.

We have looked for the explanation of this fact in the post-test question "Do you think you have learned anything?" to check whether this observation could be due to the test itself. Answers to this question suggest that the increase is due to the video game, which gives users a new perspective of bullying cases that can happen in schools, and helps them to empathize with the victims who suffer mainly insults or discrimination: 60% of all users answer the question by stating that the game has taught them something. 27% leave the answer blank, and only 13% say they do not know or that they have not learned anything. About 30% of affirmative answers say that the game has made them understand victims better, think about bullying cases and their consequences, and that they are more aware of the issue after playing the game. 21% say that the game has made them see how actions they did not think could have serious consequences could, on the contrary, greatly affect people. Another repeated answer is that users consider that they have learned a new tool to use with the students to

TABLE 1. Results of pre and post by type of user.

| | Number of users | Pre-test | | Post-test | |
|-------------------------------|-----------------|----------|------|-----------|------|
| | | Mean | SD | Mean | SD |
| All Users | 188 | 6.28 | 1.10 | 6.72 | 0.72 |
| Educational Sciences Students | 104 | 6.28 | 1.16 | 6.76 | 0.75 |
| Teachers | 84 | 6.28 | 1.02 | 6.68 | 0.68 |

TABLE 2. Responses to applicability questionnaire.

| Response | Q1 | | Q2 | | Q3 | | Q4 | | Q5 | | Q6 | |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | TEA | ESS | TEA | ESS | TEA | ESS | TEA | ESS | TEA | ESS | TEA | ESS |
| Yes | 78.6 | 89.4 | 77.4 | 86.5 | 57.1 | 59.6 | 89.3 | 85.6 | 71.4 | 80.8 | 83.3 | 92.3 |
| Maybe | 20.2 | 9.6 | 19.0 | 12.5 | 29.8 | 37.5 | 9.5 | 14.4 | 28.6 | 18.3 | 16.7 | 6.7 |
| Not usually | 1.2 | 0.0 | 2.4 | 1.0 | 13.1 | 2.9 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| No | 0.0 | 1.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 1.0 |

*TEA = % of responses from teachers

*ESS = % of responses from educational sciences students

prevent bullying (9.5%), and that they have learned how video games can be very useful tools when dealing with important issues such as social problems (8.6%).

C. APPLICABILITY

Once it has been proven that the game fulfilled its main goal of increasing awareness with both in-service teachers and ESS, and not only with secondary school students, as shown in a previous study [34], it is important to check that the educators who will be in charge of applying it in class perceive it as a useful tool, which they will be able to use with their students.

Regarding their opinion of the videogame and its applicability, there are few differences between both participant profiles. The clear majority of participants see the game as a useful tool that can be applied in class, and answered that it satisfies the goal of being a tool that promotes a discussion in class based on the common experience of players. Both teachers and ESS see the game as a tool that depicts a reality, and think that its players can readily identify themselves with the different characters of the game.

Table 2 shows that there are very few negative responses to the game. Q3 "Would you apply other video games in your class?" is the question that has received the least number of "yes" answers. This further highlights the good results of the game, as users are generally willing to apply *Conectado* in class but not so much other types of games. This result is in line with the issues hinders the adoption of serious games in general: lack of validation and alignment with the curriculum; and difficulty for teachers of using technologies that they do not master. Therefore, providing teachers and

ESS validated serious games, and offering them a chance to explore them first-hand can clearly change their perceptions on using serious games.

D. ACCEPTANCE

Regarding acceptance, the results are quite positive. The free-text comments of most users exhibit a high acceptance of the *Conectado* videogame as an educational tool, although users also provide many responses suggesting ways to further improve the game (e.g. including new cyberbullying situations). These free questions were also used to contrast the previous responses to the questions regarding the applicability of the game.

Comments to questions Q7 and Q9 have been manually coded prior to analysis. First, two of the authors independently coded all responses using binary labels (each answer could be coded with any number of labels). Once labeled, both codings were compared measuring agreement for each of the 3 questions using the average of the Jaccard Index over all responses, and reclassified until a similarity of over 90% was achieved. Once this process was completed, the first author's coding was used for all subsequent analyses. The results of this coding can be seen in Table 3 and Table 4.

The other questions (Q10 and Q11) asked for feedback on what participants liked, and what they would change or improve. Among the things most liked by players of the game is the decision of having the protagonist be the victim. On the other hand, many complained regarding the small role played by the teacher avatar in the video game. Among responses to Q8, there are several users that propose creating a game mode in which the teacher can use the game with

TABLE 3. Responses to Q7 "How do you think play in class can help?"

| Label | Meaning | ALL | TEA | ESS |
|-------|---|------|------|------|
| Nega | Negative opinion: participant does not find the game useful | 0.5 | 1.1 | 0.0 |
| Empa | The game successfully promotes empathy with the victim | 31.6 | 25.0 | 35.4 |
| Real | The game is realistic in terms of events and its portrayal of bullying | 9.7 | 9.8 | 9.7 |
| Refl | The game helps to raise awareness and make the player think. | 31.1 | 32.6 | 30.1 |
| Help | The game shows the importance of asking for help and helping victims. | 13.6 | 15.2 | 12.4 |
| Iden | The game makes players feel identified as victims, observers or aggressors. | 11.2 | 8.7 | 13.3 |
| Talk | The game helps victims understand the importance of dealing with their problem and can give them courage to talk to teachers and parents. | 20.4 | 14.1 | 25.7 |
| Deba | The game is useful for creating a discussion in class. | 18.9 | 14.1 | 23.0 |
| Role | The game is useful to identify the characteristics of bullying and cyberbullying and learn about the problem. | 12.6 | 8.7 | 15.9 |
| Conv | The game showcases the importance of communication; the climate in a classroom can be assessed based on how the students act. | 1.9 | 0.0 | 3.5 |

*ALL = % of responses from all users

*TEA = % of responses from teachers

*ESS = % of responses from educational sciences students

TABLE 4. Responses to Q9 "What do you think of this video game?"

| Key | Meaning | ALL | TEA | ESS |
|------|---|------|------|------|
| Nega | Negative opinions. | 2.4 | 4.3 | 0.9 |
| Neut | Opinions that are neither good nor bad or highlights good and bad things. | 7.3 | 10.8 | 4.4 |
| Like | Positive opinions. | 84.5 | 78.5 | 89.4 |
| Inte | The game is an interesting tool. | 9.2 | 15.1 | 4.4 |
| Usef | The game is a very useful tool that can be used in class. | 27.7 | 14.0 | 38.9 |
| Real | The game is realistic in terms of events and its portrayal of bullying. | 11.7 | 9.7 | 13.3 |
| Deba | The game is useful for creating discussion and working on the topic of bullying in class. | 5.8 | 4.3 | 7.1 |
| Educ | The game is educational. | 5.8 | 2.2 | 8.8 |
| Refl | The game helps to raise awareness and make the player think. | 19.9 | 10.8 | 27.4 |
| Empa | It is useful to put the player in the victim's place and show him the feelings of the victim. | 10.2 | 8.6 | 11.5 |
| Iden | The game makes players feel identified as victims, observers or aggressors. | 5.8 | 4.3 | 7.1 |
| Youn | The game is ideal for junior high school students. | 2.9 | 6.5 | 0.0 |
| Easy | The game is easy, simple or intuitive. | 1.9 | 2.2 | 1.8 |
| Long | The game is long, boring or repetitive. | 3.9 | 7.5 | 0.9 |

*ALL = % of responses from all users

*TEA = % of responses from teachers

*ESS = % of responses from educational sciences students

the whole class, instead students playing it on lab computers or their own devices. This would allow actions within the game to be commented by the whole class while playing. Still others mention that it would be good to have a game

mode in which the user is a witness, instead of the victim. As seen in Table 3, most of the comments highlighted the usefulness of the game to put the player in the shoes of the victims of harassment, to understand how they might feel and

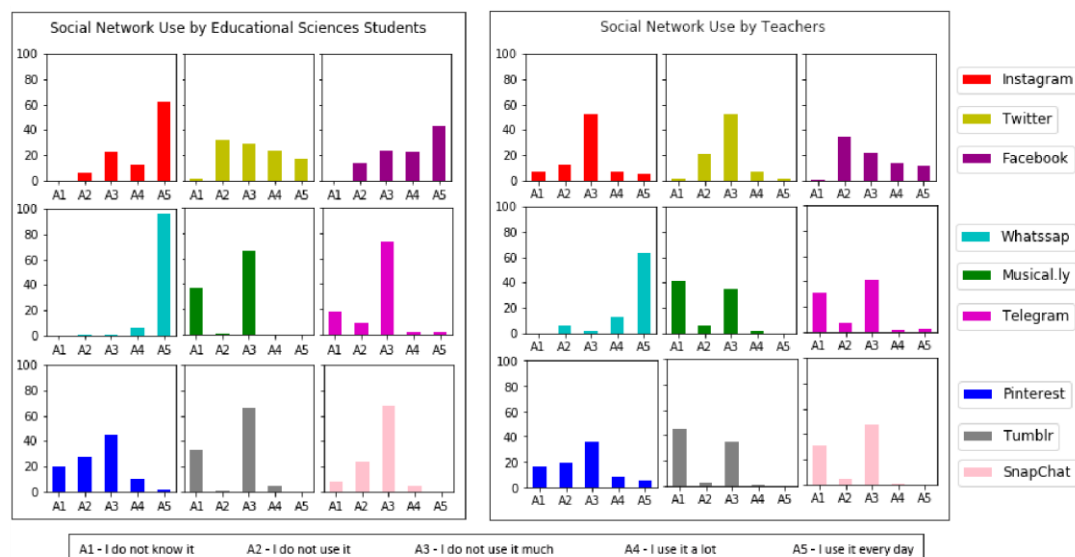


FIGURE 4. Use of social networks by ESS (left) and teachers (right).

to raise awareness and make the player reflect about the problems of bullying and cyberbullying and their consequences. Another of the most common answers is that the game is useful to encourage the victims to ask for help talking about their problem with other (e.g. parents, teachers). There has only been a negative response from a teacher that did not agree, as a matter of principle, with the use of games as an educational tool. Only 3.9% of users left Q7 blank. Somewhat surprisingly, ESS mention more often than in-service teachers that the game generates empathy and that it can promote that victims ask for help after playing it. All these answers concur with the results obtained with the previous questions evaluated on a 4-value scale, where about 80% of participants answered that they would use the *Conectado* game in their classes and that they found it applicable and useful. Table 4 shows the comments regarding opinion about the video game. Most comments (84.5%) were positive and only 5.8% of participants did not respond. The most repeated comment highlights the usefulness and usability of the game as well as its possibilities to raise awareness and make players think about harassment. Although it should be noted that in these answers there is a big difference between teachers and ESS since most of these comments come from ESS.

While general acceptance has been high, we can observe that the game has been more popular with ESS. The results can be explained by the age of the players and their proximity to the new technologies and the target age of the game.

E. SOCIAL NETWORKS

Social networks play a key role in cyberbullying processes and we wanted to know how teachers and ESS use them, because a minimum understanding of those networks is

necessary to better understand technology-mediated aggressions. We discover that the use of social networks between teachers and ESS is significantly different. In the case of teachers, they mostly use WhatsApp, rarely mentioning other social networks. However, ESS also mention, in addition to WhatsApp, using Instagram and Facebook, and are more aware of the existence of other social networks even if they do not use them or use them much less, as can be seen in Figure 4. In general, ESS are more familiar with the use of social networks than teachers. This aligns with the fact that young people tend to be more familiar with the use of new technologies and with computers in general. This was observed in the experiments themselves, where at the beginning of the game teachers, generally the older ones, found it more difficult to understand the game's controls. This can be partly explained by a generational shift in game use: newer generations are much more likely to be familiarized with videogames, as evidenced in the increase of 4 years in average gamer age between 2013 and 2018, from 30 to 34 years old, according to ESA's reports [35], [36].

In principle, we expected a more widespread use of different social networks (and, in particular, Twitter and Facebook). We believe that it would be interesting to conduct further studies on the use of different social networks, and whether they are related to different types of players and their frequency of play; as well as the relationship of these variables with the acceptance of new technologies as educational tools by teachers.

IV. CONCLUSION AND FUTURE WORK

In this paper we have presented the evaluation of the videogame *Conectado* as a tool for teachers to use in

classrooms to increase the awareness of students regarding bullying and cyberbullying. The game had already been initially tested and validated with its target users (students from 12 to 17 years old). However, to complete its validation and achieve its intended goal of being used as an educational tool in the classroom, it was essential to test the game also with potential teachers, since post-game classroom discussions are a vital feature of the educational game design. Additionally, our experiments have included educational sciences students (ESS), which will be the next teachers-in-training. Comparing active teachers to ESS allows us to partially account for the rapid pace of technological change.

Results have shown that the video game also has positive results when tested both with both groups. Therefore, we can say that *Conectado* is perceived as a useful tool that can be applied in class to raise awareness among players and to create a subsequent discussion about bullying and cyberbullying. Both group of users agree that *Conectado* provides a common experience that helps players identify the different aggression roles, and understand how victims of these severe issues can feel. *Conectado* had previously shown that it creates a change in the majority of users who play it, and that although it has a greater effect on its target users of young people aged 12 to 17 (0.66 over 7), surprisingly, and against expectations reflected on hypothesis H2, it also makes users outside this range (teachers and ESS) increase their awareness on bullying noticeably (0.44 points over 7).

Another conclusion drawn from the results is that the differences in completion time in both target groups (teachers and ESS) can be better explained by their age difference than by their different profiles or by their use of the new technologies (e.g. social networks). Results show that age is an important factor when it comes to dealing with the game. For instance, age affects the time it takes to complete the game (the older the users, the more time needed to complete it). This is probably related to their different familiarity and use of new technologies. Questionnaire results have also shown that the game is more popular among users in their 20s and 30s than in older users, as 78.5% of the teachers had positive opinions about the game compared to 89.4% of the educational sciences students.

On the other hand, the differences in the applicability test are very small, with generally positive responses from both user profiles, and both agreeing that the game is applicable in class, that it is realistic and that it serves to raise awareness and create a discussion in class, although this perception is higher in the students of educational sciences. With the answers to question Q3, the game appears to have a greater acceptance than other educational games. Although more than half of teachers would use games in their classes, an additional 21% would use *Conectado*, but not any other video games. In the case of educational sciences students, this difference of percentage is even higher, reaching 30%.

Although we have found no relationship between the use of social networks, the time used to complete the game, the cyberbullying awareness of users, and the acceptance of

the game, it would be valuable to study how other variables, such as the subjects taught by teachers, their ease of use of new technologies, and whether they already play or even apply video games in their lessons, can affect their perception of serious game use in their classrooms.

Among the limitations of the study, we can mention that the number of centers of educational science students that have participated in this work is small, and all were in the same region of Spain, which could bias the results. We hope to obtain more data from students of educational sciences from a more diverse set of locations. Finally, we are also working on the creation and validation of a guide for teachers on the different possibilities of using *Conectado* in class.

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6.4. Creating awareness on bullying and cyberbullying among young people: validating the effectiveness and design of the serious game Conectado

6.4.1. Cita completa

A. Calvo-Morata, C. Alonso-Fernández, M. Freire-Morán, I. Martínez-Ortiz and B. Fernández-Manjón, **Creating awareness on bullying and cyberbullying among young people: validating the effectiveness and design of the serious game Conectado**. Documento interno de e-UCM mandado a revista.

6.4.2. Resumen original de la publicación

Serious games have proven to be educational tools with numerous positive effects, capable of promoting learning, changing behavior, or improving training and skills development, among other effects. Serious games can also be applied to address and prevent social problems. This study describes the experiments and analyses we have carried out to test the effectiveness of Conectado, a serious game created to prevent bullying and cyberbullying in schools by increasing awareness of the problem in players. We have used the results from these experiments to answer different research questions regarding the game's acceptance and effectiveness, validating several characteristics of the game design. We have also studied the influence of players' characteristics on the effect of the game, as well as the relationship between the in-game behaviors of players' and their degree of awareness. We have verified a positive effect of the game in terms of an increase of awareness regarding bullying and cyberbullying for all target users, and have provided further insight into how this increase is related to different players' characteristics and behaviors.

Creating awareness on bullying and cyberbullying among young people: validating the effectiveness and design of the serious game *Conectado*

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Abstract

Serious games have proven to be educational tools with numerous positive effects, capable of promoting learning, changing behavior, or improving training and skills development, among other effects. Serious games can also be applied to address and prevent social problems. This study describes the experiments and analyses we have carried out to test the effectiveness of *Conectado*, a serious game created to prevent bullying and cyberbullying in schools by increasing awareness of the problem in players. We have used the results from these experiments to answer different research questions regarding the game's acceptance and effectiveness, validating several characteristics of the game design. We have also studied the influence of players' characteristics on the effect of the game, as well as the relationship between the in-game behaviors of players' and their degree of awareness. We have verified a positive effect of the game in terms of an increase of awareness regarding bullying and cyberbullying for all target users, and have provided further insight into how this increase is related to different players' characteristics and behaviors.

Keywords: Games; Improving classroom teaching; Secondary Education

1. Introduction

Bullying is a social problem that is present all over the world, regardless of culture or country. With the extensive use of the internet and technology in daily life, cyberbullying has also become increasingly prevalent and relevant. Many studies have been carried out to understand the characteristics of (cyber)bullying and find methods to prevent it (Kowalski, Giumetti, Schroeder, & Lattanner, 2014; Menesini & Salmivalli, 2017; Zych, Ortega-Ruiz, & Del Rey, 2015). Both bullying and cyberbullying are highly prevalent among young people and can seriously affect them in many ways: causing psychological and physical effects, and manifesting themselves through changes in behavior, difficulties in adapting or in maintaining attention. They can also trigger psychological disorders that accompany the victim throughout their adult life and, in the most severe cases, lead to suicidal ideation and even documented suicides (Beran & Li, 2007; Carr-Gregg & Manocha, 2011).

Because of this high prevalence and the devastating effects (cyber)bullying can have on victims, it is crucial to find, develop and test tools that help society to address these problems at all phases, including detection, prevention, and fighting the aggression when it has already started. Among the resources available, some are established at school level such as prevention campaigns (Gaffney, Farrington, Espelage, & Ttofi, 2019) or training talks, while other resources are geared towards families and teachers, including online resources such as best-practices guides or initiatives such as pantallasamigas.net and stopbullying.gov. There are also other approaches, such as chats and telephone numbers, to help victims and families (Ballesteros, Santiago Pérez de Viñaspre, Díaz, & Toledano, 2018).

We consider that serious games are one of the most promising multimedia resources, both as (cyber)bullying prevention and detection tools. Serious games have been applied for educational purposes in multiple fields such as medicine, education, and research (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Wattanasoontorn, Boada, García, & Sbert, 2013). Video games have certain characteristics that make them useful tools for education, and which are also especially useful to improve the prevention or detection of (cyber)bullying. Games allow players to safely experience risky situations through simulations and controlled environments, providing instant feedback to in-game actions. The combination of storytelling and feedback, in turn, keeps players engaged and immersed, breaking their usual barrier of 10 minutes of attention (Weinschenk, 2011).

This study presents *Conectado* (Spanish for *Connected*) a serious game to raise awareness of

bullying and cyberbullying, and the experiments carried out to validate it. The complete game validation has been performed using pre-post questionnaires to check the effectiveness of the game at increasing the awareness of (cyber)bullying, and collecting player-game interaction data to provide additional evidence-based validation. Game learning analytics techniques have been used to further validate some aspects of the game design, such as gameplay time. The paper is organized as follows: in section 2 we provide a brief overview of previous studies using other video games related with bullying and cyberbullying; section 3 describes the characteristics of *Conectado* as well as the three experiments that have been carried out for its validation; section 4 presents the results obtained; and finally, section 5 discusses these results and provides some guidelines that can help other researchers when conducting serious gaming studies.

2. Related Work

Studies have shown the effectiveness of serious games to prevent bullying, sometimes as part of prevention programs (Garaigordobil & Martínez-Valderrey, 2015), and in other cases as support tools for teachers or students (Bradley & Kendall, 2019; Hall, Jones, Paiva, & Aylett, 2009). These studies, however, have several limitations, and it is necessary to continue studying game effectiveness. Among these limitations, we find that many experiments have been carried out with a low number of users, and most of the serious games studied are no longer available. Hence, it is challenging to replicate or compare their results with those of new studies. Additionally, most of those video games focused specifically on either bullying or cyberbullying, although it is common for both to occur simultaneously at schools. Moreover, most studies use a particular approach for (cyber)bullying prevention, focusing on different aspects such as empathy, awareness, change of behavior, or teaching how to detect the situations. (Álvarez-Bermejo, Belmonte-Ureña, Martos-Martínez, Barragán-Martín, & del Mar Simón-Marquez, 2016; DeSmet et al., 2016; Lievense, Vacaru, Liber, Bonnet, & Sterkenburg, 2019; McEvoy, Oyekoya, Ivory, & Ivory, 2016; Raminhos et al., 2016). This variety of approaches lead us to think that there is little evidence of the effectiveness of each specific approach. For example, one experiment may focus on empathy and be targeted towards 12-14 year olds, but this leaves a gap regarding other strategies in this age range, or the same approach on other age ranges.

Regarding how these studies are carried out, a majority of them use questionnaires to get the experimental data, and very few collect in-game player information to analyse how users interact with the game and whether this affects the effectiveness of the tool. This broader use of questionnaires is common in all serious game studies (Calderón & Ruiz, 2015), although recent research is introducing use of Game Analytics (El-Nasr, Drachen, & Canossa, 2013) or Game Learning Analytics to provide a richer insight into players' actions in the game (Alonso-Fernández, Calvo-Morata, Freire, Martínez-Ortiz, & Fernández-Manjón, 2019). The use of these techniques can help not only to evaluate the effectiveness of the game, but also to provide contrasting data to those obtained by questionnaires, thus helping to validate the design and ensure that the hypotheses of how the game is played and its effects are correct.

3. Materials and methods

We have developed and validated a serious game to be used as a tool for teachers to raise awareness on (cyber)bullying at school and to create empathy towards the victims. The evaluation has been performed through multiple experiments focused on validating different characteristics of the game and its effectiveness. During these experiments, the developed video game has been applied in various high schools from different regions of Spain.

This section describes the research questions of this study, the video game *Conectado*, the questionnaires used for its validation and the objectives of each of the experiments.

3.1. Research questions

The experiments carried out as well as the analyses performed aim to answer the following research questions:

- RQ1. Is *Conectado* well accepted among students?
- RQ2. How long does it take for players to complete the game *Conectado*? In particular, are they able to complete the game in the average time available in one school session?
- RQ3. Does playing *Conectado* produce a positive effect on players' awareness of bullying and cyberbullying?
- RQ4. Does playing *Conectado* produce a different effect depending on players' previous use of social networks?

- RQ5. Does playing *Conectado* produce a different effect depending on players' previous experience with cyberbullying?
- RQ6. Does playing *Conectado* produce a different effect depending on players' age or gender?
- RQ7. Does players' previous awareness affect the way players interact with the characters of *Conectado*?
- RQ8. Are there gender differences in the way players interact with *Conectado*?
- RQ9. Are players' interactions, decisions and behaviors in *Conectado* related to their change in awareness?

All these questions are answered in Section 4, the results section.

3.2. *Conectado*, the game

Conectado is a first-person point&click 2D graphic adventure where players take the role of a (cyber)bullying victim. Note that students it are not warned beforehand that they are going to play this role. To increase the identification of players with their in-game characters, players are not graphically represented as avatars in the game. The player starts in a new school and has to make friends. However, every day more and more in-game characters will begin to (cyber)bully the player in different ways. Player can make different decisions when interacting with other game avatars to address the (cyber)bullying harassment. However, no choice will lead to effectively solving the problem before the fifth and last day of the story. The decisions and freedom of movement through the different scenes are designed to make players feel in control of the game. However, only a few of those decisions have a significant impact on the story, since we want to combine user choices with the educational requirement that all players should have similar in-game experiences that the teacher can work with and elaborate into a class-wide discussion afterward. Apart from decision-making and dialogue, *Conectado* has four simple mini-challenges at the end of each of the first four days. These mini-games are represented as nightmares, and are designed to continuously increase in difficulty so that players cannot overcome them. The mini-challenges are designed to elicit feelings of helplessness and frustration in the players, and to convey that cyberbullying aggression is 24/7. The game is designed to show (cyber)bullying at school realistically and to bring the player closer to the feelings of frustration, helplessness, sadness, and anger that victims of such (cyber)bullying may experience. It also conveys the key idea to the player that bullying can only be overcome by asking for external help (e.g., family, teachers) and never by remaining silent.

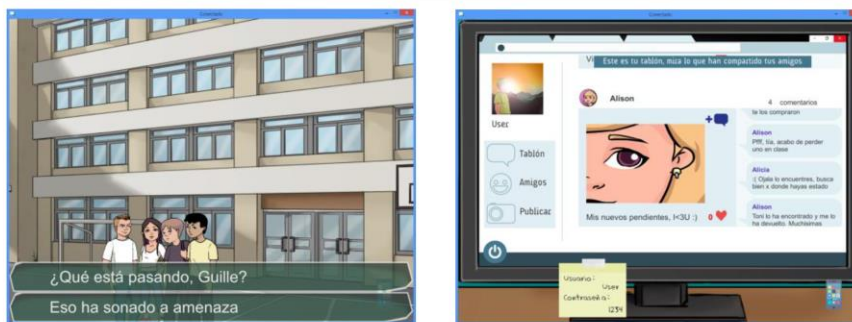


Figure 1. *Conectado* screenshots with the school and the in-game simulated social network.

Conectado has been developed to serve as a tool for teachers to use in class, and designed for students from 12 to 17 years old. Once the students have completed the game, their teacher can conduct a discussion and reflection session based on their shared experience in the game. *Conectado* is a free and open-source project available on GitHub. The game can be downloaded at e-ucm.es/Conectado. A teachers' guide is also available, explaining the events in the game and giving ideas on how to use this information to conduct a discussion and reflection session. Although currently available only in Spanish, we are working on publishing the corresponding English version.

3.3. Data acquisition

In order to measure the effectiveness of *Conectado*, its acceptance in the classroom, and ultimately answer the research questions, different data have been collected during the experiments. The two main

sources were questionnaires and players' interactions within the game, which were sent as traces to a game analytics server. Before carrying out the experiments, we informed each of the schools about the experiment, and their management team reviewed and approved the use of the game as a school educational activity, signing an informed consent document which described the data we intended to collect, including plans for anonymization, retrieval, and later use. Both questionnaires and interaction data were anonymized, and linked to each other only by a unique identifier that was randomly assigned to each student at the beginning of the session. Once the sessions are over, particular students can no longer be traced back to their data again, as no student-to-identifier mapping is retained. The questionnaires used during the experiments included:

- Demographic questions, eliciting players' age and gender. This information of the players that have participated in the different experiments is useful to analyze later if these variables affect the previous awareness of the users and the effect that the game has on them.
- Bullying and cyberbullying awareness test, an adaptation and combination of four different questionnaires: CUVE3 (Alvarez-García, Nuñez-Pérez, & González, 2013), ECIP-Q, EBIP-Q (Ortega-Ruiz, Del Rey, & Casas, 2016) and Cyberbullying test (Garaigordobil & Aliri, 2013). This adaptation presents a Cronbach's Alpha of 0.95. The questionnaire is composed of 18 items that are evaluated on a Likert-type scale from 1 (Strongly Disagree) to 7 (Strongly Agree). 11 of the items assess awareness of cyberbullying, and the other 7 assess awareness of bullying. We interpret the average questionnaire score of each player as that player's level of awareness. The players fill in this test before and after playing, and the comparison of both scores shows the effect of the game on the player.
- Cyberbullying test, a questionnaire to measure the level of cyberbullying in the classroom for the three roles (observer, victim and aggressor). The test is made up of a total of 45 items, 15 for each of the roles, rated on a Likert-type scale from 1 (Never) to 4 (Daily). Its objective is to check, in the schools where the experiments were conducted, the degree to which these roles were present.
- Use of social networks, a questionnaire to measure the frequency of use of 10 different applications and social network on a Likert-type scale from 1 (I do not know it) to 5 (I use it every day).
- Acceptance of the video game, consisting of two free text questions: "What did you think of the game's look, and what would you change?" and "Do you think you have learned something?"

Moreover, the in-game player interaction data is sent as traces in xAPI-SG format (Serrano-Laguna et al., 2017). These xAPI-SG traces include all the game relevant interaction data such as the timestamp of the interaction, the choices in the player's dialogues, the interactions with objects or characters, and the changes of day and place (home, classroom, hallway, etc.).

3.4. First pilot, a formative evaluation

Once the first version of the game was developed, it was tested in three different high schools (2 in different cities and one rural school). The goal was to check if the video game fulfilled the objective of raising awareness and if the students liked it (answering RQ1, RQ2, RQ3, RQ4, and RQ5). This evaluation involved 257 users from three different high schools located in three different regions of Spain. Each session of the experiment lasted between 50 and 60 minutes and consisted of three parts in the following order:

- Pre-test questionnaire: including the demographics questions (age and gender) and the bullying and cyberbullying awareness test.
- *Conectado* session: complete gameplay of the videogame, up to the maximum available time.
- Post-test questionnaire: including the bullying and cyberbullying awareness test, the cyberbullying test, the use of social networks, and the acceptance of the video game.

Also, to verify if the game produced any change in the players, we wanted to check in a real setting and with actual final users if there were any usability problems and if the gameplay time was adequate, we used the data collected from the interactions made by each player during the session.

3.5. Experiment with control group

This experiment sought to verify, with a control group, that differences between the initial (pre-test), and subsequent (post-test) questionnaires were caused by playing *Conectado* and not by the context of use (e.g., extra motivation from the use of a videogame) and the questionnaires themselves (providing

further evidence to answer RQ3). To this end, an experiment was carried out with 40 users aged 15 and 16 years old from 15 different high schools of the Madrid region, randomly divided into two groups of 20 students. The sessions of both groups lasted an hour and a half, the last 30-40 minutes for play a second videogame, and consisted of four phases in the following order:

- Pre-test questionnaire: including the demographics questions (age and gender) and the bullying and cyberbullying awareness test.
- Game play session using *Conectado* in the experimental group and using a different serious game (*First Aid Game*, unrelated to bullying) in the control group.
- Post-test questionnaire: including the bullying and the cyberbullying awareness test.
- Game-play session using *First Aid Game* in the experimental group and *Conectado* in the control group.

In the control group, we used *First Aid Game*, a serious game for learning basic resuscitation procedures (Marchiori et al., 2012). We chose it because it covered a topic of interest for the schools entirely unrelated to bullying. The experiment was carried out in the laboratories of the Faculty of Computer Science of the Complutense University of Madrid during the career orientation week. This is the only experiment that could be carried out with a control group. In all other experiments, participating educational centers had several restrictions that made use of control groups impractical. For example, schools were reluctant to have only a part of the students receiving the intervention, had limited numbers of computer rooms and computers available, or had scheduling constraints that made extended use of these resources and classrooms difficult to justify for, from the point of view of these schools, little educational benefit.

It is also important to note that *Conectado* is a tool for teachers to address the issue of bullying and cyberbullying after the students play. Teachers can use the shared experience that players acquire while playing the game (use of social networks, exclusion, nicknames, and insults, etc.) to adapt it to their specific case, going deeper into these topics and carrying out reflection sessions or other complementary activities. In this experiment, the game is compared with another game that is not about bullying or cyberbullying. We do not want to check if *Conectado* is better than another tool, but to corroborate that the game has a positive effect on the player and that this effect is not caused by the experimental design, the questionnaires or the possible memory effect (Lavrakas et al., 2019).

3.6. Summative evaluation

This large-scale evaluation was carried out to measure with more data the effect of the game and to assess whether different variables such as gender or age lead to a distinct increase in (cyber)bullying awareness (providing further evidence to answer RQ3, and answering RQ6, RQ7, RQ8 and RQ9). A total of 1004 students from 12 to 17 years old from 8 different high schools in 4 regions of Spain participated. Five of these schools are public, and the other three are charter/private schools. This set of schools is a representative sample of the schools that exist in Spain (Instituto Nacional de Evaluación Educativa, 2019). The phases, time and questionnaires used in this experiment were the same as those used in the pilot test: the Pre-test questionnaire including the demographics questions (age and gender) and the bullying and cyberbullying awareness test; the *Conectado* playing session; and the Post-test questionnaire including the bullying and cyberbullying awareness test, the cyberbullying test, the use of social networks and the acceptance of the video game. In this experiment, as in the pilot, all in-game player interactions were collected. With this data, we also wanted to validate the game design and check if the decisions taken in its development have the desired effects and if there is any kind of relationship between the questionnaires and the way of interacting with the game.

4. Results

In this section, we describe the results obtained in each of the experiments through the analysis of the completed questionnaires and the traces collected from the players' interactions during the different sessions. With these results, we answer the research questions and also compare the various experiments in order to discuss the validation process carried out.

4.1. Results of the first pilot

This experiment was divided into two groups of sessions. 64 of the 257 total users participated in the first group sessions. From the traces collected, we found that actual game completion time was longer than expected. Therefore, we decided to shorten the game by removing some reiterative events. In the

first version, players had to repeat, although with some changes, the second in-game day; and had the option to repeat the fourth depending on certain decisions made on previous days. These repetitions were intended to frustrate players and check if they took different actions when repeating days, but had no effect on the final outcome of their games). The 193 players in the second group sessions who participated in the first pilot's experiment used the shortened version without repetitions. From a total of 257 users, 223 players (45 from the first version and 178 from the second one) completed both questionnaires.

Addressing RQ1, "Is *Conectado* well accepted among the students?", the general acceptance of the game was high, as 65% of the players liked the game and left positive comments. Only 2% said they did not like it. 18% did not fill in the question, and the remaining 14% left neutral comments that did not indicate whether they liked the game or not. Besides, 63% considered that they had learned while playing *Conectado*, and 19% did not answer. On the other hand, 10% believed that they had not learned anything, while an additional 9% thought that they already knew what the game covered.

Table 1. First pilot pre-post awareness results. Awareness ranges from 1 (lowest) to 7 (highest).

| | N | Mean age | Pre-Test | Post-Test | p-value |
|--------------------------|-----|----------|-----------------------|-----------------------|---------|
| All | 223 | 14.20 | M = 5.72 SD = 1.26 | M = 6.38 SD = 1.11 | <0.001 |
| Initial version | 45 | 14.93 | M = 5.81 SD = 0.97 | M = 6.22 SD = 1.29 | <0.001 |
| Final, shortened version | 178 | 14.01 | M = 5.68 SD = 1.30 | M = 6.42 SD = 0.79 | <0.001 |

Concerning RQ2, "How long does it take for players to complete the game? In particular, are they able to complete the game in the average time available in one school session?". First, this pilot evaluation allowed us to find and fix minor errors and to discover that it was challenging to complete the game in the assigned time. With the improvements made to shorten the game, the time to complete the game was reduced by 8 minutes on average (from M=41.07 and SD=5.68 in the original version to M=32.97 and SD=6.23 in the modified version). Only 62% of players in the extended version completed the game, while the short version was completed by 86%. Therefore, our modifications made the game easier to complete within a school session, although a small percentage of users could still not finish it within the allotted time. Notice that this is in part due to shorter-than-usual sessions, as they had to complete the questionnaires before and after playing, which in a classroom setting can take longer than expected.

Regarding RQ3, "Does playing *Conectado* produce a positive effect on players' awareness of bullying and cyberbullying?", both the free-text responses of the players and the comparison between the pre- and post-game awareness test show that the game has a positive effect, increasing the awareness of its players (Table 1). This experiment also points out that the game is more effective in students aged 12-15 than for those aged 16-17, although sample sizes are small when segmented by age.

Looking into RQ4, "Does playing *Conectado* produce a different effect depending on players' previous use of social networks?", and contrary to what we expected, the data did not show an influence of the use of social networks on the effect of the game or the level of awareness of the previous questionnaire. There appeared to be a small, statistically not-significant difference in initial awareness, of 0.33 points in a 7-point scale, linked to the number of social networks that participants reported as frequently-used.

Finally, with regard to RQ5, "Does playing *Conectado* produce a different effect depending on players' previous experience with cyberbullying?", while differences in pre-game awareness have been observed, being for example somewhat lower in those students who have reported acting as bullies before, we observed no differences in the effect of *Conectado* depending on the roles of players.

4.2. Results of experiment with control group

Of the 40 students who agreed to participate in the experiment, four missed the session, and one did not submit the post-game questionnaire, leaving a valid data set of 19 students from the control group, which played the *First Aid Game*, and 16 from the intervention group, playing *Conectado*.

As can be seen in Table 2, the intervention group showed statistically significant changes when conducting a Wilcoxon Test while the control group did not. Although the number of users in both groups is small, the results are very positive as this change is seen in the intervention group but not in the control

Table 2. Changes in awareness in control and intervention groups. Awareness ranges from 1 (lowest) to 7 (highest).

| | N | Mean age | Male% Female% | Pre-Test | Post-Test | p-value |
|--------------|----|----------|------------------|-----------------------|-----------------------|---------|
| Control | 19 | 15.6 | 57.89% 42.11% | M = 5.37 SD = 1.31 | M = 5.21 SD = 1.16 | 0.0585 |
| Intervention | 16 | 15.5 | 56.25% 43.75% | M = 5.54 SD = 0.82 | M = 6.15 SD = 0.57 | 0.0016 |

group (which even decreases its awareness results from pre- to post-test). If we compare the distribution of the results of the initial questionnaire of both groups with a Mann-Whitney U Test, we do not find a statistically significant difference. However, comparing the post-test questionnaires using another Mann-Whitney U Test, the difference between both groups is statistically significant with a p-value of 0.0014: *Conectado* produced a change in the awareness and perception of bullying and cyberbullying in users while *First Aid Game*, as expected, did not. These results reinforce the affirmative response to RQ3, “Does playing *Conectado* produce a positive effect on players’ awareness of bullying and cyberbullying?”, obtained by the pilot experiment.

4.3. Results of summative evaluation

This experiment was conducted with 1004 participants aged 12-17, 902 of which completed both questionnaires, of which 860 had a corresponding game traces file which contained their main in-game interactions. Apart from a larger scale than previous experiments, the availability of in-game interaction data from participants sets the summative evaluation apart from other experiments, as interactions provide a richer insight than the simple increase in awareness obtained with the pre-post questionnaires.

The results of the awareness test before and after playing *Conectado* can be seen in Table 3. Revisiting RQ3, “Does playing *Conectado* produce a positive effect on players’ awareness of bullying and cyberbullying?”, as in the pilot experiment and the intervention group of the control group experiment, we found positive results. Again, we find a statistically significant change in (cyber)bullying awareness, with a p-value < 0.001, applying the Wilcoxon Test. The mean difference in the score obtained between both questionnaires is 0.51 (SD=0.97, Q1=0.06, Q2=0.33, Q3=0.78), which, due to already high pre-test awareness scores, amounts to ~42% of the possible score improvement on our 7-point scale. The positive change in awareness occurs in both bullying and cyberbullying questions. This positive change is demonstrated in all items, with statistically significant values, the average value of these items ranging from 0.15 to 1.34. The highest increase occurs in those items where the pre-test shows lower awareness values. The mean of awareness for each item in the pre-test ranges from 4.74 to 6.28, while those in the post-test range from 6.08 to 6.46. These data show that the video game has a

Table 3. Summative evaluation pre-post awareness results by gender and bullying/cyberbullying questions. Awareness ranges from 1 (lowest) to 7 (highest).

| | Pre-Test | Post-Test | p-value |
|---|----------------|----------------|---------|
| <i>All users (N=860 Mean age=13.79 SD=1.49)</i> | | | |
| Total | M=5.78 SD=1.28 | M=6.29 SD=1.30 | <0.001 |
| Cyberbullying | M=5.86 SD=1.33 | M=6.34 SD=1.30 | <0.001 |
| Bullying | M=5.65 SD=1.42 | M=6.22 SD=1.37 | <0.001 |
| <i>Male (N=454 Mean Age=13.82 SD=1.50)</i> | | | |
| Total | M=5.51 SD=1.43 | M=5.98 SD=1.55 | <0.001 |
| Cyberbullying | M=5.60 SD=1.49 | M=6.02 SD=1.56 | <0.001 |
| Bullying | M=5.36 SD=1.57 | M=5.87 SD=1.62 | <0.001 |
| <i>Female (N=406 Mean Age=13.78 SD=1.48)</i> | | | |
| Total | M=6.08 SD=1.01 | M=6.66 SD=0.80 | <0.001 |
| Cyberbullying | M=6.15 SD=1.07 | M=6.69 SD=0.79 | <0.001 |
| Bullying | M=5.98 SD=1.14 | M=6.60 SD=0.87 | <0.001 |

positive effect on the awareness of players by making them reflect on acts that they previously considered as minor, as compared to those which they already considered hurtful. For example, in the pre-test questions related to exclusion, discrimination and avoidance, many participants initially considered these behaviors, when carried out over social networks and chat applications, as only weakly constituting bullying or cyberbullying (M=5.74 and M=4.74, respectively). In the post-test, players were much more aware of the effects that these behaviors can have on the victims when repeated over time (M=6.08 and M=6.21).

Regarding RQ6, “Does playing *Conectado* produce a different effect depending on players’ age or gender?” as we see in Table 4, the game is effective in all ages and for both genders. However, boys show a lower average awareness than girls both before and after playing. When analyzing the questionnaires from the point of view of age, for girls, the older they are, the higher the initial awareness. Also, in girls, the awareness gain among the 12 and 13-year-old groups is higher than in the 14, 15 and 16-year-old groups with a $p < 0.01$. Although after playing the awareness of the 12 and 13-year-old group is still lower, the difference in awareness between the two age groups decreases. This difference in awareness depending on age is not observed in boys. Another result that stands out is that 17 years old players, particularly boys, show less awareness. This result can be due to lower diversity and smaller sample sizes for this age group: 89% of the 17 year-old players were from the same school, which had already carried out previous prevention campaigns.

Table 4. Summative evaluation pre-post awareness results by age and gender. Awareness ranges from 1 (lowest) to 7 (highest).

| | Pre-Test | Post-Test | p-value |
|-----------------------|----------------|----------------|---------|
| <i>Age 12 (N=205)</i> | | | |
| All users | M=5.77 SD=1.25 | M=6.33 SD=1.18 | <0.001 |
| Male (55%) | M=5.74 SD=1.18 | M=6.17 SD=1.24 | <0.001 |
| Female (45%) | M=5.80 SD=1.32 | M=6.51 SD=1.07 | <0.001 |
| <i>Age 13 (N=217)</i> | | | |
| All users | M=5.61 SD=1.42 | M=6.14 SD=1.52 | <0.001 |
| Male (49%) | M=5.28 SD=1.69 | M=5.73 SD=1.85 | <0.001 |
| Female (51%) | M=5.93 SD=1.01 | M=6.53 SD=0.96 | <0.001 |
| <i>Age 14 (N=167)</i> | | | |
| All users | M=5.83 SD=1.30 | M=6.27 SD=1.36 | <0.001 |
| Male (50%) | M=5.38 SD=1.53 | M=5.77 SD=1.72 | <0.001 |
| Female (50%) | M=6.29 SD=0.77 | M=6.78 SD=0.46 | <0.001 |
| <i>Age 15 (N=138)</i> | | | |
| All users | M=5.80 SD=1.30 | M=6.37 SD=1.27 | <0.001 |
| Male (60%) | M=5.49 SD=1.46 | M=6.10 SD=1.52 | <0.001 |
| Female (40%) | M=6.26 SD=0.84 | M=6.79 SD=0.51 | <0.001 |
| <i>Age 16 (N=85)</i> | | | |
| All users | M=6.12 SD=0.83 | M=6.48 SD=0.99 | <0.001 |
| Male (52%) | M=5.86 SD=0.95 | M=6.18 SD=1.23 | <0.001 |
| Female (48%) | M=6.40 SD=0.58 | M=6.80 SD=0.47 | <0.001 |
| <i>Age 17 (N=50)</i> | | | |
| All users | M=5.75 SD=1.18 | M=6.29 SD=1.11 | <0.001 |
| Male (52%) | M=5.34 SD=1.27 | M=5.75 SD=1.30 | <0.001 |
| Female (48%) | M=6.20 SD=0.90 | M=6.87 SD=0.30 | <0.001 |

By comparing the results obtained from pre- and post-game questionnaires, the game has a positive effect on players in all experiments and groups – except in the control group, which played a different game. This effect can be seen in Figure 2, which depicts the results of both awareness

questionnaires of the different experimental groups. The same happens if we only consider 14- and 15-year-old students, the age of the players who participated in the experiment with the control group.

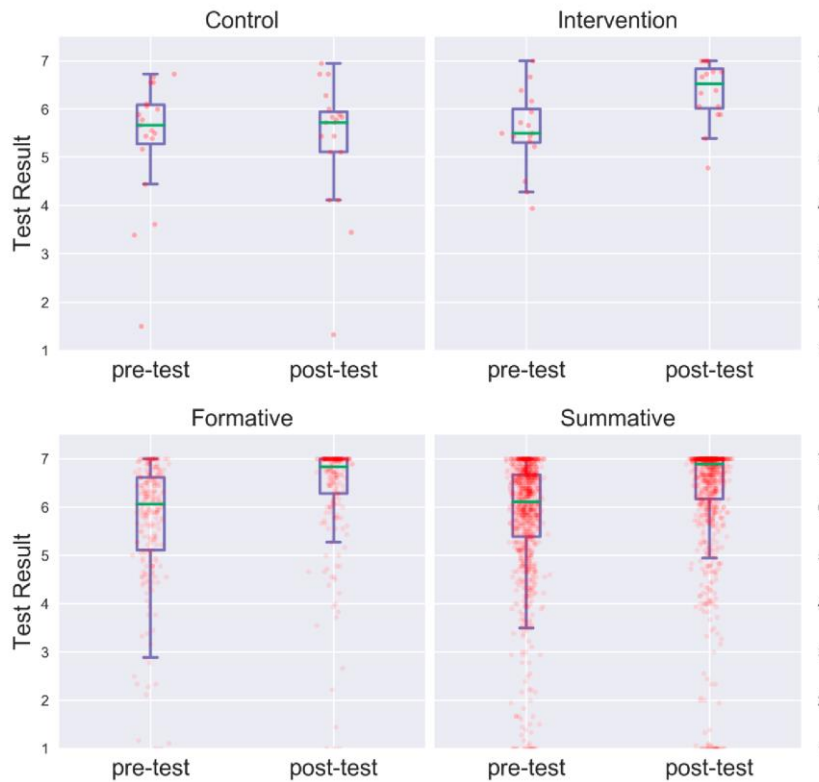


Figure 2. Pre-post test awareness results in experiment with control (upper-left) and intervention (upper-right) groups and in the formative (lower-left) and summative evaluations (lower-right).

4.3.1. Completeness and gameplay time

With the data collected, we can answer RQ2, “How long does it take for players to complete the game *Conectado*?”, and we can further explore if the game has an effect on those players who do not complete it or if there are differences in the time it takes for players according to their gender or age.

The game is designed to be completed in about 35 minutes, allowing time for a 5-minute pre-test and a 10-minute post-test. These times add to 50 of the 60 minutes of a typical class in participating high schools. Therefore, we expected the percentage of completion to be high. 82.79% of the players successfully completed the game, with a higher percentage of boys (88.10%) than girls (76.85%). All players completed day 1 of the game, while only 9 players (1.04% of the total) stayed on day 2 of the game, 36 players (4.19%) did not advance past day 3, 65 (7.56%) remained in day 4 and 38 (4.42%) arrived at day 5 but did not complete it. It should be noted that all schools had computer rooms in dedicated classrooms, including some in different buildings from where the students had their regular classes. In those schools, participating students had less time to play, because they first had to reach the computer room. In other schools, players had to leave as soon as their sessions were over, as opposed to being allowed to stay a little longer until they finished. When using the game as a tool in a regular school session, without doing the questionnaires, there would be additional time to complete the game. In some cases, it may be necessary to do the reflection part in a later session.

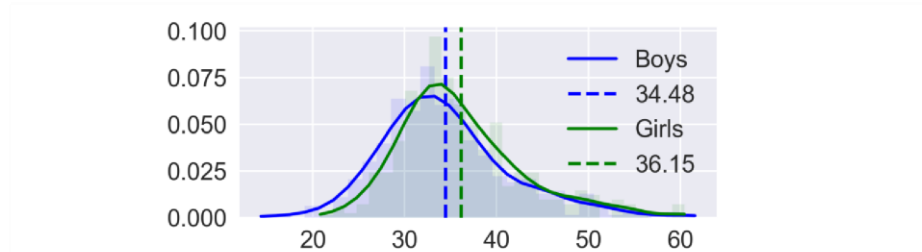


Figure 3. Time to complete the game by gender

Analyzing the results in the questionnaires of those players who have not completed the game, we can see that the game also had an effect on them, although this effect was a little lower ($N=148$ $M=0.42$, $SD=0.41$, $MD=0.28$) than that of players who completed the game ($N=712$, $M=0.52$, $SD=1.01$, $MD=0.36$). Besides, for those players who did not complete the game, the results show the more they have progressed in the game, the higher the effect is. This result is consistent with the design of *Conectado* as the bullying and cyberbullying that appear is progressive in the game: the game shows new forms of bullying and cyberbullying and more game characters opposing the player as the player progresses through the game. Data from players who have completed the game show that girls generally take longer to complete the game (Figure 3). The average difference is only 1 minute and 37 seconds, but is statistically significant and may be related to a higher percentage of girls not finishing the game. But this difference is reduced and even disappears after 45 minutes of play due to the experimental design. At this point, players were forced to leave the game and fill out the questionnaire if they had to go to another class.

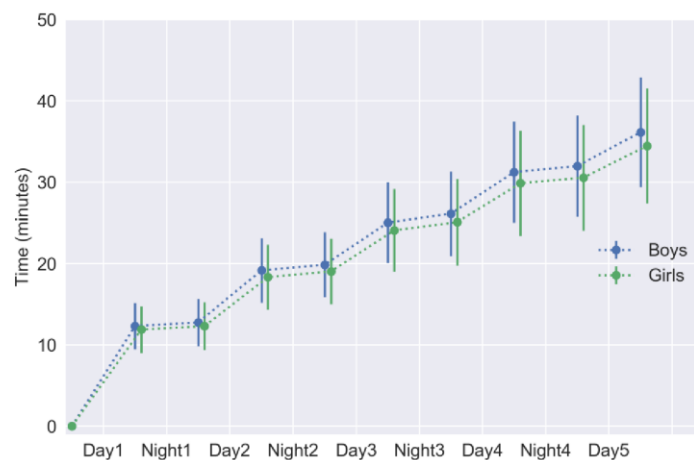


Figure 4. Time (accumulated) to complete each part of the game by gender

All players take the longest to complete the first game-day (Figure 4). This result aligns with our expectations because, at the beginning of the game, players are learning how the game works, how to move, which doors they can go through, and what they can interact with. In terms of age, players aged 12-14 take more time to complete the game than those aged 15-17. This outcome is true for both genders, although girls take longer than boys of the same age. Since one of the main mechanics is that of dialogues, it is normal that younger players take longer to complete the game, as their reading speed is generally lower.

4.3.2. In-game choices

During the game, players have the option to choose from several replies in the dialogues. Some of these choices influence the game story. The data collected from players' interactions allows us to check if these choices also change the effect of the game on the players. On the other hand, it also allows us to

check if the decisions made by players depend on their pre-game awareness. To analyze player behaviors, we have classified the players according to their in-game choices. Choices that decrease the risk of victimization score positively, while choices that increase the risk score negatively. For example, having a good relationship with their parents by talking with them about what happens at school, asking for help from the teacher when they have problems, avoiding confrontation with bullies, not sharing their social network password, and being nice to other classmates score positively. We have classified players according to their choice-scores into 4 different groups, ranging from Wrong (most decisions increased victimization) to Perfect (all decisions minimized victimization). Table 4 shows the classification of the 4 groups and their pre-game awareness scores.

With regard to RQ7, “How does players’ previous awareness affect the way players interact with the characters of *Conectado*?” and RQ8, “Are there gender differences in the way players interact with *Conectado*?”, results show that there is a higher percentage of girls who have a higher score than boys during the game (Table 5). In particular, a higher percentage of girls are ranked in the group with highest score. Also, the group of players with the highest score in both genders show a greater awareness pre-game with some statistically significant differences. Regardless of prior awareness, players can make any decisions in the game. Still, the more awareness they have, the more likely they made choices that decrease the risk of victimization during the game.

Table 5. Differences between in-game behavior of players, by gender.
Wrong = choices increased likelihood of victimization; Perfect = all choices decreased likelihood of victimization.

| Behavior | N | Pre-Test | p-value comparing with | | | |
|---------------|--------------|----------|------------------------|---------|-------|---------|
| | | | Wrong | Neutral | Good | Perfect |
| <i>Male</i> | | | | | | |
| Wrong | 99 (24.75%) | 5.09 | - | 0.030 | 0.055 | <0.001 |
| Neutral | 175 (43.75%) | 5.43 | 0.030 | - | 0.407 | 0.028 |
| Good | 44 (11.00%) | 5.63 | 0.055 | 0.407 | - | 0.109 |
| Perfect | 82 (20.50%) | 5.95 | <0.001 | 0.28 | 0.109 | - |
| <i>Female</i> | | | | | | |
| Wrong | 47 (15.06%) | 5.94 | - | 0.289 | 0.335 | 0.018 |
| Neutral | 115 (36.86%) | 5.99 | 0.289 | - | 0.136 | 0.027 |
| Good | 54 (17.31%) | 5.82 | 0.335 | 0.136 | - | 0.003 |
| Perfect | 96 (30.77%) | 6.31 | 0.018 | 0.027 | 0.003 | - |

In terms of the effect of decisions and behavior on the increased awareness caused by the game, to answer RQ9, “Are players’ interactions, decisions and behaviors in *Conectado* related to their change in awareness?” different effects are observed for girls and boys. On the one hand, the increase for girls is inversely proportional to the previous awareness, being lower in the group of girls with the highest score. This effect can be explained by the high level of initial awareness, which limits the extent of possible improvements. However, the opposite is observed in boys. Those boys with greater previous awareness have a greater increase, to statistically significant degree when comparing the group with lowest scores and those with highest. This last effect on boys is unexpected, and therefore several extra checks have been carried out, which are detailed in the following sub-section 4.3.3.

While players cannot see their own avatars, they can, at the start of the game, choose their avatar’s gender, which changes some of the game dialogues and some of the graphic resources of the game (e.g. the player’s social network, and the bathroom the player can enter). These small changes help the immersion of the player in the story. But do players choose their actual gender? To check this, we have compared the gender stated in the questionnaire before playing with the gender selected at the beginning of *Conectado*. 98% of the players selected characters of the same gender. Only 5 girls and 8 boys chose to play with a character of the opposite gender. Comparing the results of the awareness test of the group who select their gender with those that select a different gender, a small but significant difference in awareness ($p=0.028$) was found in those girls who selected the opposite gender in the game: they tended to score less. Notice that the sample of players who did not select their gender to play is tiny. In future experiments, it would be interesting, given the gender properties of Spanish language, to study whether the immersion and change produced by the game are affected by the gender used by the player. The data collected from the boys make us think that there may be several players who did not take the session seriously enough to affect some of the analyses made. When observing the traces, traces, we have not

found evidence of groups of players that played randomly or without paying attention. However, in this analysis, we have realized that it would have been useful to know when the dialogues of the game finished, and not only when they started, to identify with more detail which players could have skipped through conversations without actually reading them. This unexpected outcome, together with the good results observed in a previous study in which a reflection session guided by a counsellor was carried out after the students played *Conectado* (Calvo-Morata, García-Diego, Freire, Martínez-Ortiz, & Fernández - Manjón, 2019), may indicate that perhaps some students answered their questionnaires randomly. We explore this in the next section.

4.3.3. Analysis of divergences between game effect and questionnaires results

While the literature has pointed out some gender differences in video games and bullying and cyber-bullying attitudes, the decisions made while the users are playing *Conectado* are not designed to create different level of awareness. The difference in awareness increase among boys depending on their choices, together with a higher standard deviation in the questionnaires results, led us to believe that some students, especially boys, filled in the questionnaires randomly or paying little attention, and yet they had been engaged while playing the game. Because of this, we have performed a more in-depth analysis to attempt to detect such students. To filter them out, we have identified the following patterns and discarded those players who, in any of the questionnaires, showed one or more of the following:

- Answering in a continuous cascade, where answers to Likert questions are always the previous value plus or minus one (e.g.: 3,4,5,6,7,6,5,4,3).
- Answering all questions with the same value.

Extreme positive and negative values have also been filtered out. A total of 141 users were discarded (33 girls and 108 boys), leaving a valid sample for this analysis of 719. 589 of these users complete the game, still with a higher percentage of boys completing the game (77% of girls and 88% of boys). Analyzing both questionnaires for the 719 players, girls still have higher values of pre- and post-game awareness; however, similar values in the increase of awareness were found in both genders (Table 6). The difference between the two genders also remains statistically significant, with a p-value < 0.001. The game had a positive effect on 81% of boys and 82% of girls.

Table 6. Summative evaluation pre-post awareness results after filtering out users with random like questionnaires. Awareness ranges from 1 (lowest) to 7 (highest).

| | Pre-Test | Post-Test | p-value |
|---|----------------|----------------|---------|
| <i>All users (N=719 Mean age=13.81 SD=1.51)</i> | | | |
| Total | M=6.12 SD=0.83 | M=6.62 SD=0.67 | <0.001 |
| <i>Male (N=346 Mean Age=13.79 SD=1.52)</i> | | | |
| Total | M=5.98 SD=0.90 | M=6.50 SD=0.74 | <0.001 |
| <i>Female (N=373 Mean Age=13.82 SD=1.49)</i> | | | |
| Total | M=6.24 SD=0.75 | M=6.74 SD=0.58 | <0.001 |

We have also re-analyzed the effect of awareness on in-game behavior, and the impact of these decisions on awareness increase (Table 7). In this case, there is still a higher percentage of girls who have a higher score than boys in the game choices. Besides, statistically significant differences in pre-game awareness remain between the groups with the highest score and those with the lowest. But in this case, the differences in the increase in awareness between the groups of boys disappear. Discarded users had average gameplay times as well as number and type of interactions. Therefore, we consider that these users paid attention to the game but filled out questionnaires without reading them.

Table 7. Differences between the in-game behavior of filtered players.

Wrong = choices increased likelihood of victimization; Perfect = all choices decreased likelihood of victimization.

| Behaviour | N | Pre-Test | p-value comparing with | | | |
|---------------|--------------|----------|------------------------|---------|-------|---------|
| | | | Wrong | Neutral | Good | Perfect |
| <i>Male</i> | | | | | | |
| Wrong | 64 (21.12%) | 5.89 | - | 0.227 | 0.499 | 0.030 |
| Neutral | 133 (43.89%) | 5.96 | 0.227 | - | 0.273 | 0.106 |
| Good | 38 (12.54%) | 5.81 | 0.499 | 0.273 | - | 0.073 |
| Perfect | 68 (22.44%) | 6.20 | 0.030 | 0.106 | 0.073 | - |
| <i>Female</i> | | | | | | |
| Wrong | 43 (15.03%) | 6.08 | - | 0.254 | 0.443 | 0.036 |
| Neutral | 105 (36.71%) | 6.15 | 0.254 | - | 0.278 | 0.072 |
| Good | 46 (16.08%) | 6.16 | 0.443 | 0.278 | - | 0.034 |
| Perfect | 92 (32.17%) | 6.36 | 0.036 | 0.072 | 0.034 | - |

5. Conclusions and discussion

In this study, the evaluation of the *Conectado* videogame has been carried out in actual schools and with a large number of students, to validate both its effectiveness and some key elements of its design. Nowadays, questionnaires are the most widely accepted and used method for validating serious games, but we consider that questionnaires combined with game learning analytics (based on in-game player interaction data) provide a more powerful tool for validating both the design and effectiveness of a serious game. We believe that these two methods are complementary and very useful when it comes to getting a better understanding of how a serious game affects its target audience.

The different experiments carried out and the data collected have allowed us to answer the nine research questions about the game's acceptance and effectiveness, and validate different parts of the game design. First, the game has been well accepted by the players, and the results show that *Conectado* can be a useful tool when it comes to raising awareness on its own. However, *Conectado* is designed to be used as a classroom tool that allows teachers to initiate reflection sessions afterwards on the shared experience obtained by the players. The pre-post questionnaires and the small control group experiment showed us that the game had positive effects on awareness in 80% of the sample, as well as gender differences. Girls show increased awareness before and after playing, although the game has a positive effect on both boys and girls. The results of the questionnaires also shows age differences, although these are only present in girls, where the group of 12 and 13-year-old users showed less pre-awareness than the group of 14 to 17-year-old players. On the other hand, analysis of interactions collected during the gaming sessions has provided insights and allowed us to validate several design decisions: (1) The game is easy to complete in the established time, and although some players could not finish it, they show an increase in their awareness proportional to the percentage of game completed. This is consistent with the design of the game, where the intensity of bullying and cyberbullying increases as the game progresses. (2) We found differences between groups of players. Regarding genders, girls take longer to complete the game, and there is a higher percentage of girls that take correct, victimization-minimizing actions within the game. On the other hand, the group of players who choose better actions shows a higher previous awareness, although this does not condition their choices. Finally, (3) the different choices that players can make that change some dialogues and parts of the game do not affect the perception and experience of those players, at least from the point of view of awareness increase; that is, the effect of the game does not seem to depend on the choices taken by the player.

All these results showed differences mainly in gender, regarding completion time, game choices and awareness of bullying and cyberbullying. This gender effect has been previously pointed out by other authors, who have shown differences in the preferences and way of playing (Lucas, Sherry, & Sherry, 2004) as well as in the prevalence of bullying and cyberbullying (Waasdorp & Bradshaw, 2015; Zych et al., 2015). The differences found in the results could make designing of games that can accurately detect the likelihood of being a victim or a bully more difficult. Although we have seen that players tend to behave better in the game if they are more aware, results also show that there is no strict relationship between the type of player and their in-game choices.

Finally, during the validation and analysis steps, the authors have carried out some actions that have proven to be especially useful in our experience. Considering that they may help other researchers who perform serious game validations by combining questionnaires and analysis of interactions, we have gathered them in the following recommendations:

- Improving and filtering the sample data: although the set of users who fill in the questionnaires arbitrarily and without taking questionnaires seriously may not affect the analysis of the entire sample, it could have an effect when we want to analyze and compare groups of users, as in our case by gender. In our analysis, the majority of users who did not take the questionnaires seriously were boys, which affected the comparison of interactions with the results of the questionnaires. Although there are studies that show that the set of users that fill in the questionnaires wrongly in general obtain worse results (Osborne et al., 2011), it is convenient to carry out this filter despite losing sample size. Note that players may take the game seriously but not the questionnaires, likely because they find the game activity more enjoyable. In our case, we could also check the data of the players who did not complete the game.
- Collecting and analyzing player interactions: while the use of questionnaires is most common and widespread when validating serious games (Calderón & Ruiz, 2015), the analysis of interactions has proven to be very useful as a complement. Analysis of interactions allows for filters and groupings that would otherwise not be possible with questionnaires alone. In this case, filtering by game behavior or checking the effect of *Conectado* on players according to the percentage of completion. In other words, the application of Game Learning Analytics and the collection of interactions can be useful in any serious game beyond those focused on the evaluation of players or the teaching of specific knowledge. Furthermore, this data collection can also be used to carry out Game Learning Analytics during the game sessions themselves, showing in real time the progress of the players or checking if they have stopped playing, and providing session managers greater control and knowledge during such sessions.
- Collecting more detailed and fine-grained analytics: for instance, in the case of games with dialogues, capturing the beginning and ending of these conversations. During the analysis of the interactions, we realized that when checking if the players had paid attention to the game, it would have been useful to collect also when they reached the end of dialogues. With this information, we could have checked the time players spent reading, and therefore found when they advanced too fast to actually read the dialogue. Together with the number of interactions and scene changes, this would have given us better filters when identifying which players are more thorough in interacting, and gaining a proxy value for engagement.

We consider that this approach combining both questionnaires and game learning analytics information will contribute to obtain scientifically validated serious games. For example, if changing behavior or increasing player awareness, use of Learning Analytics by itself to measure changes in players would be challenging, but relevant information can be missed if only using questionnaires. We consider that proving efficacy of games with this combined approach can contribute to the generalization of serious games in mainstream education, and that it is key for games to contribute to evidence-based educational approaches.

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6.5. Making understandable Game Learning Analytics for Teachers

6.5.1. Cita completa






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6.5.2. Resumen original de la publicación

When used for education, games can increase students' motivation and engagement and provide a more authentic learning environment where they can apply knowledge, making them especially suited to schools. However, actual application of such (serious) games in schools is still limited. Teachers still consider that using games is a complex process that they do not fully master and that requires extra effort from them. We consider that simplifying teachers' tasks when deploying games is crucial to promote their use. In classroom scenarios, teachers can greatly benefit from knowing what is happening as a serious game is being played. Game learning analytics (GLA) is the process of collecting, analyzing and displaying student interaction data with the games to improve the educational experience. GLA can be used both at real-time, providing teachers with information while their students are still playing, and offline, inspecting already-finished game sessions. In both cases, analytics is only useful when it manages to bridge the gap between large collections of interaction data and pedagogically sound insight. Analytics dashboards should therefore provide not only complete but meaningful and easy-to-understand information, considering that teachers will most probably not know all the details of the analyses performed underneath. In this paper, we review our experiences on game learning analytics dashboards for teachers, and describe some of the steps we have taken to improve our dashboards.



Making Understandable Game Learning Analytics for Teachers

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Abstract. When used for education, games can increase students' motivation and engagement and provide a more authentic learning environment where they can apply knowledge, making them especially suited to schools. However, actual application of such (serious) games in schools is still limited. Teachers still consider that using games is a complex process that they do not fully master and that requires extra effort from them. We consider that simplifying teachers' tasks when deploying games is crucial to promote their use. In classroom scenarios, teachers can greatly benefit from knowing what is happening as a serious game is being played. Game learning analytics (GLA) is the process of collecting, analyzing and displaying student interaction data with the games to improve the educational experience. GLA can be used both at real-time, providing teachers with information while their students are still playing, and off-line, inspecting already-finished game sessions. In both cases, analytics is only useful when it manages to bridge the gap between large collections of interaction data and pedagogically sound insight. Analytics dashboards should therefore provide not only complete but meaningful and easy-to-understand information, considering that teachers will most probably not know all the details of the analyses performed underneath. In this paper, we review our experiences on game learning analytics dashboards for teachers, and describe some of the steps we have taken to improve our dashboards.

Keywords: Learning analytics · Serious games · Dashboards · xAPI
Game-based learning

1 Introduction

There are many characteristics that make games adequate for education, including their engaging and motivating nature [1, 2]. Despite these advantages, the adoption of serious games is still poor, partly due to a lack of standards for development, validation and deployment in schools [3]. Collecting and analyzing student gameplay is one of the keys to increase serious game adoption in schools, because collected data can provide insight and improve all steps in the process, and even become a major selling point in

itself, thus driving adoption. In educational settings, Learning Analytics (LA) is used to provide insight into learners' actions to improve their learning process and contexts. When applied to games, Game Learning Analytics (GLA) [4] focuses on information gathered from players via in-game interactions.

Figure 1 represents a generic Game Learning Analytics pipeline, focusing of two main stakeholders: students playing a serious game, whose information is tracked, stored and analyzed within the Analytics System; and teachers supervising the game session. Analyses and visualizations (embedded in a dashboard) provide information for teachers. Other stakeholders, such as students themselves, game developers, and academic officials can be presented with their own dashboards.

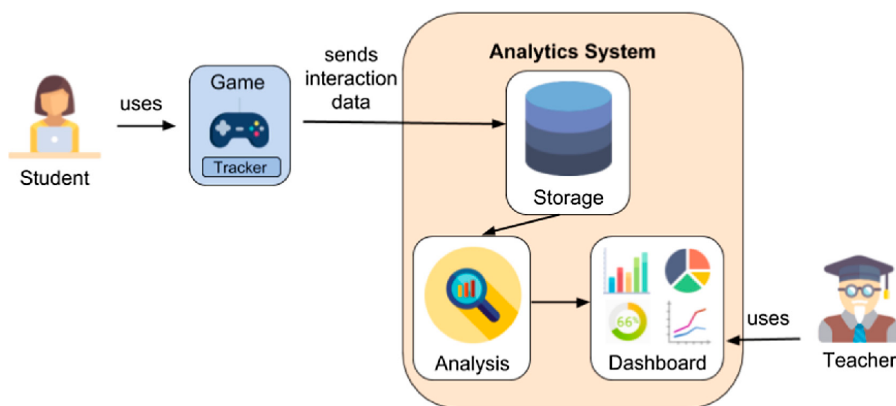


Fig. 1. Game Learning Analytics pipeline: a student plays a game that includes a tracker component. The tracker sends interaction data to the Analytics System for storage, analysis and visualization. Teachers, among other stakeholders, interact with dashboards to gain insights into student gameplay and educational outcomes.

Dashboards are the usual way to communicate information to stakeholders [5]. They can display important metrics, and provide a visual overview of other information while allowing filtering and limited query capabilities to gather more in-depth data. Among the usual stakeholders of interest for game learning analytics (students, teachers, game developers), this paper focuses on teachers, as they oversee the actual educational environments and are, in our opinion, the first stakeholder that needs to be considered to improve analytics for games in education: student dashboards are also important, but teachers are who decide whether or not to use games. More narrowly, the last step of Fig. 1 depicts the teacher using the dashboard, which requires teacher dashboards to be understandable, as described in [6].

Generating teacher dashboards starts with tracking interaction data, which must be done with care to guarantee privacy. Interaction data can then be displayed in different visualizations, for example displaying previously-identified KPIs (*Key Performance Indicators*), the choice of which will be different from other stakeholders. Data collection and analysis should be entirely transparent to teachers. The final step, the visualization of the information, is where game learning analytics can provide value to

teachers. In this sense, dashboards need to be evaluated as pedagogical tools, taking into account their goals, affect and motivation, and usability [7].

The process of collecting, analyzing and displaying data from in-game interactions to yield useful teacher dashboards comprises several steps, each of them beset by possible issues:

- a. **Data collection:** Collected interaction data cannot be easily shared unless a collection standard is being followed. Once standardized, privacy issues need to be addressed. Furthermore, what data should be captured depends on the games, and game developers are understandably more interested in designing games – rather than selecting what to send and then, on top, having to perform anonymization and sending it according to specific standards. While data collection is not, in itself, an issue that is specific to teacher dashboards, decisions made at this step (particularly what is collected and how it is anonymized) greatly influence dashboard outcomes.
- b. **Low teacher expectations:** Teachers are often new to analytics dashboards, and do not really know what to expect. In our experience, when asked what they expect to see, teachers described only basic information, such as times of completion, difficulty, results in terms of counts of right and wrong answers, or number of attempts; possibly displayed using simple visualizations. Also, teachers assume that analytics will only be available after the intervention, and do not expect to receive any information while students are playing.
- c. **Dashboard design:** The design space of possible dashboards is vast, and designing useful visualizations requires both pedagogical knowledge and game-specific information. Teachers are generally not experts in dashboard design (see point *b* above); and are unwilling to make significant investments in dashboard design upfront, before the game is even available.
- d. **Changing dashboard requirements:** Teachers will often request additional visualizations for their dashboards after the game has been played (see points *b* and *c*). Fulfilling these may be costly or even impossible (for example, if the requisite data was not originally collected; see point *a*) – unless the whole system has been designed to allow the necessary flexibility.
- e. **Beyond stand-alone games:** Teachers may want to use games as parts of larger courses, which may in turn be games as well. In these cases, dashboard granularity needs to be configurable, allowing the game to be analyzed not only by itself, but also as a part of a whole, and even as a whole with several parts.

As participants in two EU H2020 Projects, we have developed a complete architecture to track, collect, store, analyze and display the data collected from serious games in a systematized way [8, 9]. Section 2 of this paper describes how our architecture, and specifically our teacher dashboards, tackle the above issues. Section 3 describes how teacher dashboards could look like in subsequent iterations. Finally, Sect. 4 summarizes our conclusions and outlines future work.

2 Improving Teacher Dashboards

For data collection (issue *a* in the previous section), we use the Experience API for Serious Games Profile (xAPI-SG) as a standard collection and archival format. xAPI-SG defines a common set of interactions that are usual in serious games, as detailed in [10]. We provide an easy to use library that greatly simplifies adding analytics to serious games, isolating game developers from the details of the standard. To avoid privacy issues, we use pseudonymous tokens for students. Tokens are unique strings of 4 characters created at the server when the game is deployed, and provided by teachers to their students, who will then use them to access the game. We then rely exclusively on tokens to identify students across play sessions, using them also to display information in the visualizations. Only teachers can, if they choose, keep the correspondence between tokens and actual students.

Regarding low teacher expectations and dashboard design (issues *b* and *c* in the previous section), since we cannot expect teachers to provide detailed lists of what should be analyzed and how it should be displayed, we have developed a default dashboard, which does not require any setup and can display basic data for any game that sends valid xAPI-SG interaction data. For example, since xAPI-SG has a specific vocabulary to indicate that a student has made a choice, and whether the game considers the choice to be correct or not, the default dashboard can easily display counts of correct/incorrect student answers. The use of a default, generic dashboard immediately provides value to teachers, and provides a useful base to elicit requirements for more complex game-specific dashboards.

Additionally, since our dashboards are updated in near real-time, with delays of few seconds between receiving interactions and displaying updated visualizations, we also include a simple alerts and warnings mechanism that can be configured to notify teachers of possible issues as they arise. We consider alerts to be higher-priority than warnings, but the underlying mechanism is the same; and, besides from increasing the situational awareness of teachers, its existence reminds teachers that the use of analytics is not limited to presenting post-mortem information on playthroughs; and that their role during gameplay sessions need not be limited to proctoring.

To provide the necessary dashboard flexibility (issue *d* above), we are not limited to the default dashboard, and allow game developers (presumably with teacher feedback) to create customized game-specific analyses and visualizations for their games. Since our dashboards are built on top of the Kibana and Elasticsearch open-source projects, dashboard creation is developer-friendly, although not recommended for non-programmers. If need be, custom analyses and dashboards can re-evaluate old data, allowing dashboards to be updated to display existing information in new ways. This allows requirements to evolve as teachers and game designers refine their understanding of how students play and learn with a serious game, or when dashboard usability issues are identified. Subjects. 2.1 and 2.2 contain two case-studies of such custom game-specific dashboards.

Finally, regarding issue *e*, games are sometimes part of more complex course structures. For example, a game may contain several mini-games, each of which can merit its own dashboards. However, it still makes sense to provide a global dashboard

to monitor progress across all the minigames. This functionality was required for the H2020 EU Project BEACONING and allows for multi-level analytics, where the results of, for example, games that launch other mini-games, can be combined and meaningfully analyzed and displayed to provide insights on overall progress.

2.1 A Custom Dashboard for a Serious Game on Cyberbullying Awareness

Conectado [11] is a serious game to raise awareness against cyberbullying by placing the students in the role of a transfer student that suffers bullying and cyberbullying after arriving at a new school. Players experience the life of this transfer student in first person, during each of 5 in-game days, while being exposed to feelings of impotence and increased (in-game) social isolation. The game keeps track of the level of friendship of the story's protagonist with each classmate. For instance, the variable called *friendship risk* indicates, based on the player's choices, the risk of being bullied in the game from 0 to 100, where a higher value corresponds to a worse social standing. There are indicators of risk for each character as well. The decisions that players make during the game, including whether the player decides to tell that is being bullied to the parents or the teacher or not, also determine the ending.

Some of the game-dependent visualizations developed for *Conectado* can be seen in Fig. 2. From left to right, and from top to bottom:

- a. Average friendship risk: this general metric describes whether the average of the class has low, medium or high friendship risk (shown in green, yellow and red, respectively).
- b. Number of players per game day: this bar chart provides a vision of the progress of players in the game. As there are five days, teachers can see in real-time how many students have played through each in-game day, and help students who are too far behind their classmates.
- c. Number of players that have taken each possible action that determines the ending: this pie chart compares the number of player who have decided to complain about bullying to the in-game parents and teachers vs. those that have decided to remain silent.
- d. Maximum friendship risk per student: this visualization provides more in-detail information that complements the general metric provided in the first visualization. This allows teachers to quickly identify which students are doing best and worse in the game. Since the visualization is sorted, it also provides an overview of the distribution of risk scores throughout the class.

These visualizations have been designed trying to cover some of the information usually required by teachers: progress (b), decisions taken (c) and specific metrics, both general (a) and per student (d).

By default, in our teacher dashboard, all visualizations were of the same shape and size. However, different sizes are possible as seen in Fig. 2. In some cases, this may even be required to fit the desired visualizations, as it is the case in the next example where a plug-in was created to provide the exact visualizations desired.

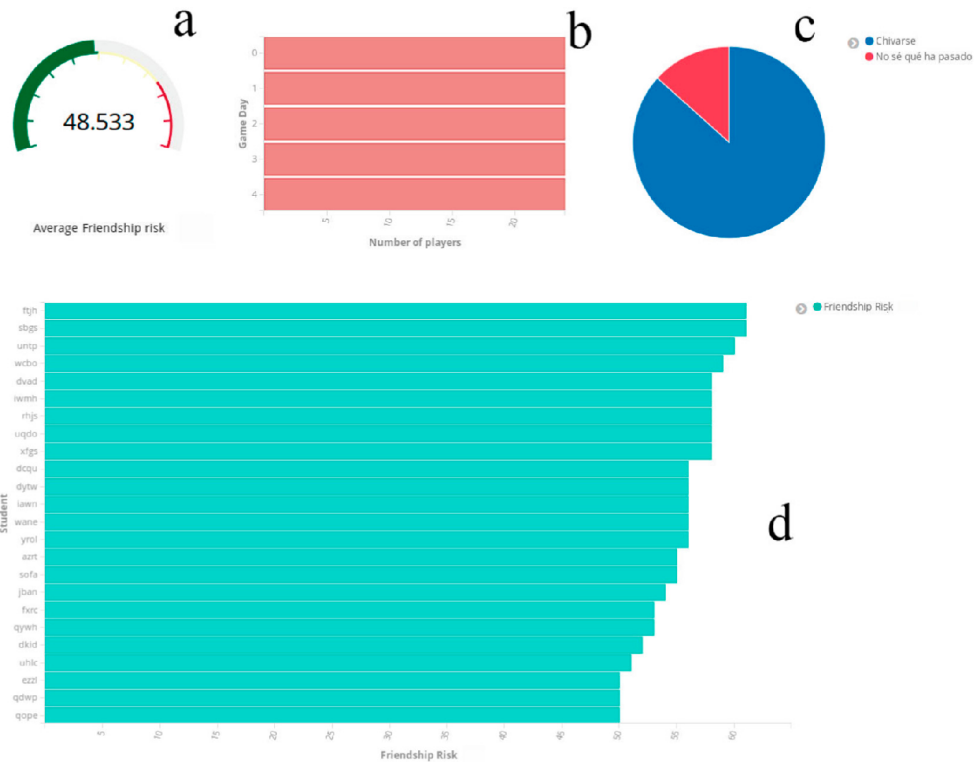


Fig. 2. Some of the game-dependent visualizations developed for the game *Conectado*. (Color figure online)

2.2 A Custom Dashboard for a Serious Game on Workplace Interaction

Another scenario where both analysis and visualizations were developed ad-hoc was for a game centered on workplace interactions developed for the EU H2020 RAGE project. The game design included a requirement to use the Thomas–Kilmann Conflict Mode Instrument (TKI) to measure and display responses to the different conflict situations that the player is exposed to while working as a team leader in a simulated game development company. The TKI is based on two dimensions of behavior, assertiveness and cooperativeness; and defines five different approaches based on the balance between both dimensions: competing, accommodating, avoiding, collaborating and compromising. A specific analysis and visualization was developed to display the TKI categorization for each player. Additionally, certain situations allowed the player to exhibit, or avert, certain types of biases (for instance, based on gender, race, or fashion sense). Finally, the game allowed players to track office morale, productivity (in terms of shipped games), and awards for quality.

Figure 3 displays the seven visualizations developed for this dashboard:

- Thomas-Kilmann classifications of a specific student’s answers over time.
- Games shipped, a measure of team productivity.
- Awards won, a measure of team quality.

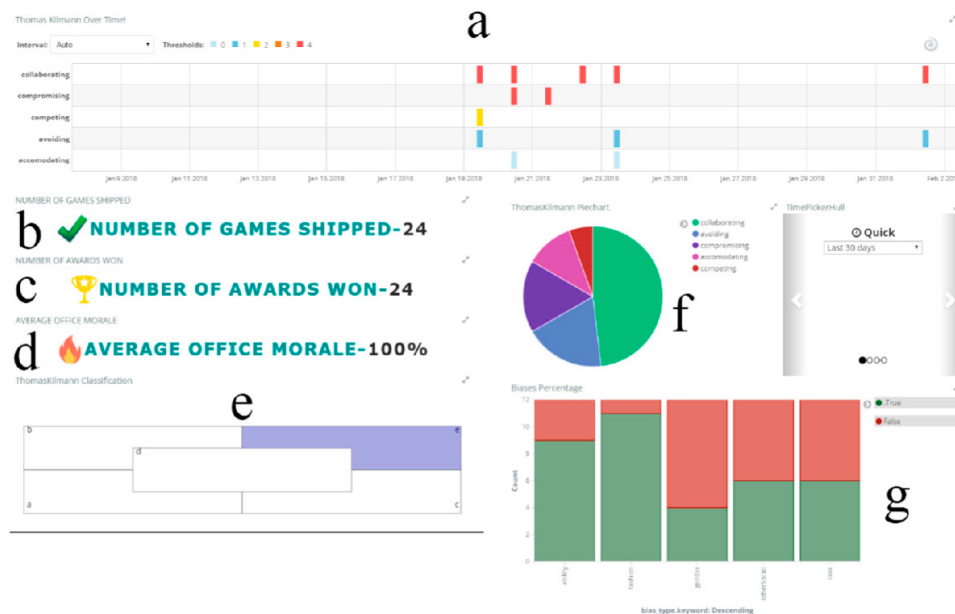


Fig. 3. Some of the game-dependent visualizations developed for the Thomas-Kilmann Conflict Mode Instrument. (Color figure online)

- d. Office morale, a percentage indicating the degree to which the player's in-game co-workers are happy with the player's choices.
- e. Overall Thomas-Kilmann classification for the player, displaying the category that has appeared more times from the five pre-set categories. This visualization is part of the standard TKI.
- f. Pie chart displaying the distribution of answers according to the 5 TKI categories.
- g. Bar chart displaying, for each bias, the ratio of responses where it was averted (green) or exhibited (red). Note that both counts are relevant, as most possible choices to the in-game conversations did not offer the opportunity to either avert or exhibit a bias.

This set of visualizations was a specific request made by the creators of the game in the project, sought to display all the information they considered to be of relevance in the game, and underwent several cycles of prototypes/changes until reaching its final iteration as displayed above.

3 Lessons Learnt in Teacher Dashboard Design

We have tested the default teacher dashboard, including an alerts & warnings visualization, in experiments with two games, played under experimental conditions by over 600 students and 150 teachers. Based on feedback from these experiments, we are currently redesigning the default dashboard to make it more understandable and actionable for teachers.

would first require sufficient baseline data to be gathered; for example, we can take all completion times from a validation run, and use these times to identify students who take significantly longer (say, one standard deviation) than their colleagues to finish. Since this analysis can be performed regardless of the game, it can be rolled into the default alerts system, benefitting all future users of the analytics system at essentially no increased cost for users. The view of alerts and warnings can also be improved, by making a better use of display area; for instance, showing triggered alerts and warnings directly in the general view if they are not too many, or showing only the most recent otherwise.

Figure 4 depicts two versions of the general view of the alerts and warnings each student has triggered. In the original version, teachers must click on a student's name or access token to see the detailed alerts and warning that the student has triggered. In the updated version, teachers see details for each student directly on the main view.

As an upcoming approach, alerts could be used after validation of games to provide extra information: for instance, alerts could be deployed to identify students who are taking much longer than the expected time and show an alert in correspondence, helping to identify the outliers in terms of completion times.

4 Conclusions

Teachers are key to increasing adoption of serious games by schools, and Game Learning Analytics should therefore focus on their specific needs. We consider that teachers' requirements should determine what information is to be collected and analyzed, to be later displayed on dashboards that are easy to understand for an average teacher. Dashboards should help teachers to make informed decisions not only after the games are played, but also while the game is ongoing and teacher interventions are still possible to help players make the most of their sessions.

In this paper, we have identified several issues with teacher dashboards, including privacy and data collection, low teacher expectations regarding the outputs of the dashboards, lack of initial input when creating initial dashboards vs. late dashboard design requirements, and the use of dashboards for non-standalone games; and we have described how we have met these challenges by using simple anonymization via tokens and the xAPI-SG standard, a default set of visualizations that provides teachers with quick and easy-to-understand information to act on the previous contexts, support for custom-built dashboards (we present two case-studies), a flexible alerts and warnings system, and hierarchical dashboards.

In our experiments using these dashboards, we have identified possible improvements (including alerts and warnings) to make them more understandable. These will be implemented on subsequent iterations, and tested and validated using the *Conectado* serious game and other games from RAGE and BEACONING H2020 projects.

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6.6. Game Learning Analytics for educators

6.6.1. Cita completa

A. C. Morata, C. A. Fernandez, M. Freire, I. Martinez-Ortiz and B. Fernandez-Manjon, **Game Learning Analytics for Educators** in *2019 IEEE Global Engineering Education Conference (EDUCON)*, Dubai, United Arab Emirates, 2019, pp. 1436-1442, doi: 10.1109/EDUCON.2019.8725089.

6.6.2. Resumen original de la publicación

Serious games have proven several advantages when used in education improving students learning. However, games are still complex to deploy in the class for average teachers. Many teachers still do not see games as a powerful tool to improve their teaching work. To this end, it is essential to humanize the game technology making the use of games more transparent to teachers in a way that they get the benefits and avoid most of the game deployment complexity. We consider that Game Learning Analytics is one of the keys to help teachers in the application of serious games in the classrooms. Game Learning Analytics allows to capture data from students' interactions with games and derive information that simplify teachers' tasks. Doing it in a transparent way within the game environment (i.e. stealth assessment) can provide evidence-based data about the learners' knowledge at each point of time. Combining both game learning analytics in near real-time and offline, and stealth assessment for games, it could be possible to leverage their use in classroom settings at real-time making their use easier for teachers.

Game Learning Analytics for Educators

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Abstract— Serious games have proven several advantages when used in education improving students learning. However, games are still complex to deploy in the class for average teachers. Many teachers still do not see games as a powerful tool to improve their teaching work. To this end, it is essential to humanize the game technology making the use of games more transparent to teachers in a way that they get the benefits and avoid most of the game deployment complexity. We consider that Game Learning Analytics is one of the keys to help teachers in the application of serious games in the classrooms. Game Learning Analytics allows to capture data from students' interactions with games and derive information that simplify teachers' tasks. Doing it in a transparent way within the game environment (i.e. stealth assessment) can provide evidence-based data about the learners' knowledge at each point of time. Combining both game learning analytics in near real-time and offline, and stealth assessment for games, it could be possible to leverage their use in classroom settings at real-time making their use easier for teachers.

Keywords—serious games, learning analytics, game-based learning, educational data mining, stealth assessment

I. INTRODUCTION

The immersive and engaging nature of games has proven to be a promising and effective environment for learning [1]. These characteristics have increased the interest regarding serious games, that is, games which main purpose is other than entertainment [2]. Their main purpose may be learning, but also to raise awareness or change an attitude or behavior [3]. Many serious games have been developed in different areas (e.g. education, military), where they have proven to be an effective learning material [4], however few of them have gone through a formal validation process to prove that these games meet their intended goals (e.g. teach some topic, improve some skill) [5]. Moreover, most of the serious games were developed in controlled environments and are difficult to scale up and deploy in real scenarios by non-specialist staff. A common scenario of application of serious games is in education, where games are used as an additional resource for educators who provide the game to students who play the game in class.

However, when it comes to actually apply serious games in educational settings, educators may face several issues (not only technological ones) that difficult their work:

- Specific technology or platform requirements: some games require a specific platform like Android or Windows and/or specific hardware components like special controllers. Not all schools are able to provide

the specific technology requirements to apply the game successfully.

- Gameplay average duration: it is important to note whether the game is designed to be used in a short session of one or two hours or whether the opposite is intended to be played for several sessions throughout the course. If it is too long that may not fit in a single average class session and it will be necessary that the design of the game facilitates the dynamics to follow between different sessions.
- Adaptation for users with disabilities or special needs: for instance, if the game is geolocalized and the educator has students with motor disabilities, educators may not be able to apply the game.
- Number of devices: the number of devices where students play can be limited and the game may not be effective for players to play in a group.

Even if the game meets all the requirements for its application in the classroom, educators may not find its application that obvious. As educators, they may not be familiar with the technology used in the game and may not feel confident with the actual games' deployment. Training for teachers may also be required so they are provided with some tools to help them when applying the game and some guidelines on what educators and students need to do while the game is in play. Moreover, it can be difficult for educators to actually know what their students are doing while playing, whether they are actually learning or not, or how to adequately apply games in classes for they to be more effective.

To avoid these issues, it is key that developers and researchers keep in mind educators' needs and try to make games more "human" in terms of transparency and equity. Specifically, this means that games need to be both more transparent and reliable, so that educators do not need to be experts neither in games nor in technology for effectively using them. Regarding transparency, educators should be aware of what students are doing in the game at any moment and obtain information on whether they are learning or not. Reliability can be ensured if the game indeed meets their intended teaching goals, so educators can be sure that letting students play in class is an adequate learning activity.

To provide information that helps educators, interaction data can be collected from students' gameplays to provide a great insight into students' actions in the game. Learning Analytics data from games (i.e. Game Learning Analytics data) can be collected and analyzed to evaluate, validate and

improve the games, but also to help educators avoid some of the previously mentioned issues. The application of Game Learning Analytics should not reduce educators' roles but change it as the learning activity also changes [6]. When collecting interaction data, equity also needs to be ensured. If developers or researchers are collecting data to improve the game design or deployment, also all the final stakeholders involved in the process, mainly educators and students, have to obtain a clear benefit of the use of this technology. Therefore, students should obtain a better and more authentic learning experience while teachers should keep control of their students obtaining real-time information about how they are playing the game and even data that can contribute to the final student evaluation. For students, equity can also be ensured if educational opportunities are provided according to students' level of need and ability [7].

Although the use of games in schools has proven to greatly benefit students, this does not mean that they are the only stakeholder to be taken into account. To promote the actual use of games in education, we consider that the full process should also consider educators as an essential part for those educational games that are going to be used in class, as they control and are the key stakeholder that applies games in their classes. Whether educators fully understand and know how to effectively apply games or not can greatly affect or even prevent the actual application of games with students. Therefore, we consider that educators should be key in the full lifecycle of those serious games designed to be used in class: from the initial game validation, applying games in classes obtaining information at real-time about their progress and results, and automatically evaluating students based on their in-game actions. Teachers' role needs to be pedagogically active at all stages: planning the session, during the gameplays and after the sessions [8].

Fig. 1 summarizes this full process where educators or teachers are placed in the center of the process and should be

involved in all stages. Technology should simplify and not difficult their work: from games validation, applying games in class where data is being collected in an Analytics System, obtaining real-time information to know what students are doing while they play, and finally, being able to evaluate students based on their in-game actions.

In the following sections, we go through all the steps of the lifecycle of those serious games designed to be used in class focusing on educators' tasks and how game learning analytics data can simplify their use of this technology in classes. The rest of this paper is structured as follows. Section 2 describes some of the considerations and steps to formally validate serious games. Section 3 focuses on the application of games in actual classes, including what educators need to do before to prepare the activity, what information they can obtain while games are in play, and what they need to do after the gameplays are over. Section 4 proposes an additional use in which learning analytics data can be used to help educators evaluate students based on their in-game interactions. Finally, Section 5 summarizes the main conclusions of our work and points out some limitations.

II. SERIOUS GAMES FORMAL VALIDATION

To ensure games meet their intended goals, the first step is that they go through a formal validation stage. The most widely accepted and commonly used method to validate serious games is to conduct a pre-post experiment consisting of three phases: first, students complete a questionnaire before playing (pre-test), then students play the game from beginning to end, and finally, after finishing the gameplay, they complete a final questionnaire (post-test) [9]. Both pre-test and post-test usually have the same (sub)set of questions. The goal is that this questionnaire assesses players' characteristics before and after playing about the topics covered in the game (the specific characteristic depends of

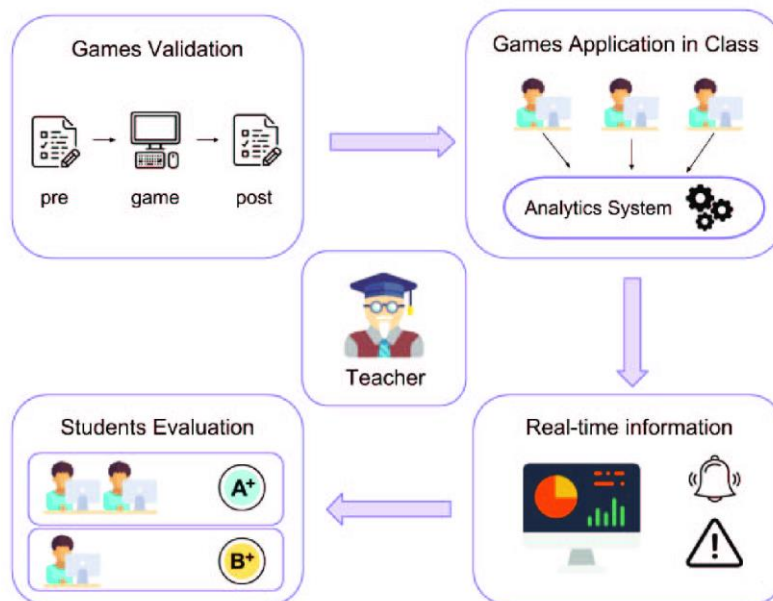


Fig. 1. Teachers' full process with serious games: From game validation, application in class, obtaining real-time information and evaluating students.

the serious game purpose including, for instance, knowledge, attitude or awareness). Results of both tests are then compared to see if the increase in the specific player's characteristics is statistically significant. If that is the case, as between both measures the only intervention is the game, it can be concluded that the increase in that characteristic is due to the game effect, and therefore the game is formally validated. There are plenty of examples in literature that use this approach to validate serious games including, for instance: a game for children with autism to learn emotions [10], a game for patients to manage pain after surgery [11] or a game to raise awareness about bullying and cyberbullying [12].

In this validation stage, if we consider the case of a learning game designed to be used in class, the questionnaires provide a measure of how much students know about the topic before and after playing the game. In order to meet the equity and improve the validation process, researchers should provide the results to the teachers and how to assess the effectiveness of the game. The pre-test can provide educators a measure of how much students know about the topic before playing the game, or even it can be used as an assessment questionnaire to measure their knowledge of the topic. After playing, the post-test can show educators the effect of the game application and how much students know after playing (and, if the game is effective, also how much students have learned playing). The validation itself can easily be carried out during a class session where educators provide students the tests before and after playing the game and collect their results.

The validation process described, however, assumes that an accepted questionnaire that measures the specific characteristic (e.g. knowledge) covered in the game exists. But this assumption may easily not be satisfied, as few validated questionnaires already exist or have been constructed for serious games [13]. If there is no accepted questionnaire to validate the game, the complexity of the process escalates as, first of all, the validation questionnaire itself has to be developed and also validated. Once the game has been formally validated, it can actually be applied in larger classes as it is already proved that it is effective.

Learning analytics is also useful in this process, where collecting data from users can help to improve and validate the game design; for instance, to find bugs in the game, highlight features to improve and check if the game time and interactions are in line with the developer expectations.

III. GAMES APPLICATION IN CLASS

After their formal validation, the main scenario where games are applied is during a class session with at least one educator supervising the activity. Another possibility is that games are used for homework or as an additional optional activity to be carried out at home. However, this scenario would limit educators' involvement in the activity as they could only comment the activity with students in class a while before and after playing and they would not be able to interact with students while they are actually playing. This scenario also restricts the usefulness of the activity for educators at real-time as they cannot obtain information while students are actually learning (that is, while they are playing). Instead, if the game is played with internet connection and sending data to the analytics system, educators could receive information after gameplays have

been completed. This information may include whether students have learned or not, if they have encountered issues playing or even assess students based on their in-game actions. As these previous scenarios avoid the possibility of educators' intervention, we focus on the common scenario of applying games in classes with at least one educator supervising the activity.

When applying games in classes, it is essential that educators fully understand the content and the mechanics of the game that they are applying. As a starting point, it would be ideal that educators have played the game before applying it with their students. Some educators may not consider it that useful as they are commonly not part of the intended target group of the game, however, actually playing the game can provide educators a great deal of information about what their students will face when they are the ones playing. Although we consider that playing the game is essential, only by playing educators may not have all the information about the purpose of each part of the game, the design decisions, etc. To complement the experience of playing the game as their students will do, a game manual for educators is extremely convenient so they can have all the information of the game to simplify its application in class. The manual for educators could include, among others: downloading (if needed) and installing instructions of the game; requirements for its application; goals the game aims to achieve; details about the game content (e.g. levels or days in-game, quests or tasks to complete, mini-games included, characters that appear, and even solutions or hints to solve game's challenges); purpose of each part of the game; additional information about the context of the topic the game is about (this can be used to raise a discussion with students after playing or to provide further information to complement and complete the content of the game); instructions for students; a list of frequently asked questions when applying the game, and so on. Some examples from literature where a manual has been provided to educators when applying games in class to support their tasks include [14] or [15].

Once educators are actually familiar with the game content and mechanics, a first step to make educators' task of applying games simpler has been achieved. Building up from this knowledge, it will now be much easier for educators to apply the game in their classes, helping students that need it and being aware of what students are actually facing in the game. But an additional step is required for educators to maintain control of what is happening in their classes when applying games. As students typically play individually, each student goes through different situations at each point of time, so it would be difficult for educators to be able to even know what each student is doing at a given moment. This can greatly undermine educators' trust in applying games in classes as they may feel that they do not longer control what students are doing. To avoid this perception, it is essential that educators obtain a complete-enough range of information while students are playing.

A. Real-time information for educators

A further step to simplify educators' task when applying games in schools is to ensure that they do not lose control of their students while they are playing. An easy way to give educators information about what students are doing in their gameplays is with some type of visual analytics that aggregates all the game learning analytics data coming from each student's gameplay. This visual information can be

shaped as a dashboard, where multiple visualizations are combined to provide an overview of the class. It may also be helpful if this dashboard can be filtered by student so educators can also see the information about specific students or obtain more in-depth information about individuals, if needed. The dashboard should collect data from students' interactions with the game and show the information derived from that data at near real-time so educators can see the current situation of their students. The information shown may include: in which part of the game students are at each moment, chosen paths, progress, actions in the game, responses, scores, times, completion, etc. For instance, Fig. 2 shows an example dashboard for teachers including (from left to right, top to bottom): total number of active players, to verify that all students are playing; percentage of players who have reached each game ending, to know if all have reached the most desirable ending or not, which may depend on their in-game actions; number of players who have gone through each game-day, to know the general progress of the class in terms of game levels or days completed; number of scenes completed for each player, to know the specific progress of each student; and the value of one in-game metric (e.g. level of friendship with an in-game character) for each student, which may provide deeper insight into in-game actions taken.

An additional visual element that may help educators while games are in play is alert and warning messages [16]. These messages can be configured prior to the application of games (or be pre-configured by the game development team) so the conditions under which each specific alert or warning will be triggered are defined. When these conditions are met, the alert or warning message will be shown to the educator, together with the identifier of the student whose gameplay data has satisfied those conditions. With these defined messages, educators can be notified at near real-time when specific situations that may require their immediate attention occur. This system can be used so educators are able both to help students that encounter issues in their gameplays and

cannot move forward, and also to provide additional tasks to students that advance too fast and may finish the game earlier than expected. This method also improves equity as all students, regardless of their particular speed or ability to complete the game, can take advantage of the activity without wasting time getting stuck in the game or finishing it too early.

The previous process requires a fundamental point: the interactions carried out by students in the game need to be collected following some standard data format that can be used to define and populate the visualizations. In our proposal, we use the Experience API for Serious Games (xAPI-SG) profile [17] that standardizes the data collection for interactions performed in serious games. Following the definitions of this profile, it is recommended to provide a set of default teacher visualizations that covers the most common scenarios without any required additional information or configuration from teachers [18].

B. Post-game activities

When applying games in classes, it is also highly recommended there is some time left after the gameplays for educators. Hence, after students have completed their gameplays, educators can have a post-intervention activity prepared in advance. Each game may have a related activity associated with it, depending on the goal of the game. It is important that games provide the necessary tools so that educators can take advantage of them and relate them to the curricular content of the game:

- The post-game activity may be a simple discussion or debriefing about the common experience they have just gone through, so the game is the tool that triggers that discussion. This class discussion after playing games is key to promote reflection [19] in an open climate where students can share their experiences and feelings playing the game.
- Educators can use this time after the activity to help

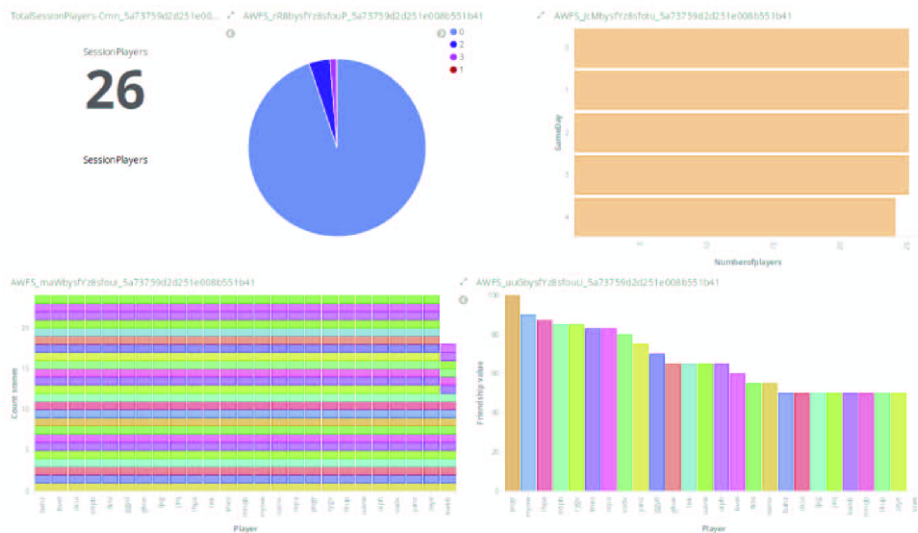


Fig. 2. Sample dashboard to show information for teachers while games are in play.

students link the game content to that of the real world and include additional information that complements the gameplay. For instance, if the purpose of the game is increase knowledge, educators may provide additional information required in the curricula and not covered in the game or review the key take-home pieces of information. In the case of games to change attitude or increase awareness, the postgame discussion can be used to go through the topics covered in the game, extract conclusions and compare the situations depicted in the game to those students were familiar with.

- A final option is to provide players with some exercises where they can apply the content they have learned with the game. These exercises may be written (e.g. tests, or even homework) or oral (e.g. role playing), and may even be used for assessment purposes.

As mentioned before, some ideas for this post-game activity may also be included in the educators' manual. For instance, in [20] teachers reviewed the key concepts of the game after the activity to ground learning and connect the game content with the curricula.

Fig. 3 summarizes educators' activities before, during and after the application of game in classes. Before, reading the educators' guide and playing the game; during the application, following students' in-game actions and progress with visual information, alerts and warnings; after gameplays, guiding the discussion and helping students relate the content of the game with the curricula.

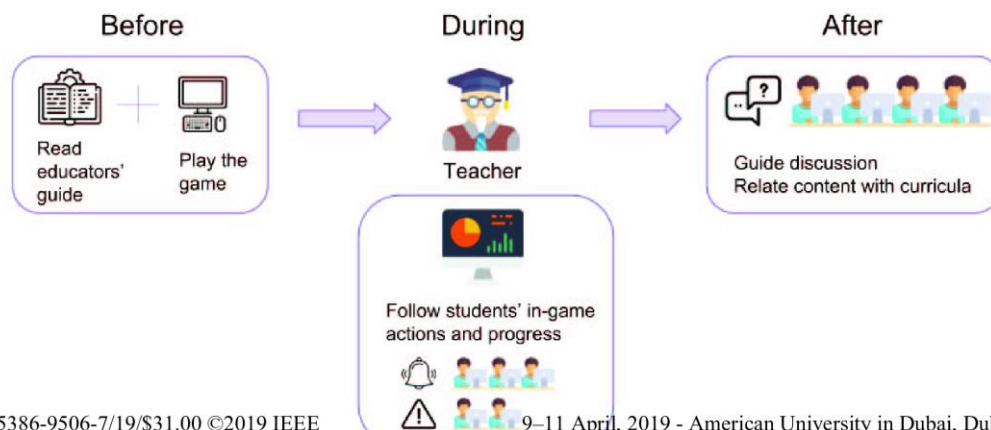
IV. STUDENTS EVALUATION BASED ON IN-GAME INTERACTIONS

A final step to simplify educators' tasks when applying games in education is that they are able to formally and automatically evaluate their students based on their actions playing the game. A commonly used method for students' evaluation follows the structure of that used when validating the game itself: players' knowledge is measured before and after playing with the pre-post questionnaires and the difference between the results in those tests shows how much students have learned playing. If the result obtained in the post-test is better than the one obtained in the pre-test, we can infer that students have learned something while playing the game. Although this is an effective method to evaluate learning, we consider that it is not that efficient. Players have

to complete two times the same questionnaire (as the pre-test and post-test contains the same set of questions to be able to compare them) in addition to playing the game, that is what students would most probably be willing to do. This method also restricts the time left to play the game as well as the time left after students have finished playing for educators to either discuss the game content or to provide additional information about the topic if needed. Also, the questionnaires themselves need to be prepared in advance which takes time and effort, and also educators need to carry out the evaluation itself going through all the results in both pre-tests and post-tests to actually assess students.

For all these reasons, we consider that this pre-post method can be improved by taking advantage of the power of learning analytics data collected from in-game interactions. Following some of the aspects of the work done on stealth assessment [21], our proposal is to predict students' knowledge after playing (as usually measured by the post-test) based on the actions players carry out in the game. To do this, the first step is to create the prediction models that take as input the interaction data and output as result the knowledge predictions. The game validation step provides a great opportunity to create models that can accurately predict post-test results based on data from players' interactions in the game. In this step, we actually have the results from the questionnaires, so we can train the algorithms and evaluate their performance against the actual data (for instance, applying cross validation, all data collected can be used both to train and test the prediction models).

Once we have developed accurate enough models and selected the most promising one, we can use it as the assessment method for students who play the already-validated game. In this case, the model created will again take as input the information from students' interactions in the game and predict students' knowledge after playing the game based on these interactions. This method avoids the need to further carry out the post-test: students complete the pre-test (if needed), then play the game and, after their gameplays are finished, they will automatically be given a score that represents their knowledge after playing. The obtained score will be the result of the prediction model applied to the input data received from the student's gameplay. It may also be required that the pre-test is included as input for the prediction model, so we can measure how much knowledge is learned based on the previous knowledge students have (provided by the pre-test). Ideally, we would like to avoid the pre-test as well, so



prediction models could predict the post-test score only based on interaction data. In this case, the time to play the game and the time left for the educator could be even further extended as neither the pre-test nor the post-test will need to be carried out.

As in the case of obtaining real-time information while games are applied in classes, the described approach with prediction models is based on the key fact that all collected data from students' interactions must follow a standard data format. This standard data format is used as the format for the inputs received in the prediction models. Again, in our proposal, we use the accepted standard xAPI-SG profile to capture interactions from the serious games. As long as game interactions captured follow this standard, we consider that our approach could be more generalizable than the approach of stealth assessments, as once the prediction models are created at the validation stage, no further game-specific features are required to be able to evaluate students

V. CONCLUSIONS

The presence of games in education can still be greatly enhanced and extended. Educators are key to promote the application of games in actual educational settings. However, it cannot be expected that educators are experts in the use of technology, so games need to be both transparent and reliable, and provide the necessary tools to simplify educators' task. First of all, games need to be formally validated with an accepted method. A common accepted validation is with pre-post experiments, as long as a valid questionnaire exists that measures the characteristics the game aims to promote. After the game to be used has been formally validated, educators need to fully understand the content and the mechanics to be able to effectively use it in their classes. Playing the game before their students and going through the game manual can help educators to have enough information about the game to effectively apply it in classes. When students are immersed in their individual gameplays, visual information can help educators to keep control of their progress and actions. Alerts or warnings can also be used to make educators aware of specific situations that may require their intervention. Finally, analysis of learning analytics data from in-game interactions can provide educators a means of assessing students without an external measurement but based on what they actually do in the game. Prediction models developed at the game validation stage can automatically provide an evaluation of students' knowledge after playing the game based on their interaction data.

However, this full process has some limitations and requirements that need to be considered. The application of learning analytics with serious games is still fragile as they are still too many sources of possible errors. First of all, the deployment of games in schools may deal with technology failures as not all schools have the same materials. The data collection process can also fail if interaction data tracking is done to an analytics system that relies on the schools' internet connection. The analytics system also needs to be reliable and be ready to handle the data collected, both in size and format. All these technologies issues make that the application of games in schools still requires some technical support and may restrict the application by educators on their own. Another restriction that needs to be taken into account when collecting data, and that is even more important if data

is from minors as it may frequently happen with serious games, is privacy and security. The data collected cannot contain any personal details about students, so the interaction data cannot be related to specific students. To ensure this, the analytics system should not retain the details about the students and all the data collected should be anonymized. To meet this requirement and ensure that information collected is still useful for educators, anonymous tokens can be given to students to use them as identifiers in the game and educators can keep the correspondence between tokens and students.

With all the steps described, we consider that educators' tasks when using games in education can be greatly simplified at all stages: from the initial games validation, actually applying games in classed in an effective and controlled way, and being able to assess students automatically based on their in-game actions. For all these steps, we consider that learning analytics data extracted from serious games is key to provide insight into students' actions when playing and simplify educators' application of games in class.

ACKNOWLEDGMENT

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6.7. Conectado in the classroom: applying a video game for the prevention of bullying at the school

6.7.1. Cita completa

A. Calvo-Morata, C. García-Diego, M. Freire, I. Martínez-Ortiz, B. Fernández-Manjón **Conectado in the classroom: applying a video game for the prevention of bullying at the school** in *ICERI2019 Proceedings*, pp. 1484-1493, doi: 10.21125/iceri.2019.0434

6.7.2. Resumen original de la publicación

Bullying and cyberbullying are very serious social problems with incidence in all countries regardless of language or culture. Videogames have proven to be an effective educational tool in different domains (p. ej. to raise awareness) and we consider that they can be used as bullying prevention tools for teachers in school. However, some teachers still feel uncomfortable using videogames as educational tools. We believe that this can be partly addressed by including educational guides together with the games. Conectado is a video game to raise awareness among 12 to 17-year olds about (cyber) bullying by placing the player in the role of a victim, thus creating empathy towards the victims. In this paper, we present the validation of a teachers' guide for Conectado, intended to simplify and facilitate its application in schools. We discuss the results of a survey of the perceived usefulness of the teacher's guide, and a case study of its actual application by teachers in a school in Madrid (Spain). These initial results provide insights from a real in-class use of the Conectado videogame and show that the guide was well accepted by teachers, as it simplifies the use and deployment of the videogame in their classrooms.

CONECTADO IN THE CLASSROOM: APPLYING A VIDEO GAME FOR THE PREVENTION OF BULLYING AT THE SCHOOL

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Abstract

Bullying and cyberbullying are very serious social problems with incidence in all countries regardless of language or culture. Videogames have proven to be an effective educational tool in different domains (e.g. to raise awareness) and we consider that they can be used as bullying prevention tools for teachers in school. However, some teachers still feel uncomfortable using videogames as educational tools. We believe that this can be partly addressed by including educational guides together with the games. Conectado is a video game to raise awareness among 12 to 17-year olds about (cyber) bullying by placing the player in the role of a victim, thus creating empathy towards the victims. In this paper, we present the validation of a teachers' guide for Conectado, intended to simplify and facilitate its application in schools. We discuss the results of a survey of the perceived usefulness of the teacher's guide, and a case study of its actual application by teachers in a school in Madrid (Spain). These initial results provide insights from a real in-class use of the Conectado videogame and show that the guide was well accepted by teachers, as it simplifies the use and deployment of the videogame in their classrooms.

Keywords: Serious Games, Secondary Education, Bullying, Cyberbullying.

1 INTRODUCTION

Bullying is a very serious social problem with incidence in all countries regardless of their language or culture. The victims of bullying commonly experience anxiety, fear, low self-esteem and may even suffer serious psychological disorders, including depression, suicidal ideation and suicides [1] [2].

The widespread use of electronic devices, social networks and the Internet, has made this problem grow even more as these tools allow new forms of violence such as cyberbullying [3]. Generally, cyberbullying is defined as bullying that is done through electronic devices. Both bullying and cyberbullying share many characteristics, including the effects and problems caused in the victims [4]; indeed, the main difference between them is the medium by which the aggression is carried out [5]. There are also studies that have found continuity between bullying at school and cyberbullying [6].

Despite the creation of very different prevention programs and other tools, many of which have demonstrated their positive effects, there is still much to do in terms of impact to significantly decrease the number of bullying and cyberbullying cases [7]. Thus, it is necessary to research and create new approaches. Note that although electronic devices are used for cyberbullying, they also allow the creation of new prevention tools, such as video games [8].

Serious games (SGs) have demonstrated advantages as educational tools in numerous studies and domains [9]. SGs are adequate for learning knowledge (e.g. mathematics, physics), change behaviours or to increase awareness about social aspects, such as drug addiction [10]. The videogames can also be effective bullying prevention tools for teachers to use in their classrooms. In the last two decades there have already been serious games aimed at preventing bullying and cyberbullying with different purposes, such as increasing empathy, teaching what bullying is, giving advice on how to deal with it, and/or showing ways to behave on the net to avoid it [11].

Even if when games meet all the educational requirements to be applied in classrooms, educators may not find their application that easy, nor have the time to analyse and internalize how to apply the game in their day-to-day activities. In many cases, educators are not familiar with the technology used in the game and do not feel confident with the actual games' deployment. Moreover, training for teachers may also be required to help them in the game administration, and provide guidance on what teachers and students should do while the game is in play.

Distrust of videogame use by teachers may be due to many different reasons, including low technological knowledge, lack of time to apply video games, not knowing how to use the game to support class goals, and/or lack of resources (e.g. computers, money) to use video games. To simplify their application, it is important not only to validate the effectiveness of a serious game but also its actual applicability in real settings. Moreover, it becomes essential to provide the necessary resources to facilitate games deployment in class as well as their adoption by teachers.

Conectado is a serious game to address (cyber) bullying, which aims to raise awareness among young people (12 to 17 years old) about of the consequences of their actions and how they can affect others, as well as to foster empathy towards the victims. In this way, Conectado provides a shared experience for the students, which can be put to good use during a teacher-led reflection session just after playing the game. During this session, teachers can converse with students to emphasize, for victims, the need to ask for help; or, for observers, the likely consequences of allowing bullying to continue unhindered. Conectado has already been validated with young people and teachers from different schools in Spain [12], [13]. Young people average a pre-test score of 5.72 (SD=1.26; scale of 1 to 7), compared to 6.38 (SD=1.11) in the post-test, a statistically-significant effect (paired Wilcoxon test yields p -value < 0.001). Teachers reported good opinions (84%) about the game, describing Conectado as a useful tool that can be applied in class to raise awareness among players and to create a subsequent discussion about bullying and cyberbullying. In order to address the teachers' issues about using Conectado, we have also developed a teachers' guide to help them to apply the video game effectively.

In this paper, we describe the validation of the Conectado teachers' guide. This guide is especially designed for teachers with an educational perspective. For instance, it clearly explains the objectives of the game and how it can be used to promote a fruitful discussion that will help students to reflect on bullying and cyberbullying from the events that they experience while playing it.

Section 2 presents the Conectado videogame and its teacher's guide. Section 3 describes the validation of the guide and how its usefulness has been evaluated. Section 4 analyzes the results obtained with the guide and finally, section 5 exposes the conclusions reached.

2 CONECTADO AS BULLYING PREVENTION LEARNING TOOL

Conectado is a videogame of the graphic adventure genre played in first person (so no need of an avatar that represent the player inside the game). The player, as main character, takes the role of a cyberbullying victim. The goals of Conectado is to make young people aware of bullying, as well as to create empathy towards the victims.

In the videogame, the players start in a new school, where they have to make new friends. Over five in-game days, players, in a safe way, experience what it means to be a victim of bullying. Within the video game, players experience the most common cyberbullying aggressions, such as social exclusion, insults, offensive nicknames, publication of manipulated images to humiliate and laugh at a person, offensive messages, theft of passwords and material objects, blackmail, etc.

Throughout the five in-game days, the player moves between school and home through different scenes. In each of these scenes, the player can interact with the other characters through dialogs. In addition to this, the players will receive messages and publications also on their in-game smartphone and social network. At the end of each day, the player experiences a different mini-game depicted as a nightmare of the main character. These mini-games do not end until the time is up or the player loses. In addition, nightmares are imbued in a dark atmosphere, and are related to the events that the player experienced during each in-game day. The mini-games does not allow the player to win, frustrating the player and transmitting a sense of impotence, a common feeling among bullying victims.

In many of the dialogs, the player can choose between several answers, which will make some of the dialogues and parts of the story change. However, in all variations, the player is finally bullied during the five days. These choices give players a feeling of freedom, making players believe that according to their actions the aggression problem can be solved. There are three possible game endings depending on the choices selected by the players. Only in one of these endings, in which the player asks for help, does the bullying end. The SG has been designed this way to transmit the idea that it is crucial and necessary to ask for help in case of bullying. Another of the endings is bitter (the bully is just expelled a few days); and the third one is bad (the player will continue to be harassed). Both the

dialogues and these mini-games are designed to convey negative feelings to the players in order to further increase empathy with victims.

The different roles involved in bullying are represented in Conectado through the main characters' classmates. Among these characters we find: Ana (f) and Alex (m) as bullies; Jose as an active assistant of the bullying; Ana and Guille as active defenders, who throughout the game become active followers and passive followers respectively; and Maria as a bystander. The parents of the player also appear in the game. The optional dialogs with the parents are important in order to reach the good end of the game, representing the importance of the relation with the family, since a bad relationship with the parents is a common risk factor.

To explain the different features of Conectado and how to take advantage of it in a class, we have created a teachers' guide. This guide aims to provide all the relevant information teachers may need to understand why it makes sense to use this video game to deal with bullying, what advantages it provides, and the different ways in which it can be used. The guide is structured as follows:

- S1. Introduction, a brief section about the topics covered in the guide.
- S2. Bullying and cyberbullying, a brief introduction about what they are and their effects.
- S3. Conectado, a section about the videogame and its goals.
- S4. Guidance for teachers, a brief section about the whys and hows of using Conectado in class. Also mentions how the guide has been structured.
- S5. The game days; this section provides a walk-through for each of the days of the videogame. For each day, the guide describes what happens in the game, what topics the day is about, and how to use this during a subsequent class discussion.
- S6. Discussion; a section about the key aspects of the game and how use it in class.
- S7. FAQs, a section with the most typical questions asked during the validation experiments.
- S8. Download and installation, where to download the game and how run it.
- S9. Bibliography and other resources, provides several web links and citations to other sources of information about others tools, serious games, and bullying in general.

Conectado has been designed and developed to be used in class, taking advantage of the characteristics of video games, providing teachers with an open and free prevention tool to deal with the bullying topic in class. In addition to the players' impact validation [12], Conectado has been validated as teacher tool too [13], receiving very good acceptance among teachers (present practitioners and students in teaching degrees). Now, it is important to test whether this guide actually helps teachers to better use the videogame in their classes and take advantage full advantage of the Conectado videogame. The guide has been developed to simplify the use of Conectado, and we have validate it with teachers and contrasted in a high school how teachers get by using the video game with the guide in class.

3 METHODOLOGY

To validate the teachers' guide, we carried out a survey on its clarity, usefulness and content. Twenty teachers from different schools took part in the survey. Additionally, to contrast its application in real scenarios, we carried out an observational experiment in a school in Madrid (Spain). In this experiment, the video game Conectado was applied in four different classrooms, two in their first year of secondary and two in their second year of secondary, with a follow-up session for discussion and reflection. During the experiment, a researcher observed how teachers applied the game, identifying possible problems and checking the extent to which teachers followed the teachers' guide in the subsequent discussion and reflection sessions with their students.

3.1 Guide validation

In order to validate the content of the guide, an online survey was passed on to 20 teachers of Secondary from different academic institutions. The answers were anonymous, and the survey was composed by 7 sections:

- 1 General information: questions about age range, gender, years teaching, use of video games and experience applying videogames in classes.

- 2 Time using the guide: section about how long they have taken to read the guide, what sections they have read and if they thought it was long.
- 3 Clarity: participants rate, on a 1 to 5 Likert scale, the degree to which the language and content of the different chapters of the guide is appropriate and clear.
- 4 Usefulness of the content as well as of the images that accompany each text. Also rated on a 1 to 5 Likert Scale.
- 5 Completeness of the content, to know if it is enough, more details are needed in certain sections, or on the contrary some are exceedingly verbose. Also evaluated on a 1 to 5 Likert scale.
- 6 Opinion on the guide and its usefulness (open response)
- 7 Verification that the respondent has read the guide and with what degree of detail. This section includes questions are about specific guide's content to check whether or not a certain topic or content is included in the guide.

With this survey we want to validate the content, the interest of the guide and if the teachers see it as a useful resource when using it together with the Conectado videogame.



Figure 1. The Conectado guide for teachers.

3.2 Conectado applicability

Conectado has demonstrated its acceptance among teachers and students of educational degrees and also its effectiveness. However, being a tool focused on its use in class, it is necessary to check if teachers are able to use it satisfactorily and if so, how. To this end, an experiment has been carried out in a secondary school in Madrid, Spain, where two classes of 1st Year of Secondary (12-13 years old) and two classes of 2nd Year of Secondary (13-14 years old) classes have used the game.

In order to verify, in a real scenario the applicability of Conectado, the school was provided with a web site to download the video game and the guide to apply it to 4 classes. The invitations to participate in the experiment declare the premises and requirements of the experiment:

- The high school could choose how to apply / use the game, when and how. In order to adequately perform the experiment only next two restrictions were established
- A researcher from the Conectado project had to be present playing and observer role.
- The application of the game had to be made by at least two different teachers. This will enable us to divide teachers in two separate groups where half will have access to the game guide but the other half will not.

In the end, the high school participating in the experiment decided to separate play and reflection sessions in different days. The play sessions were controlled by the tutors of each course. Each class played at a different time. Two of the tutors were given guidance week before, while the other two were not. This design intended to check if there were any differences when it came to run the class during the sessions. The reflection session was carried out by the counsellor of the high school to which the guide was also provided a week early and she had total freedom to structure the class with the activities and questions that he considered appropriate. The main researcher of the project was only an observer and supervised the sessions.

Section 4.2 describes how the sessions were conducted as they were the result of providing the video game to the school. These sessions are the object of study to check if Conectado is applicable by the teachers in class and if the guide is a useful resource for them when applying the video game.

4 RESULTS

The results of both, the surveys and the experiment about the use of Conectado in class, have been positive. We have been able to verify that teachers consider that the content of the guide is useful in helping them to apply the video game, although they think its duration is a little long. In addition, we also confirmed that teachers have been able to apply the video game by themselves, and that they have adapted the guide to make their own personalized reflection sessions with the students, while using the main ideas of the guide as a base. In Figure 2 the reader can see a schema of the different parts of the experiment that we will talk about below.

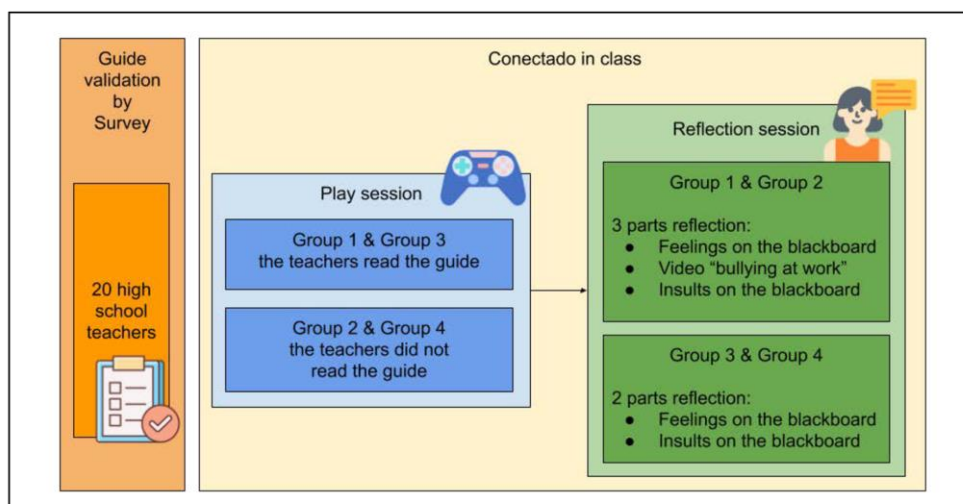


Figure 2. Schema of the experiments carried out by Conectado and its teachers' guide.

4.1 Guide usefulness

The survey has been fully answered by 20 people, 7 men and 13 women. Most of them are over 49 years old and only 3 are under 30 years old. All respondents have at least 2 years of teaching experience (N=20, M=18.45, SD=9.06). 65% of the teachers surveyed have never applied games in their classes. 6 of the respondents play video games (30%), one of them daily between 1 and 2 hours, the other 5 play between 1 and 4 hours a week, play puzzle games, arcade, strategy, shooter and mobile games.

The maximum time a respondent has taken to read the guide is 60 minutes (N=20, M=22.56, SD=23.73) having read most of the guide. The least read section is that of references and other resources. In contrast, the most read sections have been the guide for each day of the game (See Table 1). In general, the length is appropriate although 20% of respondents thought it was long. In terms of the language used, 90% thought it was appropriate and good.

On the other hand, the language seems to be clear in most of the guide, although 20% see the section on Conectado (S3) as unclear and 5% the sections on teacher orientation, each day and discussion (S4, S5 and S6). On the other hand, 80% think that the images accompany the text and are adequate, 10% do not see it clearly and 10% think that only part of the images do their goals.

Regarding the general opinion about the guide, 90% of respondents like it and only one of them (5%) is negative (speaking about the videogame) because they say that the approach does not seem right and that when playing the video game has not felt empathy for any of the characters. Another of the aspects asked in the survey were the miss or excess of the guide's topics. Teachers declared that, among the topics to be covered by the guide about the game, a 10% think that it is necessary to add a more detailed explanation about how to move and what to do in the game. Regarding theoretical issues, 20% asked to include explanations about the following topics: the motivations of the aggressors to behave like this; safe ways to use social networks; explanation of the importance of acting as passive role; a section on didactic methodology. Among the things to remove, 20% see the need to shorten the theoretical questions mentioned in the guide, change the end of the game and synthesize the text of the guide.

Table 1. Distribution of the guide's content reading level.

| | <i>Deep reading</i> | <i>Skim reading</i> | <i>No reading</i> |
|--------------------------------|---------------------|---------------------|-------------------|
| S1 - Introduction | 85% | 10% | 5% |
| S2 - Bullying | 85% | 15% | 0% |
| S3 - Conectado | 80% | 20% | 0% |
| S4 - Guidance | 80% | 20% | 0% |
| S5.1 – Day 1 | 95% | 5% | 0% |
| S5.2 – Day 2 | 90% | 10% | 0% |
| S5.3 – Day 3 | 95% | 5% | 0% |
| S5.4 – Day 4 | 85% | 15% | 0% |
| S5.5 – Day 5 | 90% | 10% | 0% |
| S6 – Discussion | 80% | 20% | 0% |
| S7 – FAQs | 80% | 20% | 0% |
| S8 – Download and Installation | 55% | 20% | 25% |
| S9.1 - Bibliography | 40% | 40% | 20% |
| S9.2 – Other Resources | 50% | 45% | 5% |

Finally, to check if they had read the guide and up to what level they remembered it, 9 questions were asked about it. Only 10% answered everything correctly and another 10% had less than 5 successes. The average of correct answers was 6.95 out of 9.

4.2 Conectado in Class

The high school that participated in the experiment had the freedom to decide how to apply the game and how to carry out a reflection session based on the students' experience when playing Conectado. As we have already mentioned, the school split the application of Conectado in two different sessions, the first one, a play session led by the tutors of each of the 4 classes that have participated and another reflection session with each of the classes led by the school counsellor, shortly after the play session. In all cases, less than a full week passed between the play session and the reflection session.

4.2.1 Play Session

The high school downloaded and installed the video game on all computers without external help and following only the instructions included in the guide. During the play sessions, there was a large difference between teachers who had access to the guide and teachers who did not. The two teachers who did not have access to the guide asked what to do quite often, while the two who had read the guide did not ask for help and also reported higher confidence. When students asked what to do in

classes where teachers had no access to the guide, their teachers asked either the observing researcher for help or asked another student. On the other hand, teachers with the guide did not need to ask the researcher for help, except in one case where a student closed the game by mistake and the session tutor asked this student to start over.

During the experiment, if a problem occurred and was not solved by the session's teacher, the session observer waited for two minutes before approaching the students to see if they could solve the problem alone. Except in the previously-mentioned case of the student who had closed the game, it was not necessary to help anyone since the students solved their problems themselves before the two minutes ran out, sometimes with the help of colleagues who were next to them.

4.2.2 Reflection Session

The school counsellor divided the reflection session into 3 activities, although in two of the four groups, due to lack of time, only two of the three activities were carried out. This can be seen on the right side of Figure 2.

The first of the three activities was focused on the videogame experience. The students were split into groups of between four and five students each (five groups total). Each group was given two sheets of paper. The first one included the question "What feelings did you experience while you were playing", leaving enough blank space to write down those feelings they experienced when playing *Conectado*. The second one included two questions, "What subjects are dealt with in the videogame?" and "What caught your attention the most?", leaving enough blank space again to write down the subjects dealt with in the game. In this second sheet, students were asked to provide specific cases, instead of simply writing down "bullying and cyberbullying". To speed up the process of collecting the feedback, groups were asked to follow additional instructions: in the first sheet, and within each group, each student had to write down one feeling and pass the sheet to the classmate on their left; and in the second sheet, after writing one item, they had to pass the sheet to their classmate to the right. The groups had 8 minutes to answer the three questions.

Once the time was over, both sheets of each group were put in common with the rest of the class, by choosing a spokesperson to read aloud what the group had written down. The researcher acted as an observer, and wrote down the main feelings on the blackboard by request of the school counsellor (see Figure 2).

Feelings of sadness, empathy, and anger appeared in all 4 classes; while loneliness, helplessness, and overwhelm appeared in 3 classes. The class with the lowest variety of feelings totalled 10, and the one with the most 16. Among the 4 classes, 36 different words appeared, among which are: sorrow, rejection, pity, nerves, distrust, intrigue, low self-esteem, anger, worry, fear, and frustration.

Regarding the topics that appear in the game, all classes mentioned bullying or cyberbullying; and among the things that were highlighted are lies, exclusion, insults, nicknames, bad jokes, hurting peers, stealing, violence, and the impact of bullying on third parties.

On the other hand, among the things that caught their attention the most are the way that the protagonist was treated, the nightmares that appear in the game, how the bully starts bullying because of a confusion on seating assignments with the bully on the first day of the game, how friends stop defending you in the middle of the game, not being able to defend yourself, and not being able to ask for help until the end of the game.



Figure 3. The observer taking notes about students' feelings on the board.

With all the words on the blackboard the counsellor began a reflection on how victims of bullying could feel in real life, highlighting all the negative feelings noted and how in real life a person can feel much worse time than in a game. On the other hand, in addition to this, she highlighted the importance of asking for help in case of being a victim or of offering it if situations such as those of the game are witness (cases which were also noted on another page).

The second part of the session in the two 1st Year of Secondary classes consisted of playing a video of a man who was being bullied at work. When the man gets home with his wife and children, he says that his day has gone well. The video ends with the fact that 75% of people who suffer from bullying do not mention it or ask for help. The video was used to compare it with the game, and to ask the students how they would act in such a case. In addition to seeing that bullying does not only happen in the school environment, but that it can happen in other places. This was not repeated in the 8th grade classes as the time was very tight, and the counsellor preferred to give more importance to the other two phases.

In the last part of the different sessions the students had to go out on the blackboard and write down the different insults they had been told over the last few years. Then they had to look at the blackboard and the counsellor asked some students how these words made them feel. The students highlighted feelings they had said before when talking about the game and how they had sometimes been made to feel that they were worthless as people. On the other hand, some students remarked that these insults are sometimes jokes between friends, and that they affect them in very different ways depending on the person who insults them and the overall context. Finally, they were given a video (<https://www.youtube.com/watch?v=uUEvKbk5-4E>) of a social experiment very similar to this last part, where students from a school wrote down the insults they had been told and how they felt, and where they finally had to say something they liked about a classmate. The video ends with the reflection that many times people insult and bring to light other people's defects very easily, while it appears to be harder to give deserved praise.

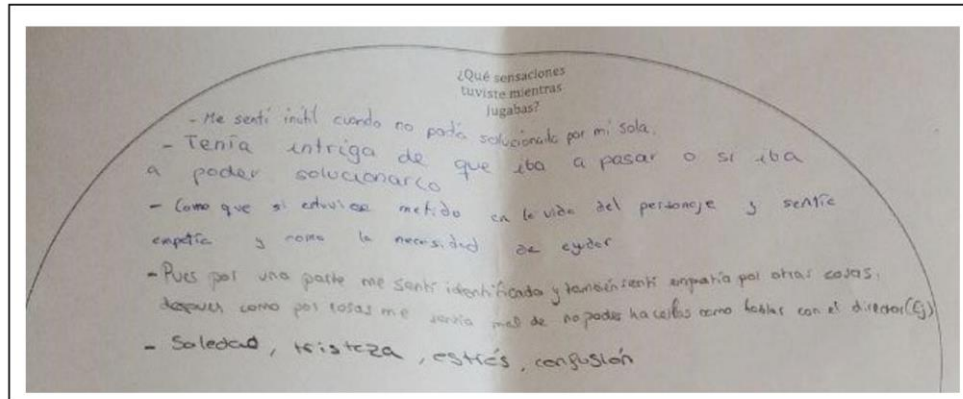


Figure 4. One of the sheets collected during the experiment.

5 CONCLUSIONS

This paper describes how the validation of the teacher's guide to the serious game Conectado has been carried out, and how the video game and guide have been put into practice at a high school in Madrid, Spain. Teachers perceived the guide as a useful resource and consider that it provides all the relevant and necessary information for the teacher who wants to apply Conectado in class. In addition, the described experiment has shown the need and usefulness of the guide in a real uncontrolled scenario as well as the applicability of the videogame. Although the game impact in students (increasing cyberbullying awareness) has already demonstrated in previous experiments, its utility and the good reception among teachers has not been proved until this experiment, where the need for a teacher's guide has been demonstrated. Furthermore, this experience makes it clear that although a game may be well perceived by education professionals, it is necessary to create training resources to help them with their application, in this case by means of a guide.

We also learnt how to improve the guide. For instance, we have to add instructions for cases where the player closes the game and at the request of the teachers we have already added sections where they can take notes if they print the guide. And we have been able to contrast how Conectado can be complemented with other activities to lead to reflection and combat bullying. In this case combining it with videos and group activities. However, one of the limitations of this study is that Conectado has been applied teacher led and in an uncontrolled manner but observed in only one high school. Though it should be noted that few serious games that are developed for use in class are associated with as many different experiments as Conectado, which has proven its effectiveness, acceptance and applicability in different ways.

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6.8. Game Learning Analytics, facilitating the use of serious games in the class

6.8.1. Cita completa

A. Calvo-Morata, C. Alonso-Fernández, M. Freire-Morán, I. Martínez-Ortiz and B. Fernández-Manjón, **Game Learning Analytics, Facilitating the Use of Serious Games in the Class** in *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, vol. 14, no. 4, pp. 168-176, Nov. 2019, doi: 10.1109/RITA.2019.2952296.

6.8.2. Resumen original de la publicación

Serious games are still complex to deploy in classrooms for average teachers. Game Learning Analytics can help teachers to apply serious games, using data from students' in-game interactions to provide learning information. Many teachers do not see games as tools to improve their classes, particularly due to perceived loss of control when using games; so it is essential to retain their benefits while avoiding most of the deployment complexity. In this paper, we describe our experience using Game Learning Analytics to encourage the application and deployment of Serious Games in class as learning tools.

Game Learning Analytics, Simplificando el Uso de Juegos Serios en la Clase

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Title— *Game Learning Analytics, Facilitating the Use of Serious Games in the Class*

Abstract— *Serious games are still complex to deploy in classrooms for average teachers. Game Learning Analytics can help teachers to apply serious games, using data from students' in-game interactions to provide learning information. Many teachers do not see games as tools to improve their classes, particularly due to perceived loss of control when using games; so it is essential to retain their benefits while avoiding most of the deployment complexity. In this paper, we describe our experience using Game Learning Analytics to encourage the application and deployment of Serious Games in class as learning tools.*

Index Terms— *serious games, learning analytics, game-based learning, educational data mining, stealth assessment*

I. INTRODUCCIÓN

Este trabajo es la versión en español del artículo publicado en IEEE-RITA, extendiendo el artículo publicado en la conferencia EDUCON 2019 [1]. En esta extensión, se ha incluido una nueva sección sobre casos de usos reales de aplicación de juegos serios, en los que se han puesto en práctica los pasos y las recomendaciones descritas en el artículo para fomentar la aplicación y simplificar el despliegue de juegos serios en la clase. Además, se han destacado algunas directrices para el uso de *Game Learning Analytics* (o analíticas de aprendizaje para juegos) y la aplicación de juegos serios como tareas para casa de los alumnos.

La naturaleza inmersiva y la atracción de los jóvenes hacia los juegos demuestra que estos son una herramienta prometedora y eficaz para el aprendizaje [2]. Este hecho ha aumentado el interés en los juegos serios, es decir, juegos cuyo propósito principal va más allá del entretenimiento [3]. Aunque normalmente su propósito principal es el aprendizaje de conocimiento, también existen juegos serios que buscan aumentar la concienciación, o cambiar actitudes o comportamientos [4]. Los juegos serios se han desarrollado para su aplicación en distintas áreas (como la educación o el campo militar), donde han demostrado ser herramientas de aprendizaje muy efectivas [5]; sin embargo, pocos juegos han pasado por un proceso de validación formal en el que se

verifique que cumplen los objetivos propuestos durante su diseño (como enseñar algún tema o mejorar alguna habilidad) [6]. Además, la mayoría de los juegos serios se han desarrollado o se han puesto en práctica en entornos controlados, donde el despliegue y la aplicación del juego se llevan a cabo por investigadores. Por tanto, son difícilmente escalables y aplicables en escenarios reales por personal no especialista. Un campo habitual de aplicación de los juegos serios es el ámbito educativo, donde los educadores utilizan los juegos como material adicional que proporcionan a sus alumnos para que jueguen durante la clase.

Sin embargo, llegado el momento de aplicar los juegos serios en sus clases, los educadores pueden sufrir diversos problemas (y no solo tecnológicos) que dificulten su tarea:

- Requisitos específicos de la tecnología o plataforma: algunos juegos requieren una plataforma específica como Android o MS Windows; y/o dispositivos especiales. No todos los centros educativos pueden cumplir estos requisitos tecnológicos que permitan aplicar los juegos con éxito.
- Duración media de juego: es importante distinguir si un juego está diseñado para utilizarse en una sesión corta de una o dos horas, o si está diseñado para utilizarse en varias sesiones durante el curso. Si la duración pretendida del juego es tal que no puede ajustarse a una sola sesión de clase, el diseño del juego deberá incluir dinámicas que faciliten la continuación del juego entre diferentes sesiones.
- Adaptación para usuarios con habilidades o necesidades especiales: por ejemplo, en el caso de un juego geolocalizado, si hay estudiantes con diversidad funcional físico motora, es posible que los educadores tengan que adaptar el juego, o incluso puede que su aplicación deba ser descartada por completo.
- Número de dispositivos: el número de dispositivos disponible para que los estudiantes jueguen puede ser limitado, y el juego puede no ser efectivo si se juega en grupo.
- Habilidad insuficiente con los videojuegos: los educadores pueden verse sobrepasados por sus estudiantes en cuanto al uso de tecnologías en general, y de videojuegos en particular, sintiéndose en ese caso

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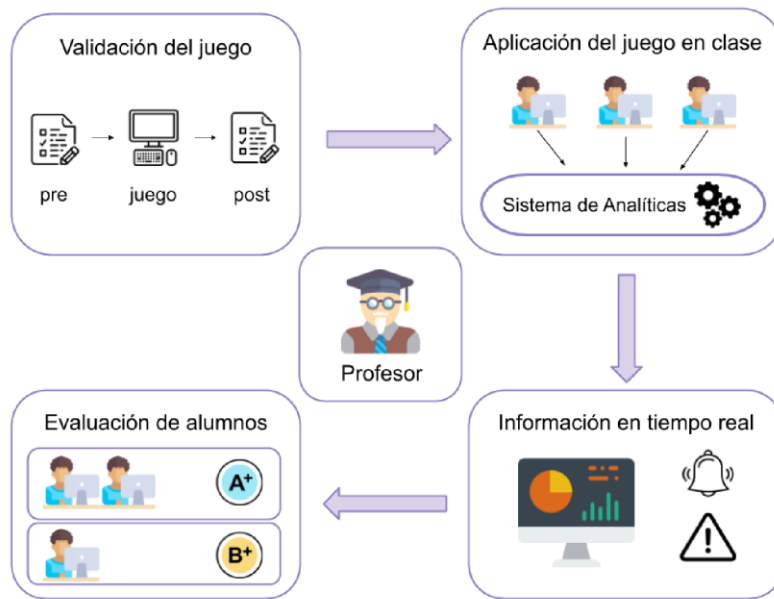


Fig. 1. Interacción de los profesores con los juegos serios: desde la validación del juego, su aplicación en clase, obtención de información en tiempo real y evaluación de sus estudiantes.

incapaces de mantener el control de la clase.

Incluso si el juego cumple todos los requisitos para su aplicación en la clase, los educadores pueden encontrar dificultades en esa aplicación. Por ejemplo, los educadores pueden no estar familiarizados con la tecnología requerida por el juego, y pueden no sentirse seguros con su despliegue en clase.

Puede ser necesario formar al profesorado y proporcionarles herramientas que les ayuden a aplicar los juegos en clase, así como indicarles las directrices sobre qué deben hacer tanto educadores como alumnos cuando estén utilizando el juego. Además, puede ser difícil para los educadores saber qué están haciendo los estudiantes mientras juegan, si están realmente aprendiendo o no, o cómo aplicar el juego en sus clases de manera adecuada para que sean más efectivos.

Para evitar estos problemas, es esencial que los desarrolladores de los juegos y los investigadores tengan en cuenta las necesidades específicas de los educadores durante las etapas de diseño y desarrollo de los juegos y que, además, intenten hacerlos más cercanos y accesibles a sus habilidades y conocimientos. En este sentido, los educadores no deberían necesitar ser expertos ni en juegos ni en tecnología para poder utilizarlos de manera efectiva. Asimismo, deberían saber qué están haciendo los estudiantes en cualquier momento en el juego, además de obtener información acerca de si están aprendiendo o no. Por otro lado, el juego debería cubrir los objetivos educativos bajo los que fue diseñado, de tal forma que los educadores puedan estar seguros de que dejar que sus estudiantes jueguen en clase es una actividad de aprendizaje adecuada. La consecución de todos estos condicionantes facilitaría la adopción de juegos serios por parte de los profesores y educadores.

Aunque se ha demostrado que el uso de juegos en clase beneficia a los estudiantes, esto no quiere decir que estos deban ser los únicos usuarios a tener en cuenta. Para

promover el uso real de juegos en educación y que sean más efectivos, consideramos que es necesario aplicar un enfoque global, donde los educadores también sean una parte esencial ya que ellos controlan lo que ocurre en las clases y por tanto son los que deciden si van a aplicar juegos en ellas o no. Por ello, el que los educadores realmente entiendan y sepan cómo aplicar los juegos de manera efectiva puede afectar en gran medida o incluso determinar si un juego es aplicado en clase. Por tanto, consideramos que los educadores deben tener un rol activo en el ciclo de vida completo de estos juegos serios: desde su origen y diseño, validación inicial, aplicación en sus clases obteniendo información en tiempo real sobre su progreso y resultados, y la evaluación automática de los estudiantes basada en sus acciones en el juego. El rol de los profesores necesita ser activo en todas las fases, cuidando de los aspectos pedagógicos: planificando la sesión, mientras los alumnos juegan y después de completar las sesiones de juego [7].

Para proporcionar información que ayude a los educadores a entender que sucede mientras los alumnos juegan, es posible recoger datos de las interacciones que realiza el jugador, aportando una visión más amplia sobre las acciones de los estudiantes en el juego. Los datos de *Learning Analytics* o analíticas de aprendizaje para juegos (también llamados *Game Learning Analytics*) pueden recogerse y analizarse para evaluar, validar y mejorar los juegos, pero también para ayudar a que los educadores eviten algunos de los problemas mencionados anteriormente.

El campo de *Game Learning Analytics* (GLA) se construye a partir de dos campos diferentes: *Game Analytics* (o analíticas de juego) y *Learning Analytics* (o analíticas de aprendizaje). El primero de ellos trata de la recogida de interacciones de jugadores con juegos en general, normalmente con el objetivo de medir la participación de los

jugadores y la aceptación de los juegos [8]. Por otro lado, el segundo se centra en entender los procesos que siguen los jugadores/estudiantes cuando interactúan con diferentes sistemas de aprendizaje (como los cursos online masivos y abiertos -MOOCs- o los sistemas de gestión de aprendizaje -LMS-) [9]. El objetivo principal de los estudios que utilizan GLA es la evaluación de los jugadores, para diferentes usuarios, aunque su aplicación incluye objetivos muy diversos como la clasificación de los estudiantes por perfil [10].

La aplicación de GLA no disminuye la importancia del rol de los educadores durante la actividad, sino que la modifica del mismo modo que la actividad de aprendizaje también cambia [11]. Por tanto, la tecnología debe simplificar y no obstruir su trabajo en todas las fases del proceso: desde la validación inicial de los juegos, hasta la aplicación en clases donde se recogen datos en un sistema de analíticas para obtener información en tiempo real que muestre qué están haciendo los estudiantes mientras juegan, y, finalmente, ser capaces de evaluar a los estudiantes basándose en sus acciones en el juego.

La Fig. 1 resume estas etapas en las cuales los educadores o profesores se sitúan en el centro del proceso. Téngase en cuenta que el educador debería estar también involucrado en todas las etapas del diseño y desarrollo de un juego serio.

En las secciones siguientes, revisamos todas las etapas del ciclo de vida de un juego serio diseñado para su uso en clase, centrándonos en las tareas de los educadores y en cómo los datos de *Game Learning Analytics* pueden simplificar su uso de esta tecnología en las clases. El resto de este artículo está estructurado de la siguiente forma. La Sección 2 describe algunas de las consideraciones y pasos para validar formalmente los juegos serios. La Sección 3 se centra en la aplicación de juegos en clases, incluyendo qué deben hacer los educadores antes para preparar la actividad, qué información pueden obtener mientras los juegos se están aplicando, y qué tienen que hacer después de que la aplicación se ha terminado. La Sección 4 propone una aplicación adicional en la que los datos de analíticas de aprendizaje pueden utilizarse para ayudar a los educadores a evaluar a los estudiantes basándose en sus interacciones con el juego. En la Sección 5, se revisan tres escenarios en los que hemos utilizado juegos serios para los usos descritos en las Secciones 2, 3 y 4. Finalmente, la Sección 6 resume las conclusiones principales de nuestro trabajo y señala algunas limitaciones.

II. VALIDACIÓN FORMAL DE JUEGOS SERIOS

Para asegurar que los juegos cumplen sus objetivos educativos, el primer paso es que sean validados formalmente. La manera más ampliamente aceptada y comúnmente utilizada de validar los juegos serios es la realización de los experimentos pre-post que consisten en tres fases: primero, los estudiantes completan un cuestionario antes de jugar (pre-test), a continuación los estudiantes juegan al juego de principio a fin, y finalmente, después de completar el juego, rellenan un cuestionario final (post-test) [12]. El pre-test y el post-test habitualmente contienen un mismo (sub)conjunto de preguntas. El objetivo es que estos cuestionarios evalúen a los jugadores antes y después de jugar en relación a una o varias características, las cuales dependen

del propósito del juego serio incluyendo, por ejemplo, conocimiento, actitud o conciencia. Los resultados en ambos cuestionarios se comparan posteriormente para determinar si el aumento en la característica específica del jugador es estadísticamente significativo. Si es así, dado que entre ambas mediciones la única intervención es el juego, se puede concluir que el aumento en dicha característica se debe al efecto del juego y, por tanto, el juego queda formalmente validado. Hay múltiples ejemplos en la literatura que utilizan esta metodología para validar juegos serios, incluyendo, por ejemplo: un juego para niños con autismo para aprender emociones [13], un juego para pacientes para gestionar el dolor después de una cirugía [14] o un juego para aumentar la conciencia sobre el acoso y el ciberacoso [15].

También es importante tener en cuenta la forma en la que el juego va a ser jugado y en qué plataformas, tanto en la fase de diseño como en la de validación del juego. No todos los centros educativos tienen acceso al mismo tipo de dispositivos ni en la misma cantidad. Por ejemplo, habrá casos en los que el educador necesitará juegos para dispositivos móviles y que se puedan jugar en pareja, en otros casos necesitará que sean para ordenador y jugados individualmente.

En la fase de validación, los cuestionarios proporcionan una medida de cuánto saben los estudiantes acerca de un tema antes y después de jugar al juego. Para asegurar la equidad y mejorar el proceso de validación, los investigadores deben entregar a los profesores los resultados y la información sobre cómo evaluar la efectividad del juego. El pre-test puede servir como punto de partida para luego comparar con el post-test, pero también puede utilizarse como un cuestionario de evaluación para medir el conocimiento del tema de los jugadores/estudiantes. Después de jugar, el post-test puede mostrar a los educadores el efecto de la aplicación del juego y cuánto saben los estudiantes después (y, si el juego es efectivo, también cuándo han aprendido los estudiantes jugando). La validación propiamente puede ser llevada a cabo de manera sencilla durante una sesión de clase en la que los educadores entreguen los cuestionarios a los alumnos antes y después de jugar el juego y recojan sus resultados.

Si es posible, la validación del juego debería realizarse en todas las plataformas posibles con las que sea compatible. Por ejemplo, no es igual jugar en una tableta que en un ordenador, y esta diferencia puede tener un efecto en el aprendizaje y la experiencia del jugador final [16].

El proceso de validación descrito, sin embargo, asume que existe un cuestionario aceptado que mide la característica específica (por ejemplo, conocimiento) que cubre el juego. Pero esta suposición puede fácilmente no cumplirse, ya que existen pocos cuestionarios validados o que se hayan creado para juegos serios [17]. Si no existe un cuestionario aceptado para validar el juego, la complejidad del proceso aumenta ya que, antes de nada, el cuestionario debe crearse y también validarse. Una vez que el juego ha sido formalmente validado, puede aplicarse en otras clases ya que se ha probado que es efectivo.

En este proceso de validación, las analíticas de aprendizaje para juegos (GLA) pueden aportar una visión más amplia sobre los progresos y los resultados de los jugadores. Los datos recogidos de las interacciones de los usuarios con el juego pueden ayudar a mejorarlo y a validar el diseño del

juego; por ejemplo, encontrando errores, destacando aspectos a mejorar, y comprobando que el tiempo para completar el juego y las interacciones están alineadas con las expectativas de los desarrolladores. Para este propósito, la herramienta Simva [18], [19] puede ser de gran ayuda, ya que fue creada para facilitar estos experimentos de validación con juegos serios. Entre sus características, Simva gestiona la creación de los cuestionarios y su asignación a clases de estudiantes, la creación y anonimización de los estudiantes, y la recogida y almacenamiento tanto de los cuestionarios como de los datos de interacciones con el juego.

III. APLICACIÓN DE JUEGOS EN CLASE

Después de la fase de validación formal, el juego serio se aplicará en escenarios reales. Estos escenarios pueden incluir, por ejemplo, que el juego se utilice como deberes o como una actividad adicional y opcional a realizarse en casa. Otra posibilidad es que los juegos se utilicen como una herramienta de aprendizaje en una sesión de clase con al menos un educador supervisando la actividad. Si el juego se juega con conexión a internet y enviando datos a un sistema de analíticas, los educadores pueden recibir información una vez que las partidas se hayan completado. Esta información puede incluir si los estudiantes han aprendido o no, si han tenido algún problema jugando o incluso puede servir para evaluar a los estudiantes en base a sus acciones en el juego.

Como tarea para casa, el juego puede utilizar GLA para enviar al profesor un informe del progreso de cada usuario, de tal forma que el profesor sepa qué estudiantes han jugado y/o completado el juego. En este escenario, la información relevante de GLA puede incluir los problemas más comunes o las fases en las que los estudiantes se han detenido, el tiempo total que han jugado, o los resultados o aprendizaje que han conseguido. La aplicación de GLA en estos casos permite al profesor conocer el progreso de sus estudiantes en todo momento si tienen internet en casa.

A la hora de aplicar los juegos en clase, es esencial que los educadores tengan un conocimiento detallado del contenido y de las mecánicas del juego que se están aplicando. Como punto de partida, sería ideal que los educadores hayan jugado al juego antes de aplicarlo con sus estudiantes. Aunque algunos puedan no considerarlo útil, ya que normalmente no formarán parte del público objetivo del juego, el hecho de jugar el juego puede aportarles mucha información sobre las situaciones a las que se enfrentarán sus estudiantes cuando jueguen. Aunque consideramos que jugar al juego es esencial, solo jugando puede que los educadores no obtengan toda la información sobre el propósito de cada parte del juego, las decisiones de diseño, etc. Para complementar la experiencia de juego, es extremadamente conveniente que exista un manual del juego para los educadores, de tal forma que puedan tener todos los detalles del juego para simplificar su aplicación en clase y, además, también para mostrarles las razones que justifican el diseño de juego y las mecánicas. El manual para los educadores puede cubrir, entre otros aspectos: las instrucciones para descargar (si es necesario) e instalar el juego; requisitos para su aplicación; objetivos que el juego pretende conseguir; detalles sobre el contenido del juego (por ejemplo, niveles o días en el juego, retos o tareas a completar, minijuegos incluidos, personajes incluidos, soluciones o pistas de retos incluidos en el juego, etc.); información adicional sobre la temática general que trata el juego (por ejemplo, para utilizarse en una discusión con los estudiantes después de jugar, o para aportarles información adicional complementaria al contenido del juego); instrucciones para los estudiantes; una lista de preguntas frecuentes a la hora de aplicar el juego, etc. Algunos ejemplos de la literatura en los que los educadores han recibido un manual a la hora de aplicar juegos en clase para ayudarles en sus tareas son [20] o [21].

Una vez que los educadores se han familiarizado con el contenido y las mecánicas del juego, se habrá logrado un

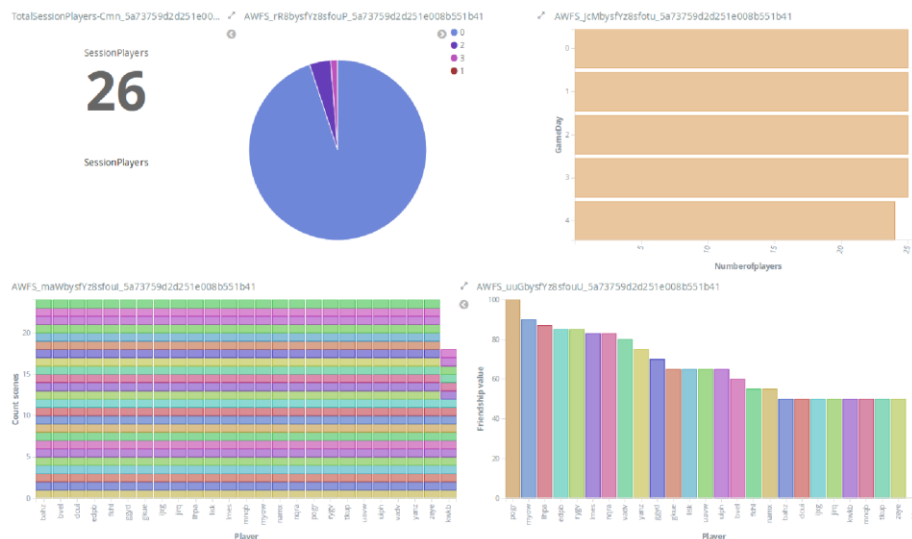


Fig. 2. Ejemplo de cuadro de mandos mostrando información para los profesores mientras los juegos se utilizan en clase.

primer paso para simplificar la tarea de los educadores aplicando juegos. A partir de este conocimiento, será ahora mucho más sencillo para ellos aplicar el juego en sus clases, ayudando a los estudiantes que lo necesiten y siendo conscientes de a qué se están enfrentando sus alumnos en el juego. Sin embargo, puede ser necesario un paso más para que los educadores mantengan el control de lo que ocurre en sus clases cuando aplican juegos. Como los estudiantes normalmente jugarán de manera individual, cada estudiante estará pasando por diferentes situaciones en cada momento, de tal forma que será difícil para los educadores saber qué está haciendo cada estudiante en un momento dado, o que el apoyo que puedan dar durante la sesión de juego no pueda ser efectivo debido a la falta de contexto en las acciones llevadas a cabo por el estudiante. Esto puede reducir la confianza de los educadores a la hora de aplicar juegos en sus clases, ya que pueden sentir que pierden el control de lo que hacen sus estudiantes. Para evitar esta percepción, es esencial que los educadores obtengan una información suficientemente completa mientras los estudiantes juegan.

Cuando se recogen datos de interacción, debe asegurarse también la equidad. Si los desarrolladores o investigadores están recogiendo datos para mejorar el diseño o el despliegue del juego, también los usuarios finales involucrados en este proceso, principalmente los educadores y los estudiantes, deben obtener un beneficio claro del uso de esta tecnología. Por tanto, los estudiantes deben obtener una experiencia de aprendizaje mejor y más auténtica, mientras los profesores deben mantener el control de sus estudiantes obteniendo información en tiempo real sobre cómo están jugando al juego o incluso datos que puedan contribuir a su evaluación final. Para los estudiantes, la equidad también puede asegurarse si las oportunidades educativas se otorgan de acuerdo a los niveles de habilidad de los estudiantes [22].

A. Información en tiempo real para los educadores

Un paso más para simplificar la tarea de los educadores cuando aplican juegos en los centros educativos es asegurar que no pierden el control de sus estudiantes mientras estos juegan. Una forma sencilla de dar información a los educadores sobre lo que están haciendo los estudiantes en sus partidas de juego es con algún tipo de representación gráfica que agregue todos los datos de analíticas de aprendizaje para juegos (GLA) que se recogen de la partida de cada estudiante. Esta información visual puede mostrarse como un cuadro de mandos, donde se combinan varias visualizaciones para proporcionar una visión general de la clase. También es útil si este cuadro de mandos puede filtrarse por estudiante, de tal forma que los educadores también puedan ver información de estudiantes concretos u obtener información más detallada sobre algún alumno en particular, en caso de ser necesario. El cuadro de mandos debe recolectar los datos de las interacciones de los estudiantes con el juego y mostrar la información derivada de estos datos en tiempo casi-real de tal forma que los educadores puedan ver la situación actual de sus estudiantes. La información mostrada puede incluir: en qué parte del juego están los estudiantes en cada momento, caminos elegidos, progreso, acciones en el juego, respuestas, puntuaciones, tiempos, completitud, etc. Por ejemplo, la Fig. 2 muestra un cuadro de mandos de ejemplo para profesores incluyendo (de izquierda a derecha, y de arriba a abajo):

número total de jugadores activos, para verificar que todos los estudiantes están jugando; porcentaje de jugadores que han alcanzado cada final del juego, para saber si todos han llegado al final más deseable o no, lo que puede depender de sus acciones en el juego; número de jugadores que han pasado por cada día en el juego, para saber el progreso general de la clase en cuanto a número de niveles o días completados en el juego; número de escenas completadas por cada jugador, para saber el progreso concreto de cada estudiantes; y el valor de una métrica del juego (por ejemplo, nivel de amistad con un personaje del juego) para cada estudiante, lo que puede proporcionar una visión más profunda sobre las acciones tomadas en el juego.

Un mecanismo adicional que puede ayudar a los educadores mientras aplican juegos, son los mensajes de alerta o aviso [23]. Estos mensajes se pueden configurar antes de la sesión de juego (o estar pre-configurados por el equipo de desarrollo del juego) de tal forma que estén definidas las condiciones bajo las cuales cada alerta o aviso específico se activará. Cuando están condiciones se cumplan, el mensaje de alerta o aviso se mostrará al educador, junto con el identificador del estudiante que lo ha activado. Con estos mensajes definidos, puede notificarse a los educadores en tiempo casi-real cuando ocurran situaciones específicas que puedan requerir su atención inmediata. Este sistema puede utilizarse tanto para que los educadores ayuden a los estudiantes que encuentren problemas en sus partidas y no puedan continuar, como para que proporcionen tareas adicionales a aquellos estudiantes que avancen demasiado rápido y terminen el juego antes de lo esperado. Este método mejora también la equidad ya que todos los estudiantes, independientemente de su velocidad o habilidad particular para completar el juego, pueden beneficiarse de la actividad sin perder tiempo quedándose atascados en el juego o terminándolo demasiado pronto.

No obstante, para poder implementar el mecanismo de apoyo anteriormente descrito, es necesario que las interacciones llevadas a cabo por los estudiantes en el juego necesitan recogerse siguiendo algún formato de datos estándar que se pueda usar para definir y poblar las visualizaciones. En nuestra propuesta, utilizamos el perfil de Experience API para juego serio (xAPI-SG) [24] que estandariza la colección de datos para interacciones realizadas en juegos serios. Siguiendo las definiciones de este perfil, es recomendable proporcionar un conjunto de visualizaciones por defecto para profesores que cubra los escenarios más comunes sin que requiera información adicional ni configuración por parte de los profesores [25].

B. Actividades después del juego

Cuando se aplican juegos en clase, es también muy recomendable dejar algún tiempo después de las partidas para los educadores. Así, después de que los estudiantes hayan completado sus partidas en el juego, los educadores pueden plantear una actividad posterior a la intervención. Cada juego puede tener una actividad posterior asociada con él, dependiendo de su objetivo. Es importante que los juegos proporcionen las herramientas necesarias para que los profesores puedan sacarles provecho y relacionarlos con el contenido curricular:

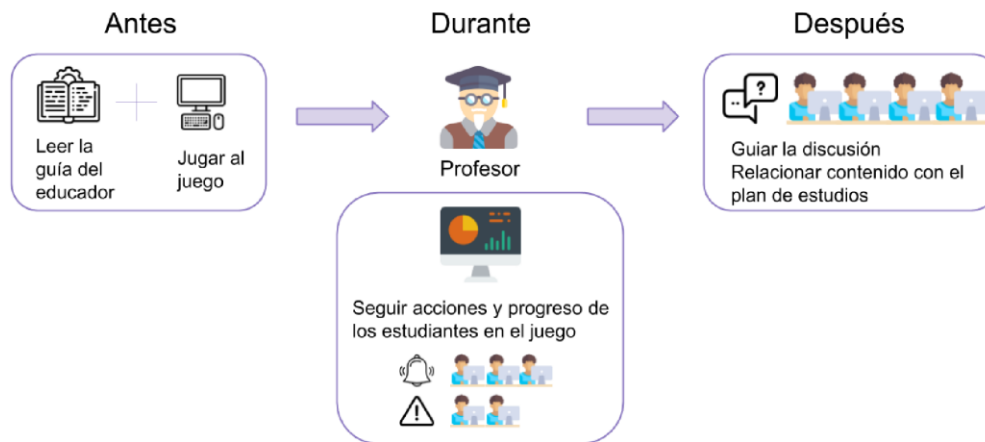


Fig. 3. Actividades de los profesores antes, durante y después del uso de juegos en sus clases.

- La actividad posterior al juego puede ser una simple discusión o sesión de seguimiento, de tal forma que el juego es la herramienta que causa esa discusión. Esta discusión en clase después del juego es esencial para promover la reflexión [26] en un clima abierto en el que los estudiantes puedan compartir sus experiencias y sentimientos jugando al juego.
- Los educadores pueden utilizar este tiempo después de la actividad para ayudar a los estudiantes a relacionar el contenido del juego con el mundo real e incluir información adicional que complemente la partida. Por ejemplo, si el propósito del juego es aumentar el conocimiento, los educadores pueden proporcionar información adicional requerida en el plan de estudios y no cubierta en el juego, o revisar los principales aspectos que deben recordar. En el caso de juegos para cambiar actitud o crear conciencia, la discusión posterior al juego puede utilizarse para revisar los contenidos del juego, extraer conclusiones y compartir las situaciones mostradas en el juego con aquellas con las que los estudiantes estén familiarizados.
- Los educadores pueden proporcionar a los jugadores algunos ejercicios en los que puedan aplicar el contenido que han aprendido en el juego. Estos ejercicios pueden ser escritos (por ejemplo, un test o tareas para casa) u orales (por ejemplo, algún juego de rol), y pueden incluso utilizarse para evaluación.

Como se ha mencionado anteriormente, el manual para los educadores puede incluir algunas ideas para esta actividad posterior al juego. Por ejemplo, en [27] los profesores revisaron los conceptos clave del juego después de la actividad para fijar el aprendizaje y conectar el contenido del juego con el plan de estudios.

La Fig. 3 resume las actividades de los educadores durante las diferentes fases: antes, durante y después de la aplicación de juegos en clase. Antes de jugar al juego los educadores leen la guía para los educadores y juegan al juego; durante la sesión supervisan las acciones de los estudiantes en el juego y su progreso mediante elementos visuales, alertas y avisos; y después del juego guían la discusión y ayudan a los estudiantes a relacionar el contenido del juego con el plan de

estudios.

IV. EVALUACIÓN DE LOS ESTUDIANTES BASADA EN INTERACCIONES CON EL JUEGO

El último paso en la aplicación de los juegos serios por parte de los educadores, es el relativo al uso de los juegos serios como herramienta de evaluación formal y automática de sus estudiantes en base a sus acciones en el juego. Un método habitualmente utilizado para evaluar a los estudiantes sigue la misma estructura que el utilizado a la hora de validar el juego: el conocimiento de los jugadores se mide antes y después de jugar, con los cuestionarios pre- y post-, y la diferencia entre los resultados en ambos cuestionarios muestra cuánto han aprendido los estudiantes mientras jugaban. Si el resultado obtenido en el post-test es mejor que el obtenido en el pre-test, podemos inferir que los estudiantes han aprendido mientras jugaban al juego. Aunque este es un método efectivo para evaluar el aprendizaje, consideramos que no es eficiente. Los jugadores tienen que completar el mismo cuestionario dos veces (ya que el pre-test y el post-test contienen el mismo conjunto de preguntas para poder compararlos) – además de jugar al juego, que es lo que la mayoría de estudiantes preferirían hacer antes que rellenar cuestionarios. Este método también restringe el tiempo para jugar al juego, así como el tiempo que queda después de que los estudiantes hayan terminado de jugar para que los educadores comenten su contenido o proporcionen información adicional sobre el tema en caso de ser necesario. Además, los cuestionarios deben prepararse por adelantado, lo que requiere tiempo y esfuerzo, y todos los resultados en ambos pre-test y post-test tienen que revisarse para evaluar a los estudiantes.

Por todas estas razones, consideramos que el método de pre-post puede mejorarse utilizando los datos de analíticas de aprendizaje recogidos de las interacciones en el juego. Siguiendo algunos de los aspectos que se han realizado en el campo del *stealth assessment* (o la evaluación no disruptiva) [28], nuestra propuesta consiste en predecir el conocimiento después de jugar (como habitualmente se mide con el post-test) basado en las acciones que los jugadores llevan a cabo

en el juego. Para hacer esto, el primer paso es crear los modelos de predicción que tomen como entrada los datos de interacción y den como resultado una predicción del conocimiento del estudiante. La fase de validación del juego proporciona una gran oportunidad para crear los modelos que puedan predecir de manera precisa los resultados del post-test basándose en los datos de las interacciones de los jugadores con el juego. En esta fase, tenemos los resultados reales de los cuestionarios, de tal forma que podemos entrenar los algoritmos y evaluar su precisión con los datos de validación (por ejemplo, aplicando validación cruzada, todos los datos recogidos pueden utilizarse tanto para entrenar como para validar los modelos predictivos).

Una vez que hayamos desarrollado modelos suficientemente precisos, y seleccionado el más prometedor, podemos utilizarlo como método de evaluación para los estudiantes que jueguen al juego una vez validado. En este caso, el modelo creado tomará de nuevo como entrada la información de las interacciones de los estudiantes con el juego y a partir de ellas creará una predicción del conocimiento de los estudiantes después de jugar. Este método evita tener que realizar de nuevo el post-test: los estudiantes completan el pre-test (si es necesario), a continuación juegan al juego y, una vez que han terminado de jugar, recibirán automáticamente una puntuación que representa su predicción de conocimiento después de jugar. La puntuación así obtenida será el resultado de aplicar el modelo predictivo a los datos recibidos de la partida del estudiante. Puede ser también necesario incluir el pre-test como entrada del modelo de predicción, lo que permite medir cuánto conocimiento se ha obtenido basado en el conocimiento anterior de los estudiantes, medido con el pre-test. Idealmente, también buscaremos evitar el pre-test, para que los modelos de predicción puedan predecir la puntuación en el post-test basándose únicamente en los datos de interacción. En este caso, el tiempo para jugar el juego y el tiempo restante para el educador pueden extenderse aún más ya que no será necesario realizar ni el pre-test ni el post-test.

Como en el caso de obtener información en tiempo real mientras los juegos se aplican en clase, la propuesta descrita con modelos de predicción se basa en el hecho clave de que todos los datos recogidos de las interacciones de los estudiantes deben seguir un formato de datos estándar. Este formato de datos estándar se utiliza como el formato para la entrada recibida en los modelos de predicción. De nuevo, en nuestra propuesta, utilizamos el perfil aceptado y estandarizado de xAPI-SG para capturar las interacciones de juegos serios. Siempre que las interacciones con el juego se capturen siguiendo este estándar, consideramos que nuestra propuesta podría ser más generalizable que la evaluación no disruptiva, ya que una vez que los modelos de predicción se han creado en la etapa de validación, no se requiere ninguna característica específica del juego para poder evaluar a los estudiantes.

V. CASOS REALES

Como se ha visto en las secciones anteriores, los educadores tienen un papel clave que afecta al diseño, desarrollo y despliegue de los juegos serios. Su papel es especialmente relevante para aquellos juegos enfocados a utilizarse en clase, ya que los educadores son los que van a

decidir si los utilizan o no como herramienta de aprendizaje para sus estudiantes. En esta sección, describimos tres experiencias en las que hemos puesto en práctica los diferentes puntos expuestos anteriormente en escenarios reales con dos juegos serios distintos. El primer juego serio utilizado es *Conectado*, una aventura gráfica que pone al jugador en la piel de una víctima de ciberacoso con el objetivo de concienciar a los jóvenes sobre el acoso así como de crear empatía hacia las víctimas. El segundo juego serio utilizado es *First Aid Game*, una simulación con estructura narrativa que busca enseñar a los jugadores técnicas de primeros auxilios en tres situaciones de emergencia distintas.

A. Validación formal de un juego serio

Conectado es un juego serio diseñado para ser aplicado por profesores en sus clases. Es importante validar que cumple su objetivo, que es crear conciencia sobre el acoso, pero también validar su aplicabilidad en una clase y recoger la opinión de los profesores. El juego fue validado en varios experimentos sobre escenarios reales que probaron también su efectividad en clases de distinto tamaño y con equipos muy diferentes.

El primer paso para la validación del juego fue evaluar su efectividad y utilidad para sus jugadores objetivo. Para este propósito, se llevaron a cabo experimentos de validación con 257 jóvenes de 12 a 17 años. El segundo paso fue validar la aplicabilidad en clase y recoger opiniones y comentarios de los profesores acerca del juego. Para esta validación, 93 profesores y 113 estudiantes de carreras de educación participaron en experimentos para probar el juego y dar su opinión. Los detalles completos de estos dos pasos de validación y sus experimentos respectivos pueden encontrarse en [15] y [29].

En los experimentos anteriores, las analíticas de aprendizaje para juegos (GLA) se utilizaron para medir el tiempo que tardaron los jugadores en completar el juego, ya que uno de los requisitos era que una partida completa del juego no debía durar más de una sesión estándar de 50 minutos. También se recogieron datos de todas las interacciones para evaluar si los jugadores se quedaban atascados en alguna escena en particular o si pasaban mucho tiempo sin interactuar con el juego, lo que podía indicar un bajo nivel de implicación. Finalmente, a través de las GLA, se recogieron las elecciones realizadas por los jugadores en cada uno de los diálogos y en el final del juego para evaluar si el nivel de concienciación antes y después de jugar estaba relacionado con estas interacciones, aunque no se ha encontrado una relación clara por el momento.

Además de los datos de GLA recogidos, se utilizaron un cuestionario inicial y uno final para evaluar la concienciación de los jugadores sobre el acoso antes y después de jugar, además de su opinión sobre la experiencia.

B. Aplicación de un juego serio en clase

Conectado es un juego serio abierto y gratuito para ser utilizado como herramienta en clase por un profesor o un grupo de profesores. El juego pretende aumentar la conciencia sobre el acoso, pero no solo eso, sino que también pretende suscitar un debate sobre la experiencia obtenida por los jugadores. Este debate de reflexión debe ser guiado por el profesor, y es importante que el profesor vea el videojuego como una herramienta que puede adaptarse de distintas formas en las dinámicas de clase. Para hacer esto, se creó una

guía del profesor que explica cada característica del juego y cómo aprovecharlas.

La guía proporciona a los profesores todos los detalles sobre cada fase del juego y los eventos que ocurren en cada fase. Para cada uno de estos eventos, la guía explica los temas relacionados con el acoso del que trata y cómo se pueden utilizar para desencadenar la reflexión de los jugadores después de la sesión de juego. Además, la guía contiene una sección resumiendo la terminología sobre el acoso y los juegos serios, una sección de preguntas frecuentes para resolver algunos de los problemas comunes que encuentran los profesores cuando usan Conectado, y otra sección sobre la instalación del juego.

Debe mencionarse que tanto el juego como la guía han sido utilizados por un asesor académico en un colegio donde pudimos acudir como observadores para observar las diferentes sesiones. De esta forma, pudimos verificar que los profesores del colegio eran capaces de desplegar y utilizar el juego satisfactoriamente como herramienta, adoptándola por completo como propia. Además, el asesor también fue capaz de usar y aplicar estos recursos para llevar a cabo una sesión de reflexión en la que combinó actividades propuestas en la guía con otras actividades y recursos diferentes.

En este escenario, el rol de GLA fue secundario, siendo principalmente utilizado para verificar que todos los estudiantes estuviesen jugando e interactuando con el juego.

C. Evaluación de los estudiantes con un juego serio

First Aid Game es una simulación con forma de juego que pretende enseñar maniobras de primeros auxilios a jugadores entre 12 y 16 años en tres situaciones: dolor torácico, atragantamiento, e inconsciencia. El juego presenta cada situación como un nivel diferente que los jugadores deben completar con éxito. En cada nivel, los jugadores encuentran diferentes situaciones en las que deben elegir entre diferentes cursos de acción posibles, presentados de forma visual o como preguntas de múltiple respuesta. También está disponible un teléfono en el juego para llamar a los servicios de emergencia simulados.

El juego fue validado previamente mediante experimentos pre-post utilizando un grupo de control que acudió a una demostración teórico-práctica realizada por un monitor. Este experimento de validación, descrito en detalle en [30], demostró que el juego era efectivo y que los jugadores aumentan su conocimiento de primeros auxilios como resultado de jugar al juego. Más recientemente, hemos realizado un nuevo conjunto de experimentos [31], [32] recogiendo datos tanto de cuestionarios pre-post como de interacciones GLA de 227 estudiantes de entre 12 y 16 años.

Con los datos de interacción capturados, creamos diferentes modelos de predicción para predecir la puntuación del post-test de los jugadores (es decir, su conocimiento después de jugar). Para predecir categorías aprobado-suspense, entrenamos modelos utilizando regresión logística, árboles de decisión y el clasificador bayesiano Naïve Bayes, mientras que para predecir la puntuación exacta del post-test entrenamos modelos utilizando regresión lineal, árboles de regresión y máquinas de vectores de soporte para regresión. Los modelos resultantes mostraron una exactitud muy alta para las predicciones, con más de un 98% de exhaustividad y 89% de precisión para los mejores modelos obtenidos para

predecir aprobado-suspense, y un error medio de 1.4 puntos para los mejores modelos para predecir la puntuación. Los modelos predictivos mostraron una exactitud similar cuando se excluía el pre-test de la entrada de los modelos.

El papel de GLA fue, por tanto, esencial para la evaluación de los estudiantes, ya que las variables más relevantes de los modelos predictivos obtenidos estaban relacionados con la información de analíticas de aprendizaje para juegos. En particular, algunas de las variables con mayor poder predictivo estaban relacionadas con la puntuación obtenida en alguno de los niveles del juego o con el número de interacciones con el personaje principal del juego.

VI. CONCLUSIONES

Todavía queda mucho trabajo por hacer para mejorar y ampliar la presencia de juegos en educación. Los educadores son la llave para promover la aplicación de juegos en escenarios educativos reales. Sin embargo, no puede esperarse que los educadores sean expertos en el uso de la tecnología. Por ello, para simplificar la aplicación y el despliegue de juegos por parte de los educadores, los juegos deben proporcionar un beneficio claro en cuanto a su utilidad; así como proporcionar las herramientas necesarias para simplificar la tarea de los educadores.

Primero, los juegos deben validarse formalmente con un método aceptado, como los experimentos pre-post. Después de que un juego se ha validado formalmente, los educadores necesitan entender el contenido y las mecánicas del juego para poder utilizarlo de forma efectiva en sus clases. Para ello, la experiencia previa de haber jugado ellos mismos, así como de haber leído el manual de juego o la guía de profesores puede ser de gran ayuda.

Cuando los estudiantes están inmersos en la actividad de juego, el proporcionar una rápida información visual puede ayudar a los educadores para mantener el control del progreso de los alumnos con poco esfuerzo y de forma no intrusiva. Pueden utilizarse alertas o avisos para notificar a los educadores sobre situaciones específicas que pueden requerir su intervención. Finalmente, los datos de analíticas de aprendizaje para juegos pueden ser una forma más directa de evaluación que no se basa en una medida externa sino en las acciones que realmente se han tomado en el juego. Modelos de predicción creados en la fase de validación del juego pueden proporcionar automáticamente una evaluación del conocimiento de los estudiantes después de jugar al juego, en base a sus datos de interacción.

Las tres experiencias descritas han mostrado diferentes aplicaciones de juegos en escenarios del mundo real. La validación formal y la aplicación en clases de un juego serio (Conectado) ha mostrado como los experimentos pre-post pueden complementarse con datos de GLA para proporcionar información más completa y mejorar el juego; mientras que el uso de un manual de juego para apoyar a los profesores ha demostrado ser esencial para ellos a la hora de entender por completo y sentirse cómodos con la herramienta de aprendizaje que van a utilizar con sus estudiantes. La evaluación de los estudiantes mediante la predicción del aprendizaje mostrada en nuestra tercera experiencia (*First Aid Game*) proporciona un enfoque para evaluar a los estudiantes en base a sus interacciones en el juego, pasando de los clásicos cuestionarios pre-post a la información más

rica que proporcionan los datos de interacción de GLA.

Sin embargo, este modelo de aplicación para juegos serios presenta ciertas limitaciones y requisitos que necesitan considerarse. Primero, pueden aparecer problemas tecnológicos antes o durante el despliegue en los colegios. Si la recogida de datos de GLA depende de enviarlos a un sistema de analíticas externo, entonces ésta confía en una conexión a internet de los colegios que puede fallar. El sistema de analíticas también debe ser fiable y estar preparado para manejar los datos recogidos, tanto en tamaño como en formato. Estos y otros aspectos tecnológicos implican que la aplicación de juegos en colegios siempre estará en riesgo de requerir apoyo técnico, lo que puede restringir su aplicación por parte de los educadores si están solos. Otro asunto que debe tenerse en cuenta a la hora de recoger datos es la privacidad y la seguridad, especialmente relevantes cuando se trabaja con menores. La privacidad puede abordarse si los datos recogidos no contienen detalles personales y no pueden relacionarse con estudiantes concretos. El sistema de analíticas debe asegurar esto no recogiendo información personal, sino recogiendo solo datos anonimizados. Para cumplir este requisito y asegurar que la información recogida sea útil para los educadores, los estudiantes pueden recibir identificadores anónimos que utilicen en el juego, y los educadores (y solo los educadores) pueden mantener la correspondencia entre identificadores y estudiantes.

Con el modelo de aplicación y las experiencias descritas, consideramos que se simplifica el trabajo de aplicación de los juegos en todas las fases: desde la validación inicial de los juegos, hasta su uso en clases de forma efectiva y controlada, incluyendo la evaluación automática del aprendizaje de los estudiantes basado en sus acciones en el juego. Para todos estos pasos, consideramos que los datos de analíticas de aprendizaje extraídas de los juegos serios son clave para proporcionar información sobre las acciones de los estudiantes mientras juegan y simplificar la aplicación de los juegos en clase por los educadores.

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Apéndice A – Repercusión en los medios de comunicación

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3. <https://ecodiario.eleconomista.es/sociedad/noticias/8738032/11/17/Preparan-un-videojuego-que-hace-sufrir-el-bullying.html>
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Prensa Internacional 2019

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Apéndice B – Cuestionarios

Cuestionario concienciación

Selecciona tu género:

Femenino

Masculino

Introduce tu edad:

¿Cómo de acuerdo estás con las siguientes afirmaciones?

1. Enviar mensajes ofensivos, insultos o amenazas a través de Internet, del móvil (whatsapp, telegram, SMS...) o redes sociales (twitter, facebook, instagram...) es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. Realizar llamadas ofensivas o insultantes a través del móvil o Internet (skype, hangouts...) es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. Publicar videos, fotos de otra persona con fin de reírse de esta es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

4. Robar contraseña para sacar información personal de otra persona es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

5. Robar contraseña para hacerse pasar por otra persona es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

6. Hacer chantaje usando videos, información o imágenes sobre otra persona es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

7. Retocar fotos de otra persona y compartirlas con terceros en redes sociales o aplicaciones de chat es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

8. Excluir o ignorar a otra persona en redes sociales o grupos de chat es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. Difundir rumores en la red sobre otra persona es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

10. Acosar sexualmente haciendo uso de Internet es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

11. Obligar a publicar o compartir a través de Internet archivos que la otra persona en un principio no quería compartir es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

12. Pegar y/o empujar es un acto de bullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

13. Insultar o hablar mal de otros es un acto de bullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

14. Extender rumores sobre otra persona es un acto de bullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

15. Amenazar es un acto de bullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

16. Robar dinero u objetos y romper las propiedades de otra persona es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

17. Excluir, discriminar o ignorar a otras personas es un acto de bullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

18. Poner motes molestos o para ridiculizar es un acto de ciberbullying.

| Totalmente en desacuerdo | Muy en desacuerdo | En desacuerdo | Ni en desacuerdo ni de acuerdo | De acuerdo | Muy de acuerdo | Totalmente de acuerdo |
|--------------------------|--------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Aceptación del videojuego y uso de redes sociales

1. ¿Te sientes identificado con alguno de los personajes que aparecen en el juego (protagonista, María, Guille, Jose, Ana, Álex, Alison)?

2. ¿Qué te ha parecido el juego y qué cambiarías?

3. ¿Crees que has aprendido algo?

4. ¿Con qué frecuencia usas las siguientes redes sociales?

| | No la conozco | No la uso | La uso poco | La uso bastante | La uso a diario |
|------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Instagram | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Twitter | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Musical.ly | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Facebook | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| WhatsApp | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Telegram | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Pinterest | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Tumblr | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Vine | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Snapchat | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Test de ciberbullying

Perfil Víctima

| | Nunca | Algunas veces | Bastantes veces | A diario |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. ¿Te han enviado mensajes ofensivos e insultantes a través del móvil o a través de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. ¿Te han hecho llamadas ofensivas e insultantes a través del móvil o de Internet (skype...)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. ¿Te han agredido para grabarte y colgarlo en Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. ¿Han difundido fotos o videos tuyos, que sean privados o comprometidos, a través de Internet o el móvil? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. ¿Te han hecho fotos robadas en sitios como los vestuarios, playa, servicios... y las han colgado en Internet o difundido por el móvil? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. ¿Has recibido llamadas anónimas, con el fin de asustarte y provocarte miedo? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. ¿Te han chantajeado o amenazado por medio de llamadas o mensajes? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. ¿Te han acosado sexualmente a través del móvil o de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. ¿Ha firmado alguien en tu blog, haciéndose pasar por ti, haciendo comentarios difamatorios, mentiras o contando tus secretos? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. ¿Te han robado la contraseña, para impedir que puedas acceder a tu blog o a tu correo electrónico? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. ¿Te han trucado tus fotos o vídeos para difundirlas a través de redes sociales o YouTube, para humillarte o reírse de ti? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. ¿Te han acosado para intentar aislarte de tus contactos en las redes sociales? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. ¿Te han chantajeado, obligándote a realizar cosas que no querías a cambio de no divulgar? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. ¿Te han amenazado de muerte a ti o a tu familia a través del teléfono móvil, de las redes sociales o de otro tipo de tecnología? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. ¿Te han difamado a través de Internet diciendo cosas de ti que son mentira para desprestigiarte? ¿Han difundido rumores sobre ti para hacerte daño? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Perfil Agresor

| | Nunca | Algunas veces | Bastantes veces | A diario |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. ¿Has enviado mensajes ofensivos e insultantes a través del móvil? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. ¿Has hecho llamadas ofensivas e insultantes a través del móvil o de Internet (Skype...)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. ¿Has agredido o has provocado a otros para dar una paliza a algún chico/a para grabarlo y colgarlo en Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. ¿Has difundido fotos o vídeos, privados o comprometidos, de algún chico/a a través de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. ¿Has hecho fotos robadas en sitios como los vestuarios, playa, servicios... y las has colgado en Internet o difundido por el móvil? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. ¿Has hecho llamadas anónimas con el fin de asustar y provocar miedo a algún chico/a? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. ¿Has chantajeado o amenazado por medio de llamadas o mensajes? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. ¿Has acosado sexualmente a través del móvil o de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. ¿Has firmado en el blog de algún chico/a haciendo comentarios difamatorios, mentiras o contando sus secretos? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. ¿Has robado la contraseña de algún chico/a, para impedir que puedan acceder a su blog o a su correo electrónico? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. ¿Has trucado fotos o vídeos de algún chico/a para difundirlas a través de las redes sociales o YouTube y humillarle o reírte de él o ella? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. ¿Has acosado para intentar aislar a algún chico/a de sus contactos en las redes sociales? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. ¿Has chantajeado, obligando a algún chico/a a realizar cosas que no quería, a cambio de no divulgar sus cosas íntimas en Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. ¿Has amenazado de muerte a algún chico/a o a su familia a través del teléfono móvil, de las redes sociales o de otro tipo de tecnología? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. ¿Has difamado, diciendo por Internet cosas de otras personas que son mentira para desprestigiarlas? ¿Has difundido rumores sobre otros para hacerles daño? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Perfil Observador

| | Nunca | Algunas veces | Bastantes veces | A diario |
|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. ¿Has visto enviar mensajes ofensivos e insultantes a través del móvil o de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. ¿Has visto hacer llamadas ofensivas e insultantes, a través del móvil o de Internet (skype...)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. ¿Has visto agredir o dar una paliza a algún chico/a para grabarlo y colgarlo en Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. ¿Has visto difundir fotos o vídeos, privados o comprometidos, de algún chico/a a través del móvil o de Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. ¿Has visto hacer fotos robadas en sitios como los vestuarios, playa, servicios y las han colgado en Internet o difundido a través del móvil? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. ¿Has visto hacer llamadas anónimas, con el fin de asustar y provocar miedo a algún chico/a? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. ¿Has visto como han chantajeado por medio de llamadas o mensajes? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. ¿Has visto a algún chico/a que haya acosado sexualmente a través del móvil o de Internet a alguna persona? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. ¿Has visto que algún chico/a haya firmado en el blog de otras personas haciéndose pasar por ellas, con comentarios difamatorios, mentiras o contando sus secretos? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. ¿Has visto que a algún chico/a le hayan robado la contraseña, para impedir que pueda acceder a su blog o a su correo electrónico? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. ¿Has visto fotos o vídeos de algún chico/a que las han trucado para difundirlas a través de las redes sociales o YouTube y humillarle o reírse de él o ella? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. ¿Has visto cómo han acosado a chicos/as para intentar aislarles de sus contactos en las redes sociales? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. ¿Has visto cómo han chantajeado, obligando a algún chico/a a realizar cosas que no quería, a cambio de no divulgar sus cosas íntimas en Internet? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. ¿Has visto que a algún chico/a le hayan amenazado de muerte a él o a su familia a través del teléfono móvil, de las redes sociales o de otro tipo de tecnología? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. ¿Has visto que a algún chico/a le hayan difamado, diciendo por Internet cosas que son mentira para desprestigiarle, o del que hayan difundido rumores para hacerle daño? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Cuestionario de aplicabilidad en el aula y aceptación por el profesor

1. Aplicación

| | No | Difícilmente | Quizá | Sí |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. ¿Crees que este juego es aplicable en una clase para mejorar la concienciación sobre el acoso en la escuela? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. ¿Aplicarías este juego en tus clases? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. ¿Aplicarías otros videojuegos en tu clase? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. ¿Te parece que el juego sirve como herramienta para generar una discusión controlada en clase? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. ¿Crees que el juego da una visión realista a los alumnos sobre el acoso y el ciberacoso? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. ¿Crees que los alumnos que sufren acoso pueden sentirse identificados con el protagonista? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. ¿En qué aspectos crees que puede ayudar el juego en una clase?

3. ¿Qué cambiarías y/o mejorarías del juego para un mejor uso en clase como herramienta educativa?

4. ¿Qué opinas de este videojuego?

5. ¿Qué es lo que más te ha gustado y por qué?

6. ¿Qué es lo que menos te ha gustado y por qué?

Cuestionario guía para el docente

1. ¿Cuánto tiempo aproximado has tardado en leer la guía? (En minutos)

2. ¿Cuáles de los siguientes apartados has leído?

| | No | Ojeado | Sí |
|--------------------------------|--------------------------|--------------------------|--------------------------|
| Introducción | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| El bullying y el ciberbullying | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Conectado | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Orientación para el docente | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Primer día | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Segundo día | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Tercer día | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Cuarto día | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Quinto día | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Debate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Otro material | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Preguntas frecuentes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Descarga e instalación | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bibliografía | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. ¿Cómo de larga te parece la guía del docente?

| | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Demasiado larga | Larga | Normal | Corta | Demasiado corta |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

4. ¿Es apropiado el lenguaje que utiliza el documento?

| | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|
| No | En parte | Sí | Sin respuesta |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

5. ¿Es claro el contenido de cada una de las secciones de la guía?

| | No lo sé | No | Poco claro | Bastante claro | Totalmente claro |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| ¿Están claros los objetivos de la guía y del videojuego? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ¿Es clara la explicación sobre bullying/cyberbullying? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ¿Es clara la explicación sobre el videojuego Conectado? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ¿Es clara la orientación que aparece para el docente? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ¿Son claros los consejos para llevar a cabo el debate en clase? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ¿Son claras las distintas descripciones y orientaciones de cada día para llevar a cabo una reflexión? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

6. ¿Es útil el contenido de los siguientes apartados de la guía?

| | No | No mucho | Un poco | Es útil | Es muy útil |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| El contenido de los objetivos de la guía y el juego es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| El contenido sobre el problema del bullying/ciberbullying es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| El contenido sobre el videojuego Conectado es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| La sección de orientación del docente es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| La sección de orientación para el debate en la clase es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| La sección de las reflexiones relacionadas con cada día del juego es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| El espacio para notas es útil | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

7. ¿Las imágenes que aparecen en la guía son adecuadas y acompañan al texto?

| | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| No lo sé | No | Solo algunas | La mayoría | Sí, todas |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

8. ¿Crees que la guía es útil y ayuda a aplicar el videojuego Conectado en clase?

| | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| No lo sé | No | Un poco | En general sí | Sí |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. ¿Crees que la guía muestra todo el contenido del videojuego Conectado?

| | | | | |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| No he jugado al videojuego | No | Un poco | En general sí | Sí |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**10. ¿Hay algún tema que aparezca en el juego que no se refleje en la guía? ¿Cuál?
(Contestar únicamente si ha jugado al videojuego)**

11. ¿Tienes alguna pregunta/duda que no aparezca en el capítulo de preguntas frecuentes? ¿Cuál?