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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.

Keywords: Games; Teaching/learning strategies; Improving classroom teaching; Media in education;

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

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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 (Monelos, Mendiri, & García-Fuentes, 2015).

Although cyberbullying is carried out through new technologies and electronic devices, we consider that these same devices can 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, 2015a). 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., 2016a) 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 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.

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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 (Figure 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").

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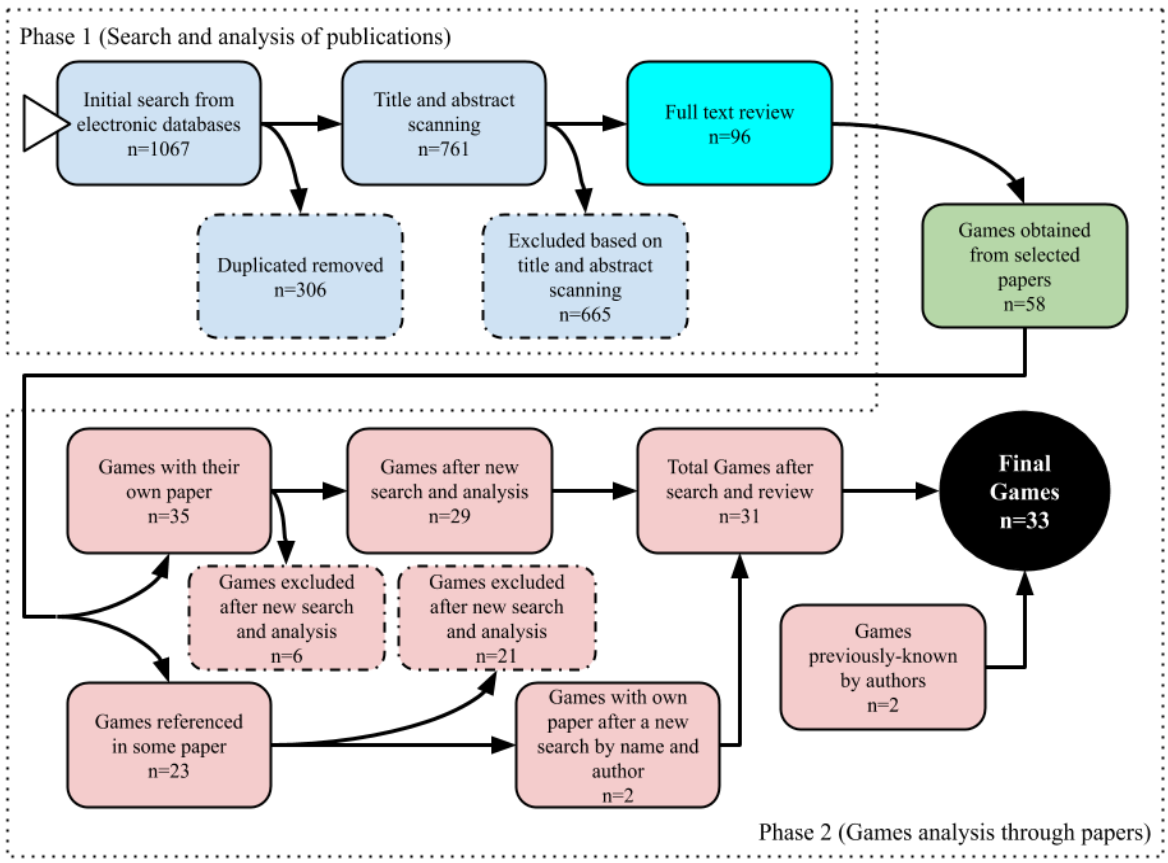

Figure 1. Review process consisting in two parts, (1) literature review and (2) serious games analysis.

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 Figure 1). When games did not have an explicit name, they were labelled as "*NN –1st author's last name"*. Therefore, these are the inclusion and exclusion criteria for the publications:

Inclusion criteria

- Publications containing a study of the design, development or evaluation of a game with the aim

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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.

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

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    - 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 analyse. 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 Figure 2, the number of publications returned by the search and those that meet the inclusion criteria has been growing over the last few years.

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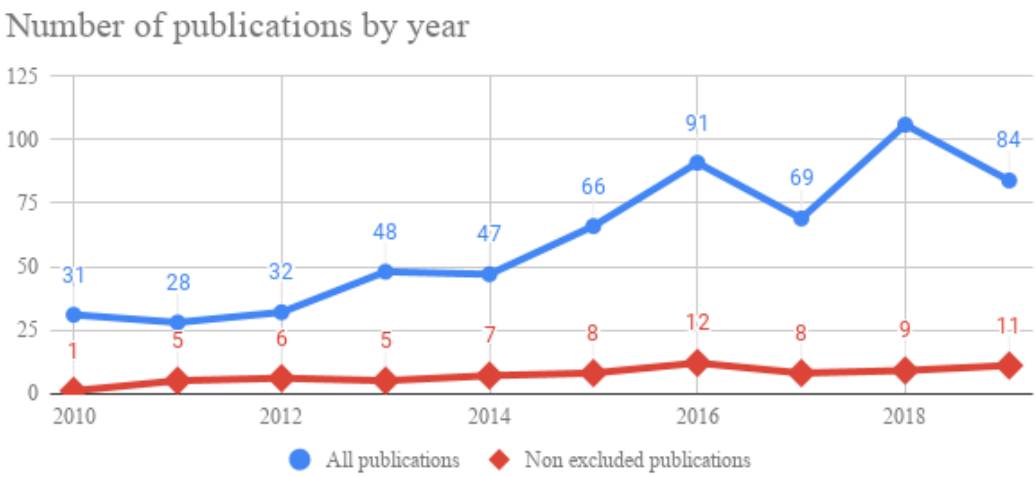

Figure 2. Growth in the number of publications related to bullying/cyberbullying and games over the last years.

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.

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Table 1. Number of studies identified in search and meeting inclusion criteria (Phase 1) and games with their own study and referenced (Phase 2) from each database.

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

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

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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.
- **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. Figure 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.

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
	Anti-Bullying Village	2014	No	PC	Teenagers	Bullying / Cyberbullying	Prevention
Virtual Env.	TheSimSafetyPark	2010	No	PC	9-11, teachers and parents	Cyberbullying	Prevention
	SchoolLife	2013	No	Web	Teenagers	Bullying	Prevention
Apps	#StopBully	2018	No	Mobile	-	Bullying / Cyberbullying	Prevention

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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	Prevention 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

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

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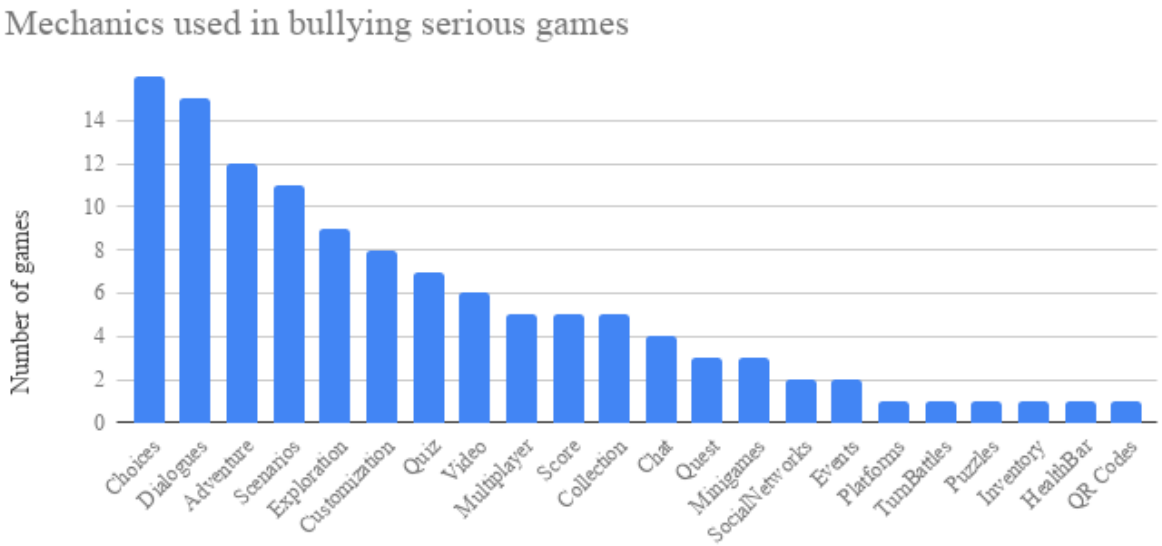

Figure 3. Main mechanics used in games to prevent and detect bullying and cyberbullying.

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 Figure 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.

Figure 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 Figure 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.
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.

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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*.

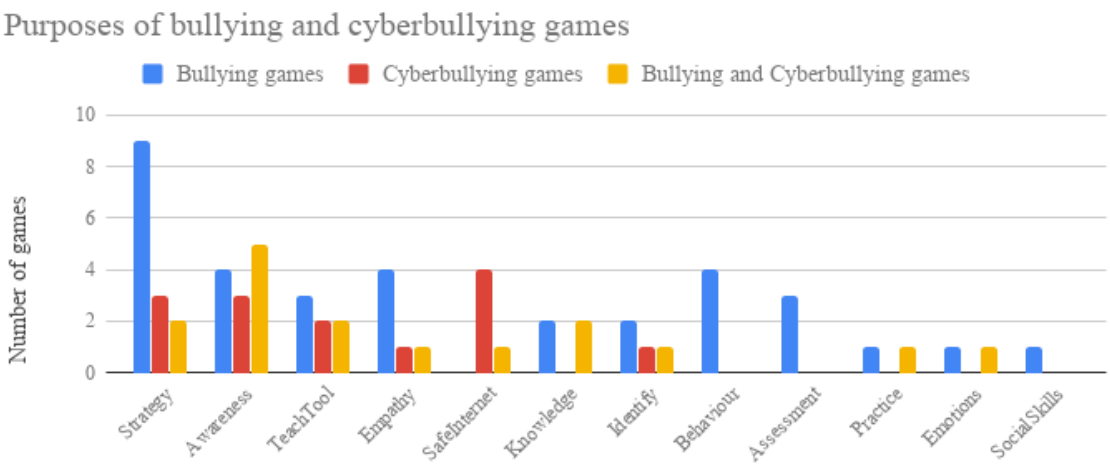

Figure 4. Main purpose of the serious games about bullying/cyberbullying.

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 to 12 years old), teenagers (12 to 18 years old), young adults (18 to 25 years old), adults (more than 25 years old), parents, and education professionals such as teachers. Figure 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.

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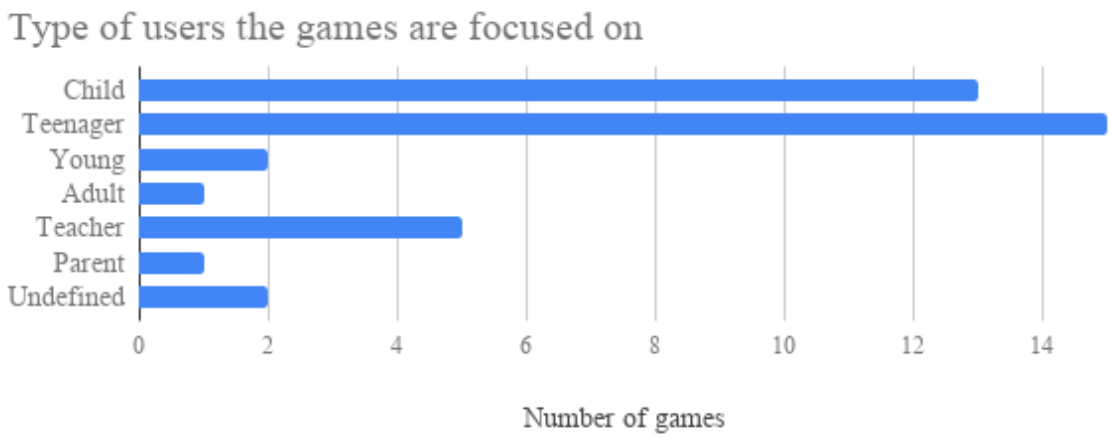

Figure 5. Type of users the games were developed for, depending on age.

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%)
- 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%)

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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	-

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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 sumarizes, 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 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 Figure 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

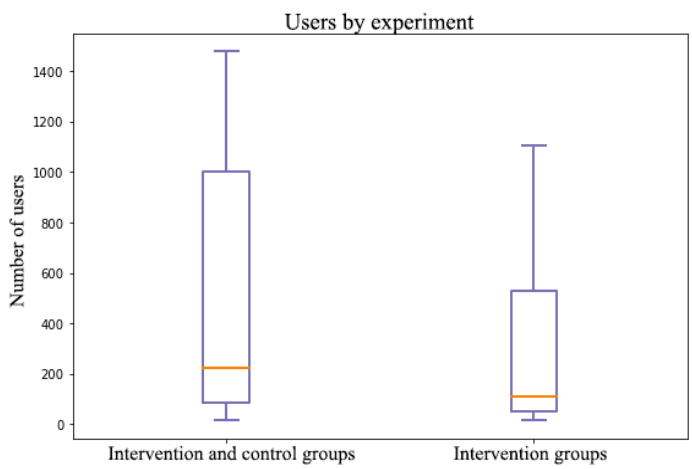

Figure 6. Number of total users (left) and number of users in intervention groups (right) in the effectiveness experiments of each game.

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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 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

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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., 2016b; Calderón & Ruiz, 2015b; 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 analyzed. 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., 2016b; Calderón & Ruiz, 2015b).

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

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(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., 2016b; Calderón & Ruiz, 2015b; 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

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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.

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