







# A Systematic Literature Review on Technological Solutions to Fight Bullying and Cyberbullying in Academic Environments

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Abstract: Nowadays, the world is more connected than ever; the use of internet, social networks and platforms allows for people of all ages to have constant communication. During the past year, due to the COVID-19 pandemic, children and teenagers have had to spend most of their time using a technological device, for educational and recreational purposes. This constant connection has carried on several issues, one of them being cyberbullied. This is when a person intentionally and repeatedly harms another one, on a virtual environment. Even with its downside, technology has many advantages; it has allowed for children and teenagers to engage in educational communities and applications. Then, studies on bullying and the ways to fight it exist from many years prior, however, there are little literature about the technological solutions to help in the fight against cyberbullying and bullying. Therefore, the objective of this research is to perform a Systematic Literature Review (SLR) about technological solutions for education and to fight bullying and cyberbullying in children and teenagers. To perform a trustworthy, rigorous and repeatable SLR, the methodology proposed by Kitchenham was used. The presented SLR, uses studies from 2009 to 2021. To start, a group of primary studies was selected, which met the characteristics to answer the research question “What technological tools, methods and models are used to educate about bullying and cyberbullying?” The primary studies were obtained from the most used digital libraries, prominent journals, and most representative conferences in the area. In conclusion, this study provides a global vision of the state of the art in this area, which represents a helpful tool for researchers to detect weaknesses and gaps and open new horizons regarding the use and design of technology to fight bullying and cyberbullying.


## 1 INTRODUCTION


The closure of schools due to the COVID-19 pandemic and the increase in using technological tools, social networks, and digital platforms brought along the need to adopt technologies in education. (E. Onyema et al., 2020). Nowadays, most academic stages have become digitized (e.g., Online courses, MOOCs, digital learning methods) (Onyema, 2019).


This technological change has also turned bullying behaviours that affect the welfare of children and adolescents, into cyberbullying (e.g., attacking peers through harmful text messages, photos, or videos) (Pedreira et al., 2011, Washington, 2014).


Bullying and cyberbullying are quite prevalent behaviours among children and adolescents at school (Cedillo L, 2020). These behaviours are primarily related to the difference in power between victims


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and victimizers and can lead to psychological consequences for the victims (Monks & Smith, 2006; Foody et al., 2015).

In this sense, due to cyberbullying being caused during the use of Information and Communication Technologies (ICTs), technological tools are being created to counteract this problem, such as vigilance software, serious games, artificial intelligence within e-learning tools, among others (Calderón & Ruiz, 2015). Besides, social networks, internet providers, and other e-learning tools have implemented functionalities for detecting when a person is virtually assaulted.

Furthermore, those intervene by monitoring and filtering parents, blocking an account, deleting content, reporting, and redirecting to online resources and safety centers in a preventive manner (Topcu-Uzer & Tanrikulu, 2018). Therefore, the use of ICTs as a strategy for intervention and prevention of bullying and cyberbullying is an excellent benefit to the emotional, psychological and social well-being of children and teenagers (Nocentini et al., 2015).

In this context, due to the use increase of prevention tools against bullying and cyberbullying, it is necessary to know the state of the art in this domain in order to determine the research lines and tools implemented and detect investigation gaps.

Therefore, this research aims to conduct a Systematic Literature Review (SLR) on technological solutions for education and the fight against bullying and cyberbullying in children and teenagers due to its importance in today's society, following the guidelines established by Barbara Kitchenham (2007). For this reason, there is a need to know the technology tools developed currently to prevent this problem and intervene in the different social and educational fields. Also, it will allow us to know which tools are the most used and in which areas they develop. Furthermore, the writing will serve as a basis for further research and technological solutions to fight this problem in schools, colleges, and universities.

Finally, this document has the following structure: Section 2 presents the related works; it mentions secondary studies related to technological tools to fight against bullying and cyberbullying. Section 3 describes the core of the SLR, its protocol execution, and results; and finally, Section 4 presents the conclusions and future works.

## 2 RELATED WORK

To define the need for the performing of this SLR, existing reviews on topics related to the use of tools

to fight against bullying and cyberbullying were found. They are presented in the following sections.

The study conducted by Topcu-Uzer & Tanrikulu (2018) presents the fact that technological tools are not 100% focused on bullying and cyberbullying. Although, there are still no scientific studies that can prove the effectiveness of new technological solutions against bullying and cyberbullying, with the exception of stop systems such as text-based detection (Dinakar et al., 2011; Soundar & Ponesakki, 2016), participant-vocabulary coherence (Raisi & Huang, 2016) or morphosemantic patterns (Ptaszynski et al., 2016). Moreover, there are recent studies such as the Rethink software and an empathy-enhancing video movie being conducted to combat these problems. They will be a key element in the development of new technological solutions to fight bullying and cyberbullying and in future research to demonstrate their effectiveness.

Calvo, A. et al., (2020) present a SLR of serious games as technological tools of prevention and detection to fight bullying and cyberbullying, through the use of video games. The study had several objectives: a) to see the benefits of using video games, b) to determine the users on which these will focus and, c) to assess the extent to which a given population can benefit. At present, these games are not yet available, but the idea is to create spaces of awareness, empathy and teaching for students, teachers and parents.

On the other hand, Nocentini et al., (2015) present a SLR on ICT used to prevent and intervene bullying, based on anti-bullying programs. Although it has relation to the presented proposal, however, this research will cover the solutions and technological tools that currently exist to prevent and intervene bullying and cyberbullying. Therefore, it will also be an important contribution for future research on this problem.

## 3 RESEARCH METHOD

In order to carry out the SLR in the framework of this paradigm, it is necessary to follow a structured procedure. The purpose of the SLR is to extract previously conducted studies according to a specific topic, to evaluate them and interpret the results obtained in each one of them in an objective and reliable way, so that it can be repeatable and applicable in the future.

This study was conducted using the methodology of Kitchenham (2007), the process has three stages. First, the planning of the review, where the research

questions are established and the protocol is started. Second, conduct of the review, in this section the primary studies are chosen, their quality is evaluated and then the data obtained in the first stage are extracted and traced in order to synthesize them. Finally, the third stage refers to the review report, which will enable the selection of the dissemination mechanisms and thus, the presentation of the SLR.

### 3.1 Planning the Review

This SLR focuses on technological solutions that help in the promotion against bullying and cyberbullying in children and teenagers. According to UNESCO (2019), bullying affects 1 in every 3 children, and cyberbullying globally affects 1 in 10 children, therefore, the main research question that has been raised is: What technological tools, methods and models are used to educate about bullying and cyberbullying?

Therefore, to answer the research question, the following research sub-questions have been proposed

- a) In what population and environment will technological tools be used to address the problem of bullying and cyberbullying
- b) What are the tools, technological methods, solutions, and deployment platforms to fight Bullying and cyberbullying?
- and c) How is the research conducted in relation to Bullying and cyberbullying technology?

#### 3.1.1 Identification of Data Sources and Search Strategy

To obtain the primary studies, several digital libraries were used, such as: Redalyc, IEEEExplore, Scielo, ACM Digital Library, SpringerLink, Science Direct, PUBMED.

The milestone date established for the search is 2009 (U.S. Department of Education, 2021), because from that year, almost everyone in the United States had access to technology and Internet. According to Purdue University, one out of every five students had a computer, 83% had laptops, 50% had a cell phone and 97% of the classrooms had one or more computers with internet (Department of Education, 2021).

For the first phase, a search string was established to facilitate the retrieval of publications related to technology used for bullying and cyberbullying. The string used to obtain these publications and then review the title and abstract was: (Bullying OR Cyberbullying) AND (tech\*) AND (tool\* OR program\*), it is important to note that the syntax varies in each digital library. In addition, for the

search to be complete, it was searched in conferences and journals.

#### 3.1.2 Criteria for Selecting Primary Studies

To select the primary studies, a complementary semantic check was performed in addition to a syntactic inquiry. The title and abstract of the documents were analysed and, if necessary, the complete article was read to corroborate that it was useful for the research and that it met the extraction and inclusion criteria.

The authors evaluated and retrieved each study from the automated or manual search in order to decide whether or not it should be included by considering its title, abstract and keywords. Discrepancies in the selection were solved by consensus among the authors after scanning the entire paper.

The studies that met at least one of the following inclusion criteria were included.

- a) Studies presenting tools to fight bullying and cyberbullying
- b) Studies presenting technological methodologies to reduce bullying and cyberbullying.
- c) Studies presenting effective psychological models through technologies to fight bullying and cyberbullying.

The studies that met at least one of the following exclusion criteria were excluded.

- a) Non-English or non-Spanish language papers.
- b) Papers that do not feature technologies to fight bullying and cyberbullying.
- c) Papers that are less than five pages.
- d) Documents published before the milestone date (2009), in which the first technological tools appeared.
- e) Introductory papers, short papers, books and workshops.
- f) Duplicate reports of the same study in different sources.

#### 3.1.3 Data Extraction Strategy

In order to answer the sub-questions, extraction criteria have been defined for each of them. These are shown in Table 1.

Table 1: Criteria for extraction of research sub-questions.

RQ1: In what population and environment will technological tools be used to address the problem of bullying and cyberbullying?		
EC1	Environment	School, Home, Social environment
EC2	Population (Calvo-Morata et al., 2019)	Students, Teacher, School Authorities, Parents, General Population
RQ2: What are the tools, technological methods, solutions, and deployment platforms to fight bullying and cyberbullying?		
EC3	Type of gadgets	Computers, Tablets, Cell phone, Laptops, I-pads, Others, None
EC4	Area of study	Psychology, Electronics, Informatics, Education
EC5	Type of interaction (Garnica Bautista & Tepán Mita, 2019)	Visual, Touch, Auditory, Other
EC6	Type of Application (Sousa & Goncalves, 2021)	MOOCs, 3D virtual, Serious Game, Apps, Others
EC7	Artificial Intelligence (Fernández, n.d.)	Data mining, Machine Learning, Automatic speech recognition, Natural language processing, Text recognition, Deep learning, Emotion Recognition, Motion Recognition
EC8	Types of harassment (Donegan, 2012)	Bullying, Cyberbullying, Physical Bullying, Psychological Bullying, Verbal Bullying, Sexual Bullying, Social Bullying
EC9	Types of development	Software, None
EC10	Usability features (ISO 25010, n.d.)	Functional adaptation, Performance efficiency, Compatibility, Usability, Reliability, Security, Maintainability

EC11	Technology suppliers (Topcu-Uzer & Tanrikulu, 2018)	Social networking companies, Internet service providers, E-mail service providers instant, Messaging applications, Cyberbullying applications, Others
EC12	Solutions for Cyberbullying (Topcu-Uzer & Tanrikulu, 2018)	Parental control and filtering, Account locking, Content removal, Reporting, Redirecting to online resources, Security centers
EC13	Technology solutions (Topcu-Uzer & Tanrikulu, 2018)	Online Cyberbullying detection systems, Software, Video film, Positive messages by technical means, Others
EC14	Software (Educba, n.d.)	Website, Application, Mobile Systems, Others
EC15	Forms of Bullying (Botell, 2017)	Social blocking, Harassment, Manipulation, Coercion, Social exclusion, Intimidation, Aggressions, Threats
RQ3: How is the research conducted in relation to bullying and cyberbullying technology?		
EC16	Phases (Wasson, n.d.)	Analysis, Design, Implementation, Testing
EC17	Validation	Experiment, Prototype, Proof of Concept, Others
EC18	Approach scope (Mårtensson et al., 2016)	Industry, Academy
EC19	Methodology	New, Extension
EC20	Area of study	Informatics, Medicine, Psychology, Electronics, Others
EC21	Country	
EC22	Year	

### 3.2 Conducting the Review

The planning, execution and identification of the primary studies was performed on December 17,

2021. Here, 180 research papers were identified from the databases, based on the automatic search.

In addition, a manual search was performed, from which 50 research papers were selected. The papers were carefully read and inclusion and exclusion criteria were applied. Several studies were read in detail and, finally, 32 were selected to be part of this secondary study, for the complete list of selected papers, see [shorturl.at/cvwRT](http://shorturl.at/cvwRT). Figure 1 summarizes the entire process, up to the final selection of articles.

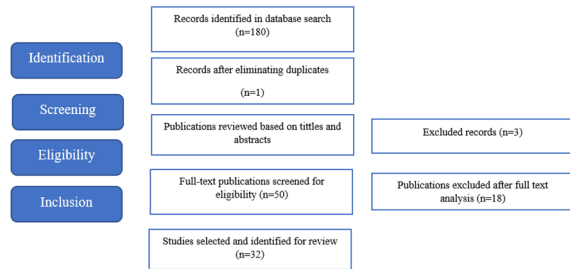


Figure 1: Articles selection.

## 4 DISCUSSION

### 4.1 Environment and Population

Most of the studies found in the SLR were conducted in the school setting, where there are various technological tools to prevent and intervene in children and teenagers. It is very important to note that they were carried out in this population, as presented by Cedillo, L (2020), based on a report of the United Nations International Children's Emergency Fund (UNICEF), it stated that between 50 and 70% of students in Latin America and the Caribbean had been involved in some type of bullying.

On the other hand, a lack of studies in school authorities and parents can be noted, which would be fundamental to educate the most affected populations. However, it can be seen that there are technological tools for teachers to identify the nature of the psychological impact experienced by students, such as automated speech emotion recognition (Iliou & Paschalidis, 2011), video games, MOOCs and 3D Virtual Reality (Sousa & Goncalves, 2021).

### 4.2 Types of Application and Artificial Intelligence

This study found that Machine Learning (ML) is one of the most widely used Artificial Intelligence (AI)

techniques in the creation of technological tools to fight bullying and cyberbullying. Its use is found in apps and other types of applications to detect language patterns used by victims and bullies, and in systems for the identification of profiles in social networks. It is important to emphasize that some AIs are combined, such as CbPIS: Cyberbullying Profile Identification System with Users in Loop (Chatzakou et al., 2019) and Cyberbullying Detection and Prevention: Data Mining and Psychological Perspective (Parime & Suri, 2014).

On the other hand, there is only one study on speech emotion recognition, which is very important in the branch of psychology. It allows to identify the psychological impact and understand the emotions of bystanders and consequently their coping styles in bullying episodes. It could introduce strategies that provide students, who witness bullying, with positive roles to counteract it (Iliou & Paschalidis, 2011).

### 4.3 Types of Application and Types of Harassment

Figure 2 compares the criteria EC6: Types of Application and EC8: Types of harassment, in order to know the tools to fight the different types of harassment. The obtained results indicate that there are many tools that use artificial intelligence to fight bullying, cyberbullying and social bullying, such as the studies of Dinakar et al., (2011); E. M. Onyema, (2019); Reynolds et al., (2011); Soundar & Ponesakki, (2016) it can be seen it in using machine learning to detect cyberbullying.

Moreover, to a lesser extent, there are tools such as serious games and MOOCs, to fight psychological abuse, verbal and social bullying, as presented in the work of Raminhos et al. (2015). However, very little information was found on tools to fight sexual bullying and verbal bullying.

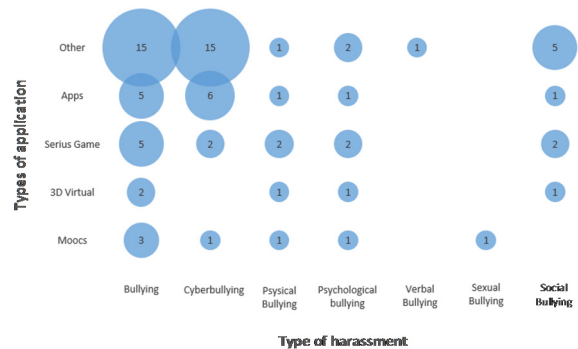


Figure 2: Comparison between EC6: Types of Application and EC8: Types of harassment.

#### 4.4 Phases and Area of Study

Figure 3 compares the criteria EC16: Phases and EC22: Area of study, in order to know how research is being carried out in relation to the technology developed for bullying and cyberbullying. As a result, the area of computer science, psychology and electronics, are conducting multiple researches that are mostly in the phase of analysis, implementation and testing, as presented by Cohen et al. (2014) and Silva et al., (2018). The education area presents, to a lesser extent, studies in the analysis and testing phase.

On the other hand, in the area of medicine, no research, promoting new technologies has been found.

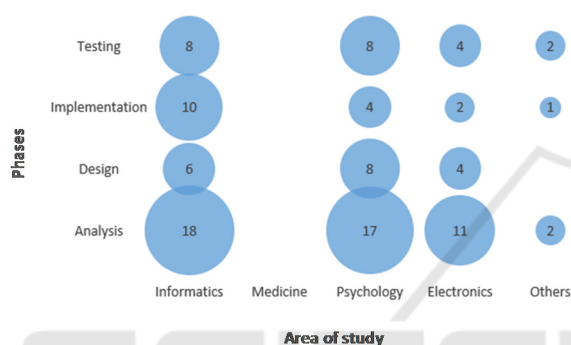


Figure 3: Comparison between EC16: Phases and EC22: Area of study.

## 5 CONCLUSIONS

Nowadays, bullying and cyberbullying have increased due to the use of technological devices, causing severe consequences for the victims and the surrounding community. For this reason, there is a need to create tools and technical solutions to fight this problem.

This research is an advance in state of the art in this domain, which can help to define what types of tools are currently being developed and which are not, to identify research gaps and to create new solutions or improve existing ones, to obtain greater effectiveness when used with children and adolescents in the school and social environment.

The methodology proposed by Barbara Kitchenham was used to perform the review, which consists of three phases: planning, conducting, and reporting the review. This SLR was conducted with 32 primary studies from several digital libraries such as Redalyc, IEEEExplore, Scielo, ACM Digital Library, SpringerLink, Science Direct, PUBMED.

Most of the created tools are used in the school environment for students and teachers (MOOCS, Apps, Serious Games). However, there are few tools aimed at other environments and users (parents and authorities). On the other hand, for the creation of detection systems, artificial intelligence such as data mining and machine learning are used to detect bullying and cyberbullying, especially in social networks. In addition, this SLR has found that there are not many tools to combat sexual and verbal harassment. Therefore, most studies are in the analysis phase in computer science, psychology, and electronics.

This work has made it possible to know the state of the art of this problem and the variety of tools aimed at different populations to reduce bullying and cyberbullying in other areas of daily life, especially in children and adolescents.

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