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TRABAJO FIN DE MASTER

Design and development of a multidevice platform for preventing bullying in schools

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UNIVERSIDAD POLITÉCNICA DE MADRID

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Resumen

El proyecto cubre el proceso de diseño y desarrollo de una plataforma online multiplataforma destinada a colegios donde los distintos usuario podrán registrarse y realizar diferentes acciones dependiendo del rol que tengan.

Para el desarrollo y la programación de las funciones se usan tecnologías como PHP, HTML, CSS o JavaScript principalmente. Junto con la plataforma online, también se desarrolla una sencilla aplicación móvil usando una tecnología creada por Facebook y que es relativamente nueva pero con gran importancia como React Native.

El administrador de la plataforma es el encargado de dar de alta los colegios y sus responsables, así como de subir los temas que los profesores tratarán dentro de las aulas. También tiene acceso a todos los datos de los usuarios y los colegios para tener la capacidad de solventar cualquier problema que pueda surgir dentro de la plataforma.

Dentro, los usuario disponen de un temario basado en bloques con diferentes dinámicas, juegos y videos y que ayudarán al profesor a transmitir los conceptos más importantes a los alumnos sobre la importancia de un ambiente adecuado y cómo mantener la clase libre de bullying y otros tipos de abusos.

Cada clase cuenta con su propia sección donde tanto los alumnos como los profesores pueden subir imágenes y reflexiones sobre lo que han hecho en clase. Para evitar contenido inadecuado, todo lo que se suba los alumnos será moderado previamente por los profesores antes de ser visible en la plataforma.

La plataforma incluye un servicio de mensajería a través del cual los alumnos y profesores pueden contactar con el responsable del colegio para transmitir sus preocupaciones o informar de algún problema dentro de las clases. Para dar seguridad a los alumnos, los mensajes pueden ser escritos de forma anónima de forma que solo se muestre la clase en la que están.

Por último, cada clase cuenta con una encuesta para ser rellenada por los alumnos donde pueden indicar qué compañeros les caen bien, con cuáles les gusta trabajar o quiénes sufren algún tipo de abuso. Todo esta información será tratada cumpliendo con la LOPD.

Palabras clave: Bullying, Colegios, Plataforma Online, Alumnos

Abstract

The project covers the process of designing and developing an online platform destined to schools where the different users can login and have the possibility of performing different actions depending on their role.

For the development and the programming, we are using technologies such as PHP, HTML, CSS and JavaScript. In addition to the online platform, we are creating a mobile app using React Native, a pretty new but established technology developed by Facebook.

The admin has the power to upload the posts in the platform and is the responsible of creating new schools and register the counselor for each of them. He also has access to all the data of the schools, the teachers and the students in order to manage any problem that may appear.

The platform includes different dynamics, posts and games that will be used by the teachers in class to educate the students in the development of a healthy environment in class free of bullying and other abuses.

Each class possesses its own section where teachers and students can upload the different activities they perform during the course and the dynamics related to the platform. Student's posts will have to be previously accepted by teachers to avoid inappropriate content.

The platform also includes a messaging service between the students and their families and the school's responsible in case they need to contact the school regarding any problem in class. To make students feel safer, they have the option of writing these messages anonymously so the message will only indicate the class they are in.

In addition, each class has a survey that all students can fill where they are able to point out which students are their friends, which are good to work with or which of them suffer bullying of any type. These results are analyzed afterwards and sent back to the school in order to detect specific problems with students or general problems in some classes.

Keywords: Bullying, Schools, Online Platform, Students

Agradecimientos

A mi familia, mis padres y mi hermano por estar ahí siempre.
A mi tutor por toda la ayuda que me ha brindado y el interés que ha mostrado en mi evolución a lo largo de la elaboración de este proyecto.
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CHAPTER 1

Introduction

This chapter is going to introduce the context of the project, including a brief overview of all the different parts that will be discussed in the project. It will also break down a series of objectives to be carried out during the realization of the project. Moreover, it will introduce the structure of the document with an overview of each chapter.

1.1 Context

In this section we present the context of the project with the idea of summarizing the points that will be treated throughout the document.

Back in March of 2019, I founded a software company based on web development and digital marketing with the intention of making it easier to entrepreneurs like me to start their project and having a good image on the Internet. After a while and after many different successful projects, we extended our target to small and medium-sized companies that are looking for a renewal of their image or that need to develop apps or webs in order to become relevant again.

As entrepreneurs, me and my associate had the conviction that, not only we should help out clients by satisfying their needs and creating the best possible solutions, but also that the projects we accepted and develop should help society in solving problems of any kind and making life easier.

In this day and age, bullying is a concept that can be heard all over the news. It has become one of the biggest problems that schools, its teachers and, most importantly, the students have to face. The teaching staff has to provide their students with the best education possible so they can grow and develop in a healthy environment where they feel they are important and that they have equality of opportunity.

Specially in children, the relationships they forge with their classmates and how they are accepted can determine the way they behave for the rest of their lives. Problems such as low acceptance between classmates can leave kids with severe self-steam problems in the future which can lead to depressions and problems in interacting with other people in their future careers.

That's why we decided to start this project where we are designing and developing a multi-device platform to help schools and teachers to provide education in these values to their students. The project aims to educate students and teachers in some crucial fields such as bullying, class leadership, respect, tolerance, conflict solving, self-steam or self-control. Its ultimate goal is to help schools raise awareness of the problems that children have to face in their daily life and that can result on lifelong problems.

To achieve all of this, the platform includes different dynamics and games that help students of all ages understand how the way they behave individually can affect the whole group and how important some values such as respect and cooperation are.

We aim to have schools that are free of bullying but, if we want to create a better society tomorrow, we have to start by educating the children we have today.

1.2 Project goals

With the development of this project, we want to reach a series of objectives in order to create a more reliable system that fulfills the needs we have found:

- **Improve the education at schools:** this project aims to improve the education that the children receive in the school regarding bullying. The online platform that will be developed will serve as a guide to educate students in the detection of bullying cases, how to act when they face these types of situations and will teach them the desirable values to have in order to create a healthy environment inside the school and the classroom where everyone feels safe and can be as they are, without having to worry about exclusion of any kind.

- **Offer a complete formation program:** with the previous investigation we have undergone, we intend to create a lesson plan that covers all the aspects related to bullying, discrimination and other abuses in order to educate students, teachers and schools in how to detect abuse cases, how to act against them and how to prevent them.

- **Provide a useful tool for students, teachers and schools:** the project will provide teachers and the schools a tool to prevent, educate, measure and act when difficult situations show up that may damage the school coexistence.

- **Enhance communication between families and schools:** the platform will also serve as a space where students and families will be able to safely talk to school's teaching staff and will enhance the relationship between all of them by providing a continuous communication and creating a relationship based on trust.

Regarding the platform itself, we will also have requirements that will need to be implemented in order to achieve and reach the goals we have just talked about. We will talk about these platform requirements deeper in **Chapter 4**, but, mainly these requirements will be:

- **Design and development of the database system**: all the data we will have access to: posts, school organization, users, links and dynamics, will be stored in our own databases and rightfully codified.

- **Design and development of an online platform**: this means we will create a platform from scratch by programming all the functions and storing all the information in our own databases. The online platform will include a messaging system, surveys

that can be filled by students, an anti-bullying lesson program as its more interesting features.

- **Creation of an admin independent panel**: apart from the platform or app itself, we will create an area where the admin user will manage all the information inside our databases and will be able to upload new schools, users or posts.
- **Development of a responsive app**: we will create a simple multi-device app that will enable us to reach from computers to smartphones or tablets.

1.3 Structure of document

Here we will give a guide of how the document is structured and will briefly explain the parts treated in each chapter present on the document.

The remaining of this document is structured as follows:

- ***Chapter 2:*** **State of art**

  In this section we discuss some current solutions that exist and that are related to our project. We also analyze them in order to discover our strengths and weaknesses regarding the field and the market we are trying to reach.

- ***Chapter 3:*** **Enabling technologies**

  We justify the choices we have made regarding the project's development and we briefly explain these technologies and how they interact with each other.

- ***Chapter 4:*** **Architecture and methodology**

  In this chapter we deepen into the system in order to understand how everything is structured and how it will all be put together in order to create a functional platform.

- ***Chapter 5:*** **Case study**

  We have a look at practical cases regarding the different roles we have inside our platform in order to better understand the way users interact with the platform and how it works.

- ***Chapter 6:*** **Conclusions and future work**

  This chapter serves like a summary where we check if the goals we set at the beginning of the project have been fulfilled and how we have overcome different situations faced during the development. We also present possible future lines of work to continue developing a better solution and adapting to the changing conditions of the market and the needs of the users.

- ***Chapter 7:*** **Bibliography**

  This section is a record of each source we use throughout the project in order to give credit to their authors and to help understand the decisions made in the development.

- ***Appendices:***

  We will include two appendices to this document: in the first one we will analyze the reach of this project and how it may impact different areas in society like social, economical, environmental. The second appendix will cover the estimation of costs like the one we have conducted by counting the hours and the tools we have needed to perform all this project.

CHAPTER 2

State of Art

In this chapter we analyse the problem we are trying to tackle with this project as well as the different platforms that are already in the market, the features they include and how are we going to do them. This analysis will help us realize if our project will create real value to the users and if it brings new things to the table the rest of the competitors don't.

2.1 Introduction

Bullying is a very complex problem that is present in almost every situation students have to face throughout their educational trajectory. This problem does not only involve the student that suffers it and the aggressor, it involves each and every student inside the school either they witness the abuse or not. All behaviours inside the school and specially the abuses conform the environment that will be present inside the school. Because of the complexity of bullying and the many ways it manifests itself, schools and companies have tried to solve the problem from various perspectives and have created many different solutions.

Before starting our project, we have carried out two main lines of investigation. First, we have investigated how bullying impacts society, how it affects students and families and the consequences of these abuses on the short-term and long-term development of people throughout their life. Secondly, we have deepened on how technology is helping to find new techniques or solutions to prevent and eradicate bullying and other types of abuses.

We have gone through a great number of articles, surveys and literature to really understand the dimension of the problem, all the approaches there are as well as how the problem manifests throughout the world. Our main goal with this investigation is to better understand how bullying appears and what are the characteristics that trigger it, as well as the complexity of the topic. A recent survey conducted in Spain by UNICEF [7] in 2019, for example, showed that a 9,36% of teenagers and children consider bullying as the main concern for people their age just behind the studies and formation (19,71%) and in front of other issues such as work and future perspective (7,27%) or contamination (3,96%).

We have also investigated many different solutions that have provided us with very important information about the way the technology is being used in the market and that have helped us understand some user needs we believe need to be fulfilled and that are being sometimes overlooked by the current solutions.

Thanks to this research, we have found out that most of the companies are focused on giving people the tools to report bullying cases or to intervene when cases have shown up. Some of the solutions we will see below are based on chats or in the extraordinary intervention of experts and psychologists that can be hired by the schools when the problem is detected.

As we will see, many of the platforms we will analyse cover specific areas that our project does too like student-teacher communication, but others don't really get into the education field where we think most of the work needs to be done.

However, we strongly believe that the solution to bullying is not only to attack it when it appears but to teach students in how important it is to respect the rest of the people

whatever their situation is and avoid these type of behaviours.

2.2 The problem

2.2.1 UNESCO Report 2019

One of the most important and interesting articles we have found is one published by UNESCO [1] in 2019. This article makes a global analysis of bullying around the world and analyses the trends of each region and their history. Since our app is expected to be operative in Spain, we will pay closer attention to all the data from Europe to better understand the social context.

The article we are analysing is named *School violence and bullying: global status and trends, drives and consequences* [1] and presents a detailed summary of the evidence on the nature of bullying, what drives it and the physical and mental health consequences it may produce. For the first time, an article by UNESCO merges information from two large-scale international surveys such as the Global School-based Student Healthy Survey (GSHS) and the Health Behaviour in School-aged Students (HBSC); allowing it to cover 144 countries all over the world. The document provides an analysis of trend data to show changes over time and presents more precise regional statistics. It also measures countries' responses to better understand the factors that help eradicate bullying and other abuses.

Figure 2.1: Conceptual framework of school violence and bullying. Source [1]

Bullying is a very complex problem and can present itself in many different forms. However, it has three main aspects: physical violence, psychological violence and sexual violence. Bullying appears most of the times as the combination between physical violence and psychological violence, but it can also appear in one of this areas excluding the others such as physical attacks, verbal abuses or gender-based discrimination. All this problems prevent countries and school to create a healthy environment where their students can be who they are and completely develop as people inside an advanced, inclusive, cross-cultural society.

According to the surveys named previously, bullying can be defined as the aggressive behaviour that involves unwanted, negative actions, is repeated over time and an imbalance of power or strength between the perpetrator or perpetrators and the victim. To consider someone as a victim of bullying, aggressions have to occur, at least, once or twice a month.

On a global basis, one out of every three students has been bullied in the past month. Whilst there are significant differences across regions in the statistics, North Africa has a 42,7% of students reporting bullying and Europe has a 25%, the numbers are very high and are a big concern in the teaching environment. But the differences don't stop on the number of cases, we can also find important differences on the most common types of bullying on each region. While physical bullying is one of the two most common types in all regions except Central and South America, places like Europe have 15.1% of bullying cases to be psychological. Anyway, these are the three most common types of bullying suffered globally:

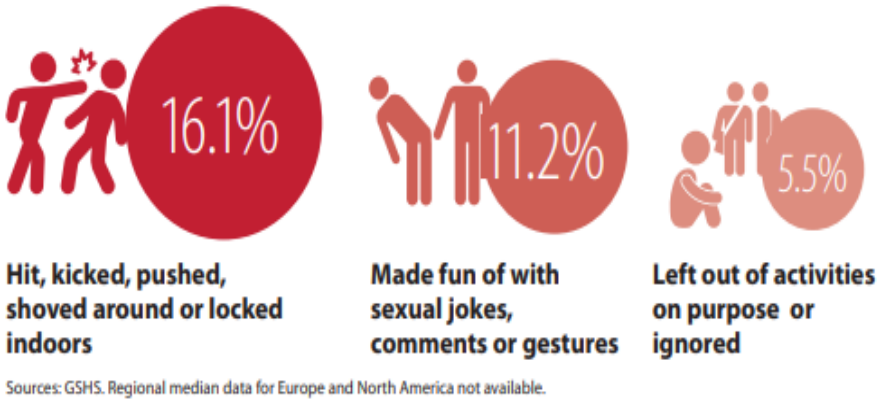

Figure 2.2: Most common types of bullying globally. Source: Secondary analysis calculations based on GSHS data. [1]

We must highlight again that, even though these are global tendencies, in Europe psychological bullying is much more reported that in other regions with a 15.1% of the cases being related to being left out or ignored by other students being the global average 5.5%;

while sexual bullying it was reported less frequently.

It is also worth mentioning how cyber-bullying has grown in the last years. In 7 European countries, the percentage of students between 11 and 16 years who used internet and suffered cyber-bullying increased from 7% in 2010 to 12% in 2014. This information is a very good indicator of how the use of technology between teenagers and children is increasing and is taking over as one of the most important ways for them to socialize while also exposing themselves.

Another interesting data shows that both girls and boys are equally likely to experience bullying around the world. Although, overall, the percentage of boys and girls who suffer bullying is similar, we find large differences in the types of bullying each gender suffers. Male students suffer much more physical bullying than female, while female suffer more psychological bullying. This results are of no surprise since, in average, boys are more violent than girls and, while men are, again in average, more interested in things, women are more interested in people.

This statement is not trivial and can be demonstrated with simple examples. As we know, men and women are more alike than they are different. If we took a man and a woman out of a crowd of 100, the probability of the man being more violent than the woman is only of 60%. However, if we selected the most 100 violent people, the proportion of men would be overwhelming in comparison with women.

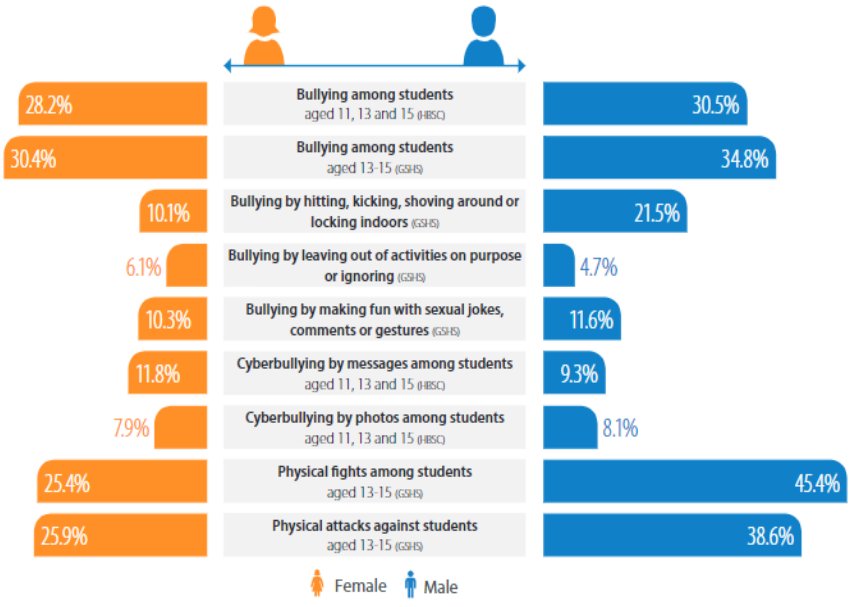

Figure 2.3: Percentage of boys and girls affected by bullying. Sources: Secondary analysis calculations based on GSHS and HBSC data. [1]

The data indeed supports our reasoning as we see a 45,4% of physical fights and a 38,6%

of physical attacks are present in male cases whilst only 25,4% and 25,9% of these two types appear amongst female students. As we said, even though the nature of the cases is different for each gender, the total result is very similar in a global level.

Another really important data we can extract from this report, is the motives behind bullying. Globally, a 15.3% of students are bullied because of how their body or their face looks, 10,9% suffer bullying regarding their race, nationality or color and 4,6% because of their religion. If we focus on Europe we find that one in four students suffers bullying because of their physical appearance, with 50.8% of victims of bullying not being satisfied with their body image and 17,2% of them suffering overweight. Europe, however, is under the average in race, nationality or color discrimination with only 8,2% of its students being bullied because of it; and also in religion issues, where 3,6% of students are victims of bullying because of their beliefs.

We also can see a relation between the social status of the student's family and the probability they suffer bullying. In Europe and North America, the numbers increase in a horrible way, 27,4% of the students who suffer bullying have a high social status, 30% have an average social status and 40,4% are from a low social status.

For us, one of the most important information from this report and that encourages us even more in the realization of this project, is the conclusion that a positive school environment reduces bullying. The data shows that the schools with a good discipline have 7% less of bullying cases and schools where students are treated fairly by teacher have 12% less.

Regarding consequences, bullying has a great number of, not only immediate consequences, but also long-term repercussions. Apart from feeling like an outsider in school, students who suffer bullying score lower in tests and are more likely to drop out before ending their studies completely than students who are not bullied. But bullying does not only have academic consequences, it also affects the habits of the victims and makes them more likely to feel lonely, consider suicide and abuse of drugs or alcohol.

2.2.2 European Guide of anti-bullying Good Practices

Thanks to the DAPHNE III program [8], which was a program applied from 2007 to 2013, aimed to contribute to the protection of children, young people and women against all forms of violence; many different projects were implemented providing a great variety of results in terms of research and revealing good practices and various aspects of the phenomenon. However, all these actions were implemented in each country individually and there was not a central strategy at European level.

In 2014, the European anti-bullying Network published a document called *"European*

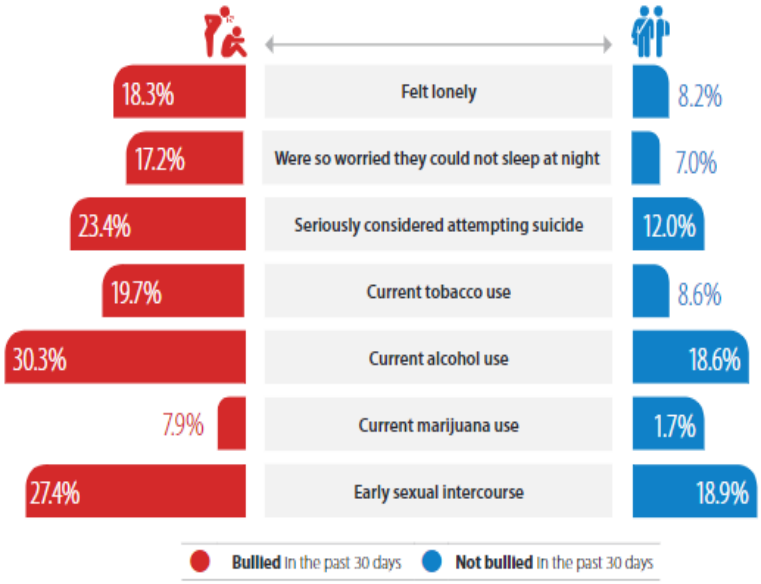

Figure 2.4: Differences in mental health status. Source: Secondary analysis calculations based on GSHS data. [1]

Guide of anti-bullying Good Practices" with the purpose of processing and evaluating the results of actions against bullying that where taking place in different countries in order to create a common European strategy. The project also looks to make more efficient and common policies at European Union level. At the time the report was made, the phenomenon of bullying was constantly growing and getting more intense both in terms of age and in relation to its different forms.

Thanks to the analysis of all the participant countries including France, Italy, Lithuania, Latvia, Spain or United Kingdom, amongst others, this document includes sixty good anti-bullying practices that were implemented at some degree in these countries. All this practices that were developed at a country level can be grouped in seven types:

- Audio-visual Anti-bulling Practices examples: this includes sessions that are supported by videos or podcasts that allow the children to see the problem is real and how it affects real people.

- Awareness raising initiatives: to inform not only the children, which are the ones involved directly by being either victims, aggressors or witnesses, but also their families and the teaching staff, who are the ones that need to teach them.

- Educational anti-bulling tools examples: these can include programs, initiatives or activities aimed to prevent and eradicate bullying by teaching everyone involved in the problem.

- Intervening anti-bulling strategies and tools examples: this category includes practices or methodologies that create more ways to respond to bullying.
- Organizations: some countries have created agencies that study the problem, create initiatives and support and defend the groups affected by the problem of bullying.
- Prevention programs examples: these programs include the development of practices in order to prevent bullying in schools.
- Telecommunications and information technology: electronic and online anti-bullying resources. This type is the one that is going to experiment the most important increase in the next few years with the arrival of cyber-bullying and the rise of the use of technology among children.

Focusing on the solutions implemented in Spain, where we are going to start our project, we find that a series of good practice examples with different characteristics have been established with the goal of tackling bullying. PEAB (Peer Education Against Bullying) was a training approach that was developed in collaboration with Italy and United Kingdom that aimed to give children the means to develop strategies, both behavioural and communicative in order to face peer violence episodes. The initiative included debates, discussions and elaboration of material by the students to make them aware of their own aggressiveness or submissiveness and the consequences they have on others.

Another project that is worth mentioning is ProSAVE, a European project developed with the collaboration of organizations from six European countries, included Spain. The project aims to create measures to prevent what they call "social violence", specially the kinds not punishable by the penal code such as leaving someone out of groups or ignoring them, spreading lies, intimidation, physical harassment or social discrimination. The project aims to the direct involvement of all, a priori, indirect actors such as teaching staff and families. Schools are responsible of elaborating rules and organizing sessions with the parents of the students where they will watch videos, read brochures and participate in activities to spread the project. The results of this program were immediately visible: trends towards violence decreased significantly in the classes where the program was used and the relationship between the students in terms of co-operation, empathy or responsibility increased significantly.

2.2.3 European Commission: Anti-bullying strategies in schools

Throughout the last years, the European Commission has started a series of projects regarding bullying, its consequences, strategies to tackle it or the importance of peer support

in the prevention of abuses. The two main projects we are analysing are: *"Anti-bullying strategies in schools"* and *"Peer support and youth participation in bullying prevention"*.

The first project included the creation of the Action Anti-Bullying (AAB), which successfully tested an innovative approach to reducing bullying by addressing the causes of bullying and creating a healthy environment both inside and outside of the school, but without the presence of isolation and punitive sanctions to the aggressors. The project created two development packs with training programs for the teaching staff that would later transmit these concepts to the students and their families. The data collected from all of them through an online platform was analysed and stored so schools could access their results and have a look at the national landscape.

If we take a look at the Handbook of the Action Anti-Bullying, we find that it is based on ten key values that possess schools that effectively fight against abuses and violence. This values include the acknowledgement of the problem, the effects and forms of bullying, regular evaluations of bullying in schools, policies and strategies to a healthy environment, school leadership, personal formation, student and families participation and the values of society.

While all these key characteristics are important, probably one of the most interesting ones is the acknowledgement of the effects of bullying. If these kinds of abuses are to be reduced, there needs to exist a shared comprehension of them between all the people involved, students, teachers and families; as well as a proper understanding of how to act when it happens. According to this study, we can recognize six types of bullying.

The first five are know as traditional harassment: physical aggression, which can be divided into direct aggression when the person is hit, pushed or kicked, and indirect aggression when the violence concentrates on damaging the person's property such as books or bags. Verbal aggression includes the persistence of insults with the goal of humiliating and hurting others with sexual, ethnics, academic or economic motives. Gestural bullying includes aggressive corporal expression such as pointing an imaginary gun. Exclusion and isolation can be the most difficult to detect and leave the victims isolated when they try to create relationships and socialize with their peers. The fifth form of traditional bullying is the blackmail or extortion where someone is threatened with bad repercussions if they don't obey orders like giving money.

Cyber-bullying is the sixth form of bullying. It is more recent and has increased significantly as a consequence of the appearance of social media and its popularization between children and teenagers. The most common forms of cyber-bullying include text messages, videos or images that are published on the internet with the intention of humiliating someone publicly.

Victims of bullying can suffer from physical illness like insomnia but also can have

psycho-social and emotional repercussions for the rest of their lifes. In the most extreme cases, bullying can provoke auto-inflicted injuries and suicidal tendencies or attempts as well as depression. But they are not the only ones who suffer consequences of bullying. Aggressors turn out to experiment suicidal tendencies and depressions in even a higher number that victims. In addition, the probability of drug abuse and breaking the law are more common between people who bullied others when they where younger.

Another point of the document that has caught our attention is the one regarding the involvement of students. In this section, after exploring a variety of methods all over Europe, we find some conclusions that can be extracted from these analysis. It is of supreme importance to understand the different roles that young people can adopt in the groups they have in the school. A good and proper program can allow all the students to find out how does it feel to be in each role, from leader to problem solver or mediator. There are three characteristics of the pair strategies:

Firstly, students are perfectly prepared to work with people outside their friendship circles. With these type of dynamics, students tend less to create prejudices, have more trust on other groups and are better at integrating people who were previously left out.

Secondly, students acquire good communication abilities. Thanks to these peer-support systems, the teaching staff can create regular opportunities where all students can participate in activities that require a group effort.

Thirdly, these systems provide a platform to analyse the procedures that guarantee the student's safety and, thanks to them, conflicts are discussed and efforts to solve them are made. These opportunities can lead to students assuming their responsibility and getting involved in the positive dynamics the school needs in order to end with bullying and all the abuses that affect the environment inside the educational system.

Finally, the importance of involving families in this problem is explained. Parents are the role models for students, specially in their early ages, so achieving their involvement in the promotion and development of good practices and having them transmit this to their children and lead by example is crucial to ensure a better behaviour both at home and at school. A coordinated action between the school's teaching staff and the parents of the students as well as an opened communication between them is of extreme importance to guarantee the security of the school's environment and the quick tackle of problems.

2.2.4 European Commission: "Peer support and youth participation in bullying prevention

In contrast to the first project, which was aimed in the detection of bullying and the ways to tackle it, the second one, named *"Peer support and youth participation in bullying*

prevention", is focused on empowering young people, teaching staff and families to prevent bullying in any of its forms. Six organizations participated not only to create a new program but to update the ones that were working and to create a learning collaborative network regarding methods of bullying prevention.

Figure 2.5: Bullying effects on learning and school engagement [2]

As we can see in the figure, bullying has an enormous effect in school relationships and behaviours. Students who are victims of bullying trust less teacher-student relationships and have worse experiences regarding themselves and the relationships wit their peers. The percentage of students who answer positively to questions like feeling accepted or feeling teachers will help in solving conflict is much lower in students who suffer bullying than in the rest of students. We also appreciate an effect on the student's self-confidence when questioned about their capacity of learning or solving issues.

These results point out the necessity of the existence of classroom rules that are followed and applied by students and by teachers who, in the end, are the ones who have authority and need to guide the students in their development as individuals and as a group. The reaction of peers to bullying is as important as the teacher's. Their beliefs about bullying and its causes affect how they act and intervene when an abuse appears. In addition, teacher's attitudes regarding this problems affect in many occasions their student's attitude too.

All this data we have collected confirms most of our previous assumptions and has helped us understanding how bullying works, which are the signs, the importance of making everyone aware, from students to teachers, families and society; of the importance of a bullying free environment. We also have had the opportunity of studying all the consequences that bullying has, both immediate such as relationships with the teaching staff or other students; and long-term effects such as suicidal tendencies, low self-esteem, psycho-social problems, anger problems or drug abuses.

2.3 Review of Platforms

2.3.1 KiVa Program

KiVa program [9] is as an innovative anti-bullying program developer by a group of experts from the University of Turku, Finland using cutting-edge research on bullying and its mechanisms to prevent it and to effectively take care of the cases that appear.

The KiVa program is evidence-based and aims to prevent bullying by tackling the cases that show up effectively. The program is based on three concepts: prevention, intervention and monitoring. These three concepts interact with each other since not only the former is important, but also the latter, so focusing on just preventing it won't solve the problem and make bullying disappear. With this in mind, tools need to be used to intervene a situation where a case of abuse is discovered. KiVa includes different online tools that produce feedback and reports for the schools so they can review how they have followed the program and the outcomes they have achieved.

Figure 2.6: KiVa Program

According to them, the KiVa program includes two types of actions: universal and indicated. The universal ones focus on the prevention concept and consist of games and lessons to teach the students about important values such as respect and tolerance to prevent bullying. The indicated actions are reserved to the intervention phase and are targeted to bullying victims, witnesses and aggressors in order to support the first two and to discourage the last.

It also includes teachers' manuals, games, student surveys or guides to provide all the actors with the best information and to prepare them to act against bullying.

The effectiveness of Kiva has been shown in a large number of studies performed in Finland to the point that most of all comprehensive schools in the country are registered in the program. It has more than 20 years of investigation to support it and is present in many countries such as Holland, Italy or Estonia as well as Finland. It has won several awards, both national and international, like the European Crime Prevention award in 2009.

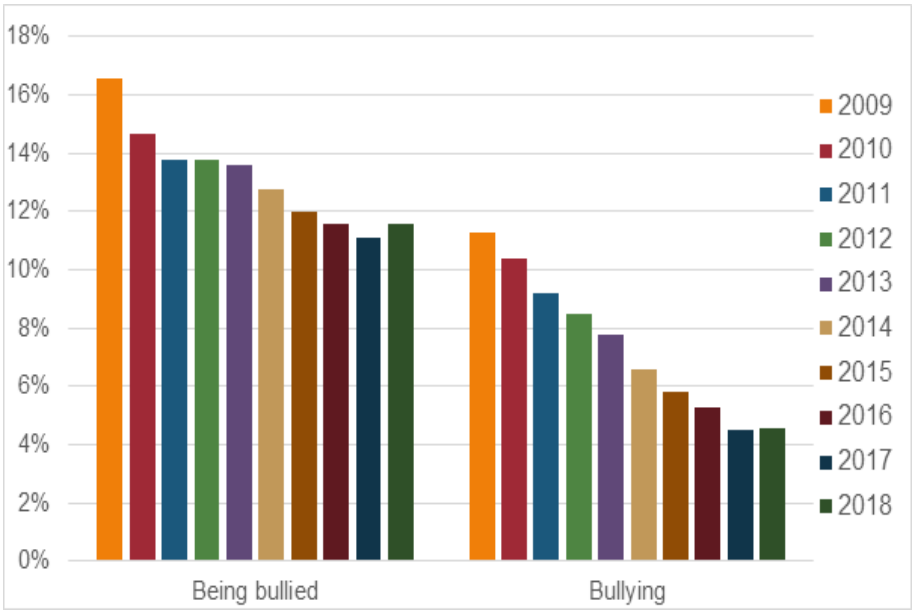

Figure 2.7: Proportion of students bullied or bullying in Kiva Schools [3]

This program is the most similar one to the project we are developing and has most of the functions we are including in our platform. It contrasts with other applications we will see later since it focuses on the formation and education of students and families on the prevention and intervention of bullying and other abuses but does not cover the communication part as much as the rest.

2.3.2 B-resol

B-resol [10] defines itself as a solution to fight against bullying, cyber-bullying, harassment, eating disorders or any other type of conflict between teenagers by using technology as an innovative element. It is a free app that can be hired by schools to provide their students with a platform that they can download and use. The app empowers students, both victims and witnesses, so they can alert of a situation immediately and safely.

The app consists on a chat where students can communicate with the school counselors about any conflict. Inside the app, they can select who they want to write to and if they want to do it anonymously. In addition, the app has a news channel where posts and videos are uploaded and are available for every user. Here, they sometimes organize webinars with groups of experts from important organizations to help everyone understand the seriousness of bullying and other abuses and the importance of using all means necessary to stop it.

The platform also gives access to the school to a control panel where they can monitor the actions taken and the alerts received by generating reports, create PDF files to measure the effectiveness of the actions performed in each situation and to consult statistics. All

this with the support of experts in different tasks that council them continuously.

The app also allows to generate PDF files with the reports of each incident and facilitates the monitoring and evaluation of the measures adopted with each conflict.

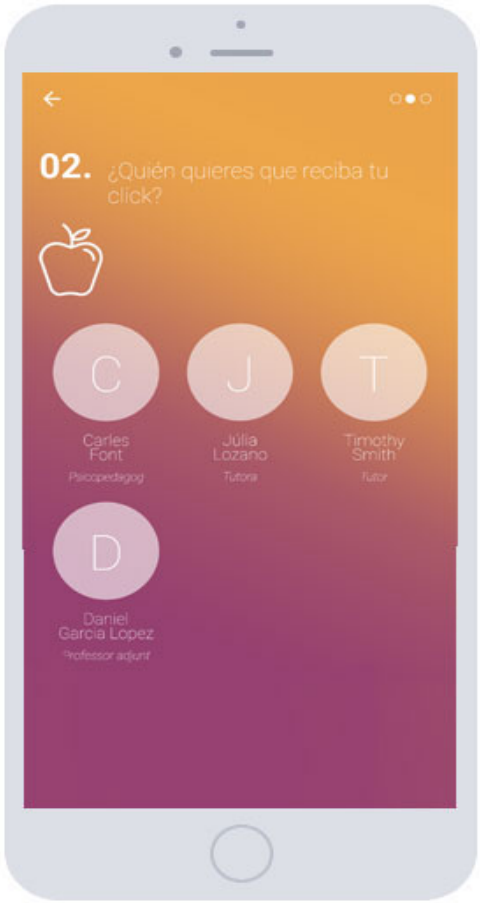

Figure 2.8: B-resol

As we can see, this app includes one of the functionalities we will have in our project, but does not go much further in trying to teach the students about the values and the behaviours that lead to a good environment we are aiming for in our project. This project in particular shows us that our idea of including a chat between the students and their families and the teaching staff is a good direction but we must not stop there and continue expanding our offer.

2.3.3 Appvise

Appvise [11] is a service based on a school communication app that allows creates a system to enhance the environment in schools and to fight against bullying. This mobile app developed in Spain gives the teachers a way to contact with a certain student or his family,

all the students in a class and their parents or all the students in the school and their families to make announcements such as school outings, reports of activities, performance or conflicts.

However, even though the app is focused on the day-to-day communication, it includes a section called Stop-Bullying that works as a direct communication instrument so students can report anonymously any abuse or case of bullying. In this anti-bullying section, the app also includes some formations directed to parents, teachers and students to help them to learn about bullying and its detection.

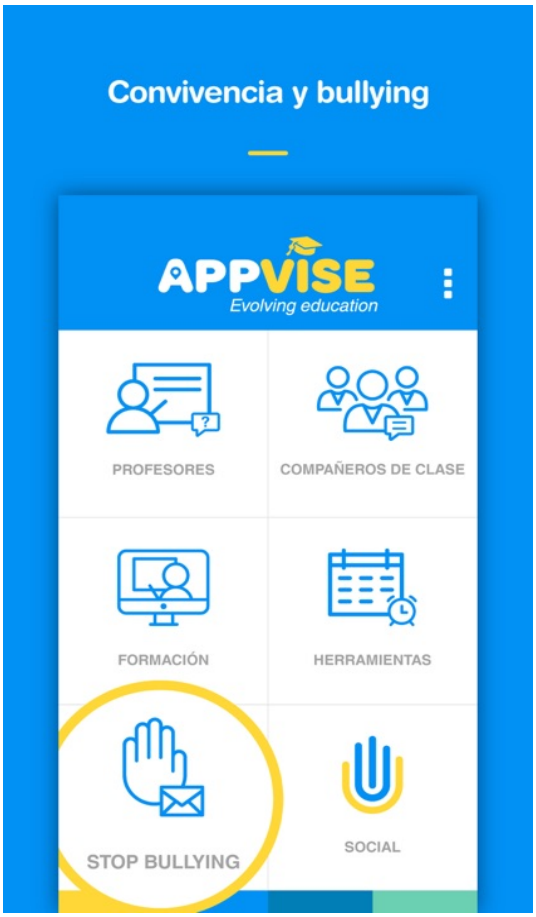

Figure 2.9: Appvise

This project is more focused on the effective communication between schools and families and the notification and detection of conflicts inside the school such as bullying. However, it hardly covers the education part we are aiming to and the creation of dynamics to do in class that will help to educate the students in the respect of each other.

As we can see, these platforms and applications share some characteristics with our project but, after analysing them and their goals, we have realized there is a big void in the education of children regarding bullying and the ways to create a healthy environment in

the classroom.

As we have stated before, not only we want to provide students and families a tool to communicate with the school in case something happens, but we also want to give the teaching staff the necessary tools to teach their students about very important values such as respect, leadership and acceptance while they develop their social skills.

2.3.4 ZeroAcoso

ZeroAcoso [12] was born with the objective of fighting and eradicating bullying. Its efficiency is based on the communication by anonymously connecting students with professionals to make possible to approach the problem from different angles. It is a private app that can only be used by members of the school that has hired the program. It provides the necessary materials to inform and educate everyone, from teachers to students and families, using presentations, guides and videos. Its purpose is to empower the victim and the observer in order to face the problem. ZeroAcoso connects anonymous students with people that can help them thanks to native iOS and Android apps.

The standard version includes the possibility of conducting surveys to all the student to measure the level of bullying in the school and to review which problems are more typical. This survey system gives students the opportunity of explaining how they feel regarding their peers and how they are treated.

The ZeroAcoso project is based on three pillars: formation, technology and intervention. The formation aims to involve all the education community by providing the tools to all the actors: counselors in charge of managing the information and coordinating the interventions, teachers that are the ones who actively interact with the students and help them to understand the importance of a healthy environment; students and families. The technology has helped to give a new point of view by empowering witnesses and victims against cases of bullying, racism or any other abuse.

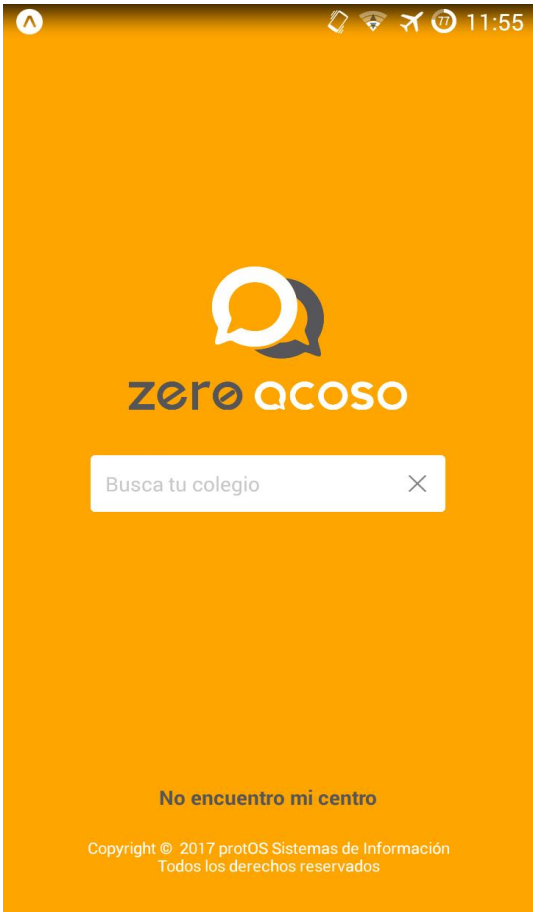

Figure 2.10: Zero Acoso

ZeroAcoso's app also gives the school access to detailed statistics and reports about the surveys results and the messages. Thanks to this information, schools can discover which category of bullying is affecting their students more, the number of messages sent by students in a period of time and filter all the results by date or category.

All this statistics give the teaching staff the opportunity of performing more effective actions after direct observation of the problem.

2.3.5 All Together Hub

All Together [13] is a whole-school anti-bullying program developed by Anti-Bullying Alliance in United Kingdom. A school that signs to the program will have access to a number of features that aim to reduce bullying of all children and young people in the school. The platform includes a pupil well-being questionnaire where the teaching staff is able to monitor progress over the course of the program and to know about levels of satisfaction and abuses like bullying among the students in the school. The Anti-Bullying Alliance website also includes a section with tools and information that explain bullying, good anti-bullying

policies, the prevalence and impact, how to prevent abuses of any type or what we must do when reporting bullying. One that really caught our attention gives some tips on how to develop surveys and questionnaires for students regarding bullying. For example, their research has shown that the results of asking behaviour-based questions instead of single item questions asking directly about bullying are more complete and give more valuable information. According to their research [14], they suggest that the questionnaires must cover four different areas: student's experience of bullying, assess bullying behaviours, school's climate including relationships with other students and with the teaching staff; and emotional and behavioural problems to measure the impact of bullying in the students.

The platform also includes resources to help tackle bullying including online training for students and teachers as well as families. All members of the school that signs to the program will have access to the All Together Hub, the online platform where schools are able to audit their current anti-bullying practices and where they can create customized action plans that fit perfectly into their needs and that are aimed to stop bullying in the school.

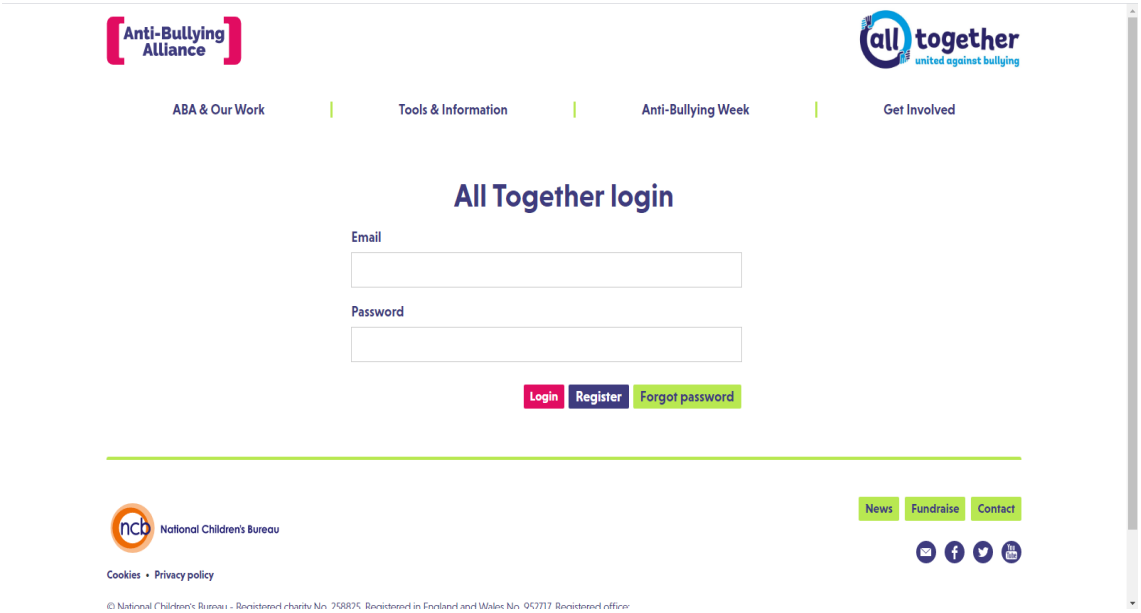

Figure 2.11: All Together Hub

This platform makes an important research thanks to which they are able to offer many resources and formations that are more efficient in achieving their objectives of decreasing the number of cases of bullying in the schools. We also realize they give a lot of importance to the elaboration of questionnaires to students and the way they have to be written to get the results as complete as possible. They also include an audit tool where the school management can set objectives and do a follow-up of them to see when and how they are

fulfilled.

2.4 Conclusions

The analysis of a great number of articles, from UNICEF Spain to various scientific papers and documentation but most importantly of the UNESCO report has enlightened us with very important data that will allow us to execute different approaches to the problem of bullying by better understanding the situation and the trends present in Europe and the world. Having all the statistics we have talked about and many more have convinced us in the importance of the creation of an effective method in the prevention and the intervention of bullying cases. This data also helps us in dividing our program in blocks and lessons that will cover more precisely all the situations around bullying and discrimination in order to offer a better solution with even better results. Moreover, all this data has also helped us in the steps we must take with the functionalities of our platform and what areas should be covered most. The prevention and education part has to be powerful and really help all users, from teachers to students, understand the importance of a healthy environment inside the school with the goal of achieving better academic results and including everyone in the dynamics and activities that are carried out. This will result in a better perspective for every student in the school and prevent them from falling into bad habits or dropping out of the school, among many more benefits.

But our analysis of the state of art does not stop on these reports, we have investigated how technology is being used and how different companies are creating solutions like apps and programs to try solving the problem and helping students, families and schools in the prosecution of this goal. The approach are very different but we have focused on how it is taken care of in Europe and, most importantly, in Spain, where our platform will be deployed at first; but with perspectives of going international.

Most of the solutions we have studied focus on the communication after the abuses or cases of bullying have appeared. They offer a secure way for students, families and teachers to communicate their problems to professionals by offering them a platform with a chat that where they can, anonymously if they prefer, report any abuses they are victims of or they witness.

After analysing all of them, we have realized that discrimination and abuses like bullying in any of its forms can be divided in four main phases in order to try and solve them: prevention, notification, intervention and monitoring.

- Prevention covers and includes all the actions, passive or active, that can be made by educating and teaching the society and the children in how to treat each other,

respect everyone no matter their age, gender, family, condition, religion, culture or any other factor. The prevention phase is probably the most important one because if a great work is made in educating society and children, they will be less likely to discriminate someone and commit abuses over them and will lead to the eradication of bullying in all of its forms: physical, psychological, sexual or cybernetic.

- Notification is probably the most hard part since abuses could be hided behind other behaviours and interests. In some cases it is easier because the bullying is performed in front of witnesses that speak up but, in many others, the aggressors carry out their actions more privately. In all cases, both the victims or the witnesses need to be brave and feel empowered in order to talk to professionals that can perform the actions needed.

- Intervention is the phase that goes from the moment the abuse is detected or notified to the moment decisions are taken and actions are performed with the goal of ending those types of behaviours and the appearance of new cases of abuses regardless of their nature.

- Monitoring is the last phase and has a lot in common with prevention. In this phase, professionals like psychologists or teachers control the environment and the behaviour of students and are always on the lookout for signs of new problems.

The solutions we have studied in the preceding sections are mostly focused on the notification and intervention phases. Here we can see a general comparison between the different platforms we have studied:

Before analysing this data, we must highlight that, while All Together has a very large number of schools around England, the Kiva Program is probably the most successful one between all this platforms at a European level, so the importance of their characteristics is somehow bigger than the rest. Anyway, we can see some clear patterns in these solutions. The importance of a chat is something widely extended in the state of art, giving the students and the teachers a tool to communicate with each other helps solving most of the problems right from the moment they appear. While platforms like Kiva or All Together have a complete lesson program, some of the solutions like ZeroAcoso don't include a whole program of online sessions in their app or platform, but they highlight the importance of prevention and the organization of sessions to teach students and families about bullying and its characteristics. Surveys and their analysis also appear as an important part if the solutions. They allow the school to know how the environment is affecting their students and can help them detect cases of abuses right from the beginning and perform more efficient actions.

	Chat	Lesson program	Surveys	Online Platform	App
Kiva Program	No	Yes	Yes	Yes	No
B-Resol	Yes	No	No	No	Yes
Appvise	Yes	No	No	No	Yes
ZeroAcoso	Yes	No	Yes	No	Yes
All Together	No	Yes	Yes	Yes	No
Our Platform	Yes	Yes	Yes	Yes	Yes

Table 2.1: Comparison between studied solutions

Another important part is the architecture of the solution. Some of the ones we have studied only have an app but some others only possess an online platform. We think our solution needs to be completely across the spectre and include both types in order to make users more comfortable when using it. We will mainly develop an online platform because the platform is aimed to be used by teachers in class, so they will access it via computer. In addition, we have much more over expertise in the technologies used to the development of an online platform so the process will be much quicker. However, we also want the students to access the platform anytime in a comfortable way, so we need to create and publish an application they can download and use in their own phones.

B-resol is based on an online chat where students can choose who they want to anonymously contact, from teachers of their school to expert psychologists, tell them their problems and if the suffer or have witnessed bullying or abuses of any kind. The main goal of this app is to empower the victims and witnesses, which is one of the most difficult things to achieve.

Appvise deepens more on the communication between students and their families and the teaching staff of their school but does not focus as much on abuses and bullying. This app offers a new way for teachers to send general or particular messages to the parents of the students regarding future activities like school outings or problems that may appear in the classroom. Even though we said this app does not focus that much on bullying, it includes

a section called Stop Bullying where they briefly cover the four phases we previously talk about. They include cooperative learning and participation, a mailbox to report any abuses and charts with statistics of bullying cases detected.

The KiVa Program is based on three aspects very similar to the four phases we have talked about. It provides a different approach to the bullying problem and, instead of only focusing on the communication once the problem has appeared, the program includes lessons to educate students and prevent the problems. Also, it includes online classes for students and teacher to help them learn about emotional intelligence and empathy and, also, a virtual mailing system to anonymously notify the appearance of cases. This one is probably the most complete we have studied and has helped us to define our objectives and complete some functions.

ZeroAcoso has a very similar approach to the bulling problem to the one from B-resol. It focuses on the communication between students and the teaching staff and the notification of abuses, but it also has a survey where students can reflect on their position on the class, how they fit and if they suffer or know of someone that suffers abuses like bullying. As we see, ZeroAcoso has a wider variety of services and offers the schools that hire them the access to statistics of the surveys and the messages to generate reports.

The All Together program is focused on the education of children and teachers in the importance of tackling bullying and stopping any abuse that appears in schools. To do so, they give the users a big variety of resources to work with online and offer a questionnaire where students can reflect their problems so the teaching staff can detect conflicts and monitor how their policies are being applied and the results of its application.

To sum up, our project offers some innovative aspects in this field by offering a platform where teachers and students can access to carry out dynamics and games in class at anytime and creating an space to share their experiences inside the classroom and, at the same time, educating and entertaining the pupils.

CHAPTER 3

Enabling Technologies

This chapter offers a brief review of the main technologies that have made possible this project, as well as some of the related published works.

3.1 Core Web Technologies

HTML, CSS and JavaScript are the basic development technologies used in almost every website or platform. These three technologies allow us to create a completely customized environment which we are able to control everything on it.

HTML [15] is the basic language used in the design and development of websites. It creates the basic structure of any page by the use of different tags to represent texts, images or any other content we may want to include inside our document.

HTML is not a programming language per se, it only allows the creation and insertion of texts, videos, images, links or forms in our website. The HTML structure is based in blocks defined by tags that help mark up the different parts of the document like the general ones: head, header, body or footer; and others more specific such as divs, paragraphs or sections.

The HTML files are sent from the server to the web servers, who compose and render the appearance of the website based on the structure of these files. However, HTML only describes the content and its organization inside different containers or divisions but, to create something more unique, HTML needs from other technologies, that will be explained later such as CSS and JavaScript, to reach its full potential.

CSS [4] (Cascading Style Sheets) is a stylesheet language that states how the content, fundamentally inside a HTML written document but also in XML and its dialects, must be displayed in the website. It is used to provide style to these documents by the use of classes or ids inside the HTML tags, which are later assigned properties in the CSS file.

CSS is nowadays standardized throughout all browsers according to the W3C specifications [16]. When a browser renders a file with HTML and its CSS information, a complex process starts where different actions are performed to correctly display the information according to the conditions provided. Roughly, what happens is:

1. Browser loads the HTML file from the server.

2. The HTML is converted into a Document Object Model (DOM) which represents the document in the computer's memory.

3. The browser obtains the resources the HTML and CSS files point to: videos, images and external links. We will later see JavaScript as it is processed later.

4. Once this resources are fetched, the browser applies the CSS rules to the different elements in the HTML files they apply according to their classes and ids.

5. After all this rules have been applied, all is structured and shown in the screen.

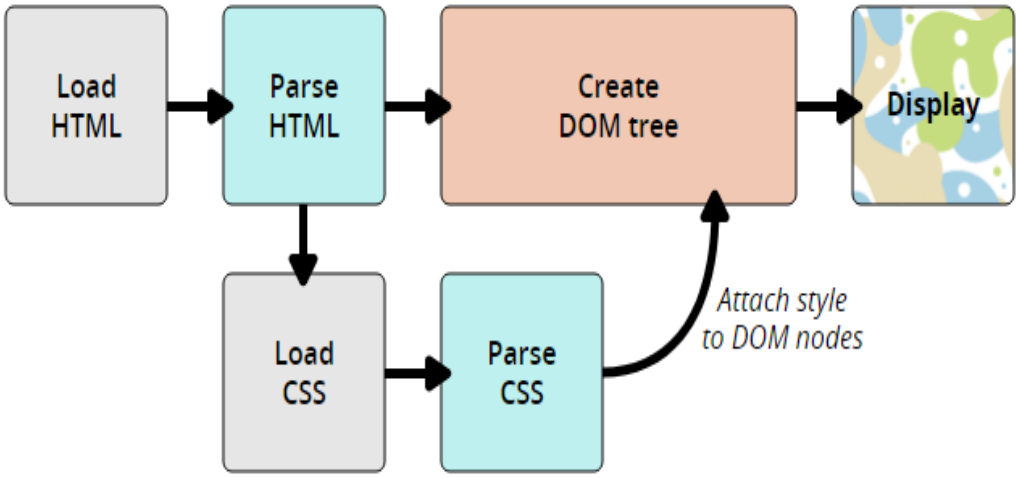

Figure 3.1: CSS and HTML render process. Source: [4]

It is worth explaining the concept of **DOM** [17] and how it works. The Document Object Model (DOM) is a tree-structured representation of the HTML document where each label, target and element corresponds to a node of the tree. A node can be parent, children or both. This means that each node depends on others above him and has some other elements under him that depend on him.

Summing up, the DOM is an object-oriented representation of the HTML document we had at the beginning, but thanks to this new structure, scripting languages like JavaScript are able of modifying it.

JavaScript [18] is a programming language that can be used both in the client and the server side with different purposes. In this project we will focus on the client-side use of JavaScript since we will use PHP to perform most of the functions on the server side.

The client-side is focused on running scripts with functions that interact with the HTML and CSS code and perform actions that could not be executed otherwise like dynamically changing classes or properties.

JavaScript enters the game once the Document Object Model is created. Once this tree-structured file is created, JavaScript is able to access it and perform a great number actions that help us deal with events and many other situations we would not be able to resolve without it. This actions go from changing or deleting HTML elements or CSS styles in the page to adding new properties or elements to the structure of the document so it is displayed when the page loads. In addition, it allows our website to react to certain events we trigger by interacting with the website such as buttons.

But the complexity of our project has required of more complete actions to satisfy all the actions users can perform and, in order to provide them with a completely customized

experience, we are using a great amount of libraries in our project that make our work easier and give us more control over what's happening. Even though we have used a great number of this libraries and with very diverse objectives, the two most important libraries and that would be worth mentioning and explaining would be jQuery and Bootstrap.

Bootstrap [19] is a free and open-source CSS framework and one of the most popular open source libraries when it comes to styling our website and personalizing its look and feel. It includes templates based in HTML and CSS and even additional JavaScript extensions. Many of the components of Bootstrap require of JavaScript and, specifically, jQuery which is a library we will talk next.

Bootstrap defines itself as mobile-first, which means that it is focused on making website responsive by offering an enormous number of predefined classes that save us a lot of time when structuring our website. However, Bootstrap does not strive to every component responsive but tries to reduce CSS overrides.

Thanks to the combination of Bootstrap and media-queries, which are CSS properties that allow us to apply different conditions to the same element depending on the size of the screen they are being displayed. In essence Bootstrap pushed the use of general classes for common properties and more specific modifier classes when there are multiple properties of values that changes across multiple variants.

Nevertheless, even though Bootstrap includes JavaScript functions as we have pointed out earlier, it is advisable to write HTML and CSS instead of JavaScript if possible, because HTML and CSS are, in general, faster in the browser than JavaScript.

jQuery [20] is a free, open-source, dual-licensed JavaScript library designed to make actions like event-handling, CSS animations or DOM manipulation much easier for the user to handle.

As we have analyzed before, the elements of a website are represented in the DOM (Document Object Model) tree and jQuery [21] simplifies the syntax used to manipulate all those elements. Thanks to its functions, we are able to avoid the addition of event attributes in the HTML to call to JavaScript functions which allows us to separate both languages.

Another big advantage of jQuery is the elimination of cross-browser incompatibilities thanks to a consistent interface that works across all browsers despite their slight differences.

3.2 Server-side Web Technologies

Our project requires a great amount of operations that will modify the state of our database and the server side of the application. Due to this fact, we have chosen to implement a XAMPP [22], an open-source, cross-platform web server package that includes MySQL, PHP and FTP among other, which are the main tools we are using.

When choosing this architecture, we had a wide variety of choices [23] such as WampServer, a Windows web development environment; MAMP or Apache Tomcat; but we finally decided to continue with XAMPP because, as we stated before, it is easy to use and includes the tools we are most familiarized with.

PHP [24] (PHP Hypertext Preprocessor) is an open-source, general-purpose scripting language specially suited for web development with the possibility of embedding it into HTML.

What makes PHP [25] different from other programming languages like client-side JavaScript is that the code is executed on the server and sends the HTML result to the client. Thanks to this, the client receives the results and can see the generated HTML but can't have a look at the underlying PHP code that is generating it. This can be made even to the extend where all the HTML files can be processed with PHP so the users can tell what operations you are doing at any level.

In addition, PHP is not only restricted to outputting HTML. It can also output other elements, from images to PDF files, and fields from databases combining it with MySQL declarations. This makes PHP one of the most useful programming language thanks to its versatility and its capacity of performing complex functions dynamically.

MySQL [26] is an open source relational database management system. This type of databases offer the possibility of performing many different actions to add, modify or delete information in them by using simple commands.

All the data from our platform is stored in different databases in order to have everything organized and, thanks to PHP, we will retrieve the data and show it on our website. The combination of these two technologies also allows us to insert, modify or delete information from the forms on our website.

3.3 App

For the app part of the project we have used three quite new technologies we have used previously that are: React, Redux and React Native.

React [27] is a technology developed by Facebook that allows us to create user interfaces easily, quickly and in a guided way. Fundamentally, it is JavaScript library based on components that enables us to easily scale our applications. The component is the simplest part of our application and is formed by JavaScript functions that receive *props* and the current *state* and return an HTML code that shows what is indicated by the logic. The components are independent JSX files and we are able to modify any of them without having to alter the others.

React follows one-way data binding [5], which means that each component throws events

that happen inside of him and, in return, receive the data needed.

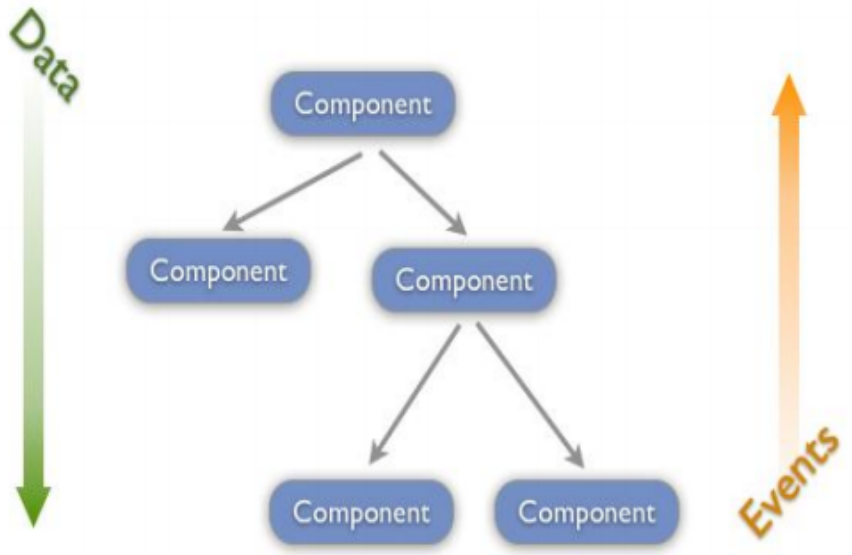

Figure 3.2: React: one-way data binding. Source: [5]

One-way data binding means that components don't have the ability of modifying the HTML. They just notify an event and the *reducer* takes care of the actions that needed to be performed to change the state of the application. Thanks to this method, changes are only performed in the parts that vary, resulting in a much more efficient process.

React projects are based on a Json file where all the packages used like Redux or Bootstrap are specified.

Redux [28] is an architecture that allows us make the state of our application predictable and easy to test by isolating it from all our components. It is a pure JavaScript library, so it can be used with other technologies like Angular. Redux is based on three principles:

- Unique source of truth: all the state is stored inside a json object and a store which allows us to do and undo action and return to previous states.
- Read-only state: the state can only be modified by performing an action thanks to the one-way data binding principle.
- Reducers take the previous state and the action to return a new state. This changes are perform by pure functions.

As we see in the following picture, data only follows a down-path and actions go directly to Redux, where the state is changed and returned to the views.

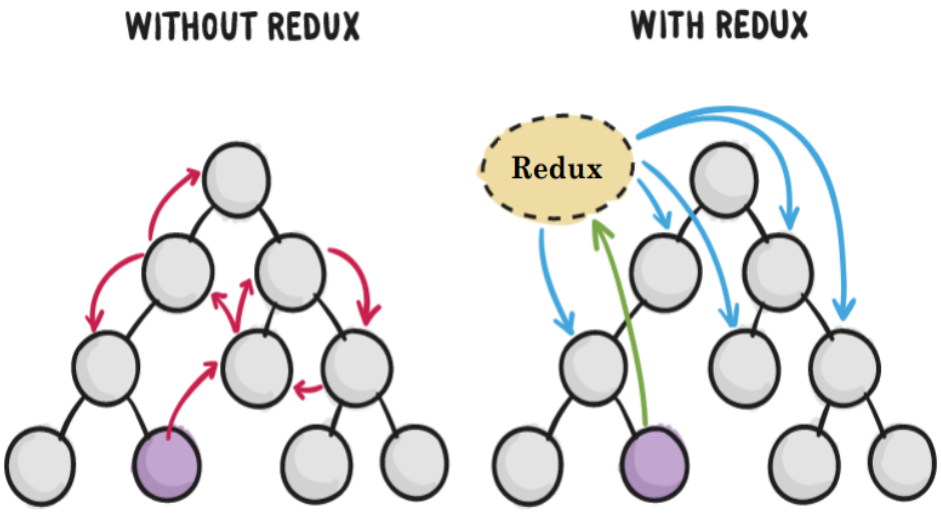

Figure 3.3: Redux architecture. Source: [6]

React Native [29] is also a relatively new technology developed by Facebook in 2015. It is an open-source framework and combines native development with React, a JavaScript library used for building interfaces.

React and React Native offer developers the opportunity of creating multi-device platforms without having to create two different projects. It allows them to create platform-specific versions of components so the same code can be shared across all the platforms.

This will be crucial in our project since we want to create an app that displays our web platform for Android and iOS without having to learn each of their programming processes.

CHAPTER 4

Architecture and Development

This chapter presents the methodology used in the project. It describes the overall architecture of the project, with the connections between the different components involved on the development of the project.

4.1 Overview

Our project consists on the creation of two web platforms, the website itself and a control panel. First we have created the control panel where the admin of the platform can manage all the information shown and save new data to the database. To do so, we have used a three-tier client-server architecture. Client-server [30][31] is the architecture that better fits our platform where a series of clients request and receive different services from a server. These clients use a platform provided by the server that displays the results of the actions performed. Many clients will access server's data at the same time through the Internet.

The characteristics of our project, where all users access and request data from the server at the same time, made impossible the use of other architecture models such as Client-Queue-Client where all endpoints are treated as clients, servers included; or Peer-to-Peer where everything relies on the computing power of each participant.

In addition, client-server architecture offers more security and allows us to carry out maintenance tasks, like the creation of new functions or the correction of errors, without affecting the client's experience.

When characterizing our architecture, it is worth mentioning the election of a Three-Tier architecture over Two-Tier architecture due to its higher level of security and the integrity of data. Two-Tier architecture [32] characterizes itself by the direct connection between the database admin and the clients. It has only two layers, client and data, allowing direct communication between client and server without any intermediary. The Two-Tier architecture has some advantages like fast development or how easy it is to modify and maintain the platform, it has a main problem: depending on the specifications of the platform, this architecture can cause data integrity issues.

On the other hand, Three-Tier [33] architecture has a higher level of performance than the Two-Tier model as it includes a middle layer that controls the application's functionality and performs all the processing. The middle tier guarantees the integrity of data as it centralizes all the logic of the platform by collecting the data inputs from the presentation layer to create queries that are sent to the database and reading or writing data. It also takes care of the management of the information from the database before displaying it to the user. This architecture has a great number of advantages [34]: it makes possible to change any of the layers without directly affecting the rest so the developers have bigger freedom when conducting updates or replacements; the applications can be easily escalated, adapting to new technologies or market specifications is simpler and teams can work on their areas of expertise rather than working as full stack developers.

At first, we thought about using a Two-Tier architecture because it is simpler and faster to deploy. In addition, data integrity won't necessarily be an issue since only a few users

can modify data and most of the information such as classes and students lists are static.

However we realized that in order to provide a good base to our platform and be able to grow with the needs of the users, we needed to implement a Three-Tier architecture. As we have stated since the beginning of the project, security is one of the main requirements of the platform, so having an extra layer to prevent the client accessing the database directly is a good measure. Moreover, the great number of advantages of Three-Tier architecture has made it easier for us to decide.

Even though we have a reduced period of time to create the platform, we are sure that investing more time on the creation of the structure will pay off by quickening the development phase and allowing us to focus on one area at a time.

As we will see in the architecture below, the platform is not only a place for the schools to upload all their data, but its core component is related to bullying. Our platform will cover two different aspects of bullying: education and communication. Education will help us prevent the appearance of abuses or bad behaviours and communication will allow the victims or the observers to speak up and will empower them to solve the problem together.

Regarding the website part of the project, we have selected a MVC (Model-View-Controller) architecture to ensure the separation between what the users see and the logic and database queries behind it. We will deeply explain it later.

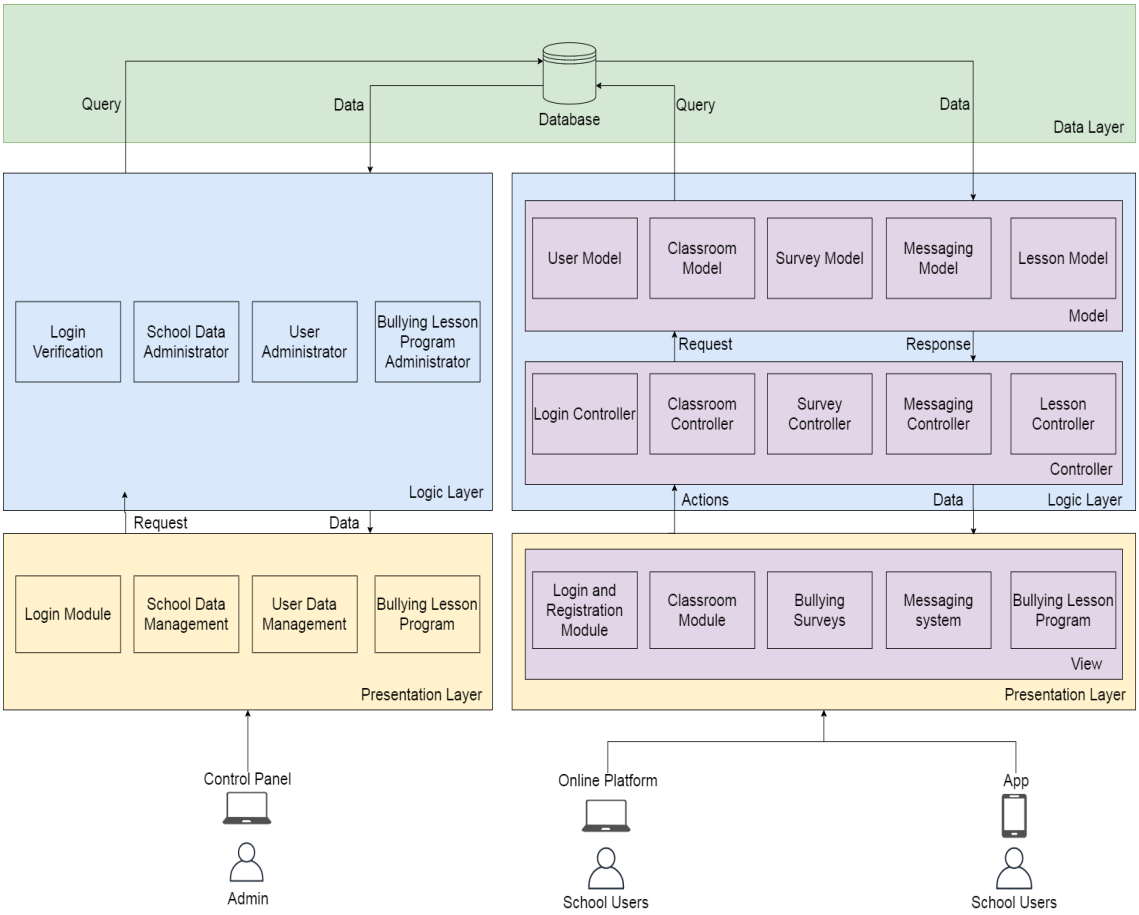

Figure 4.1: Global Architecture Block Diagram

4.1.1 Server Modules

The server hosts all the data from our platform thanks to a relational database that receives queries from the logic layer and gives in return the results. The main component of this layer is the database: this module represents the databases that store all the data that is displayed in the platform. We will explain later its structure and how they are connected. The database structure will be specified and discussed in the following section 4.3.

4.1.2 Logic Layer Modules

In this layer all the logic of the platform is developed. The logic area receives the actions and requests performed by the user and sends queries to the database to get the necessary data. In the architecture, we have divided the logic area in two: the left one corresponds to the admin panel and the right one to the online platform. Each area has its own characteristics because of the purpose it serves.

Regarding the control panel logic player, we can see we have different modules that correspond to the main functionalities of the area:

- **Login Verification**: this module takes care of login and registration attempts. It contrasts the information provided by the user with the one stored in the databases. Since we want our app to be very secure, this model has some complexity and performs different actions to ensure and verify the credentials provided.

- **School Data Administrator**: the module in charge of processing the actions regarding school data, classes or students. The admin has access to all this data so he can always control everything and can carry out maintenance works in case a problem appears.

- **User Adminsitrator**: this part of the logic layer is in charge of all the users registered in the platform and their data. Again, the admin has access to all of them in order to monitor the behaviour of everyone.

- **Bullying Lesson Program Administrator**: this is one of the most important modules in the admin area regarding bullying. It is in charge of updating the information corresponding to each lesson, games, videos and dynamics. The admin will be the one responsible of managing all that data and look for the correct display of all the lessons and blocks.

The logic layer in the online platform is slightly different to the one we have previously explained. The website has been developed following the Model-View-Controller architecture, so the logic layer is divided in two main modules:

- **Controller**: is the part of the logic layer that receives the actions performed by the user, sends requests to the model and sends the data to the view when it receives a response.

- **Model**: the module that receives the requests from the controller and sends queries to the database to return the data to the controller.

In the figure we have highlighted some controllers and models that cover the functionalities of some important parts of our online platform. The login and registration module is different from the one in the admin area where the user was not able to register but would only login thanks to the credentials that were created for him beforehand. In the online platform, as we will explain later in **Section 4.4**, the process to register to the platform has an extra step before being able to create a username and a password where the user

has to insert his personal data that was provided by the school and a private code attached to his classroom.

The classroom controller and model is in charge of retrieving all the data related to the user's classroom depending on his role.

The surveys are a very important part of our solution and the controller and model related to it are responsible of storing the data on the database.

The messaging part is in charge of retrieving the messages and conversation of the user and allows them to send new ones.

The lesson program is the main part of our platform regarding the education of the community in bullying and its objective is to keep the students interested in the topics by using games or group dynamics. The teacher is responsible of proceeding with the lessons but the students have access to the lessons anytime they need to.

4.1.3 Presentation Modules

The presentation layer is also different in our two platforms. While the style of both will be very similar to maintain a good corporate image, the interfaces won't. In the control panel, the admin will have access to, fundamentally, four modules where he will manage the contents and the data in the platform. Taking into account the modules we have explained in the logic layer of the control panel, the interfaces displayed in the presentation layer correspond to each of them, so we will have:

- Login Module: where the admin user is able to access using his credentials.
- School Data Management: in this module the user sees all the data from the schools, their classes, their teachers and their students.
- User Data Management: here, the admin has a record of all the users in the platform, their personal data and their role.
- Bullying Lesson Program: the admin is the responsible of uploading all the content regarding the anti-bullying program as well as the games, the videos and the dynamics related to each of them.

Again, because of the specifications of each platform, the online platform has different modules to the ones we have seen in the admin area.

- **Login and Registration Module**: this module is the one in charge of displaying the forms regarding the registration of the users and their subsequent login.

- **Classroom Module**: is in charge of displaying the information related to the user classroom depending on their role. In the case of a student, he is be able to access a section called My Class where he can upload content and see what the teacher or other students in his class have uploaded. As a teacher can be assigned to one or more classes, he is able to see all of them and access the list and the information of all the students.

- **Bullying Surveys**: the survey its questions are displayed to the students and send the data when the user submits the results.

- **Messaging System**: all the conversations of the user are displayed as well as the messages of each one. The notification is shown in case there is an unread message.

- **Bullying Lesson Program**: the users can access all the lessons and its content anytime they need to.

As we can see, the app and the online platform are connected to the same structure. As we will explain deeper in **Section 4.6.3**, the limited period of time to develop all this project has forced us to find a solution where the app will display all the content in the online platform thanks to a WebView component in the app.

4.2 Website

For the website part, we have selected one of the most extended methods used for development, called Model-View-Controller [35] method. In this method, the development is divided into three different and independent parts and allows us to make changes in one of the sections of the platform without having to modify anything but the files related to this section. The MVC architecture consists of three parts:

- **Model**: it is the part in charge of sending queries to the database when an action is performed and, once the data is received, it is sent back to the Controller. The model is completely independent of the view.

- **View**: is the visual part that presents to the user all the data retrieved from the database and provided by the controller. It is important to highlight that the view does no processing and only presents data to the user and allows him to interact with it.

- **Controller**: the controller part manages all the actions from the user and requests data to the model depending on the action performed. The Controller essentially defines how the interface is going to react to events triggered by the user.

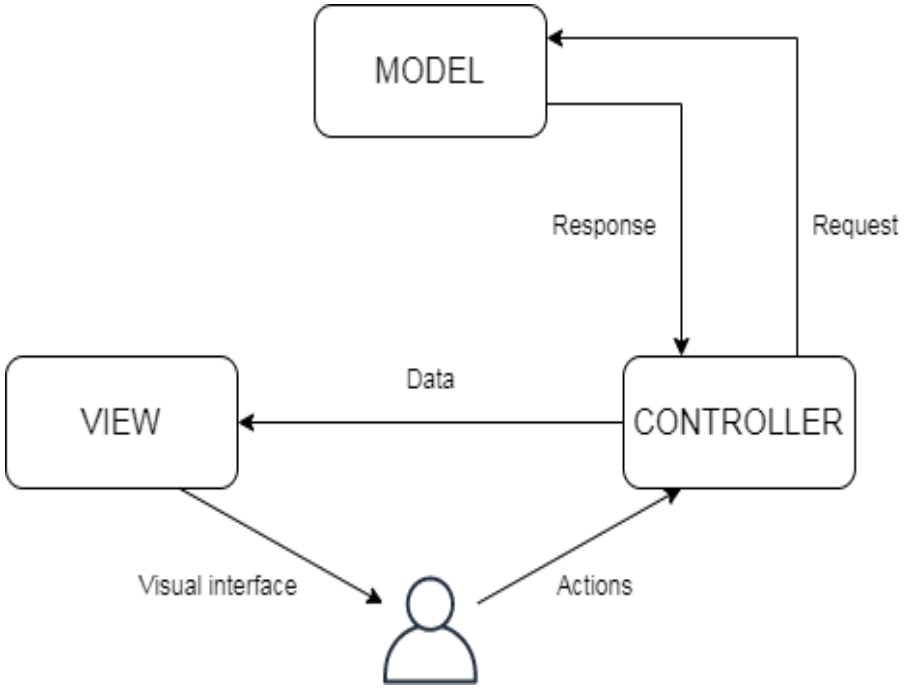

Figure 4.2: Model-View-Controller

A Model-View-Controller architecture allows us to keep the HTML part completely independent from the part where the data is received from the database and stored in order to be used, which is the Controller. The view only reflects the structure of the interface that will be used by the user and with which he will interact in order to perform actions. When, for example, a user wants to see the information of a lesson, the Controller send an order to the Model with the information of the user. Then, the Model sends a query to the database and retrieves all the data related to the user that is needed. The data is sent back to the Controller, which sends it to the View in order for this to display everything correctly.

There is a Controller for each different element in the platform and each Controller can manage one or more Views related to said element. Regarding the posts, for example, we will have three types of views: the one with all the posts that belong to the primary cycle *indexprimaria*, another with the posts from the secondary cycle *indexsecundaria*; and one more that displays one single post *single*. These three views will be managed by the same *postController* where we give instructions of the calls that need to be made to the database and the conditions that apply to each of them. In the function related to the concrete view, a variable called *$data* stores in an array all the different data that is then passed to the view and used. The calls to the database are made in the Model, the part where the information of the database is provided and the functions are created before being used in

each Controller. In this case, there is a Model for each Controller.

The reason why the app is also connected to this architecture is that, as we will explain later, the app we have developed as a preliminary version consists of a WebView that reflects exactly what the online platform has. We will detail more of this development in the *Section 4.6.3*.

4.3 Database

Our platform contains a great amount of information of different types. From posts to users, classes, schools, students and teachers, all the information is stored in our server. To maintain an order inside our platform, we created a series of diagrams to better understand the structure of the project, what data includes each database and how they interact with one another.

We can distinguish two main parts inside our structure: the one concerning the school and its distribution and the one regarding the posts. Both of these parts are hardly related since the posts part is uploaded by the admin of the platform and the schools can only access this information without being able to modify or erase it.

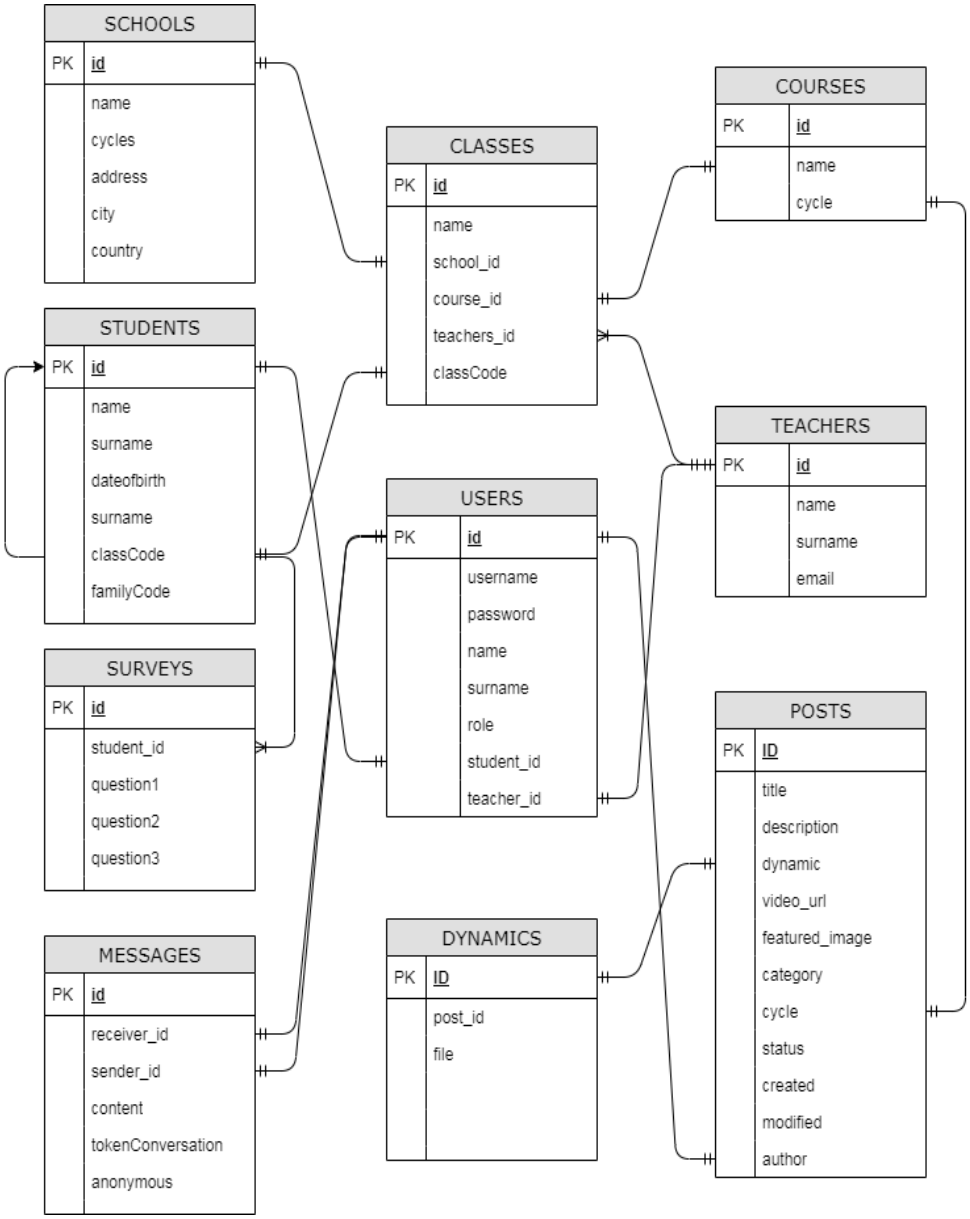

Figure 4.3: Database Model

The courses table is a predefined one including all the courses in the Spanish Scholar System. Each school is created by submitting all the values in its table. Then, all the classes are created and assigned to a course. A unique code is created for each of them. Students and teachers are uploaded by submitting CSV files with a defined structure in order to save it inside said tables and are automatically assigned to the class selected.

We must also note the Surveys table, where all the results are encoded and properly stored for its future analysis. We will extensively talk about this topic in the next sections.

Each post has its own id and includes a series of fields that are filled before the upload.

The cycle field specifies if the post is for Primary cycle, Secondary cycle or both and helps us when a school only hired the platform for a certain educational cycle. With the created, modifies and author fields we want to include an extra level of security so we can know when a post has been created or changed and by who with the id of the user. The status is also a crucial field since it will allow us to control the display of posts when needed.

The messages table saves all the messages sent through the platform and each of them is classified inside a conversation so we are able to retrieve all messages and conversations correctly. In case a student chooses to send a message anonymously, the anonymous field will be set to one and the counselor will only be able to see the student's class and course.

4.4 Login and Register Process

As we have explained, the login and register process is the most complex one that takes place in our platform. To avoid the access or registration of users without authorization, we have created a two-step registration process where private data is verified.

A student, for example, can only register by introducing his exact data and the private code assigned to his class. After that, he will be able to create an account with a user and password that only he knows.

Even though we will widely explain this process in the next chapter regarding case studies, it is worth mentioning that the two step registration process enables us to ensure a secure platform for everyone. The first step will determine the user role and he will need to insert all data related to him that was previously imported by the counselor before being able to create an account. This security barrier makes sure no one outside of a school who has hired the platform can access and use the platform. Even if said outside thief had access to the school's lists and data of the students, he would not be able to access the platform because a private code is automatically generated for each class and teacher, that only the teachers or the counselor know. We want to ensure that our platform is safe beyond any common attack since we are working with very sensible data as are the personal data of children and people under 18 years old.

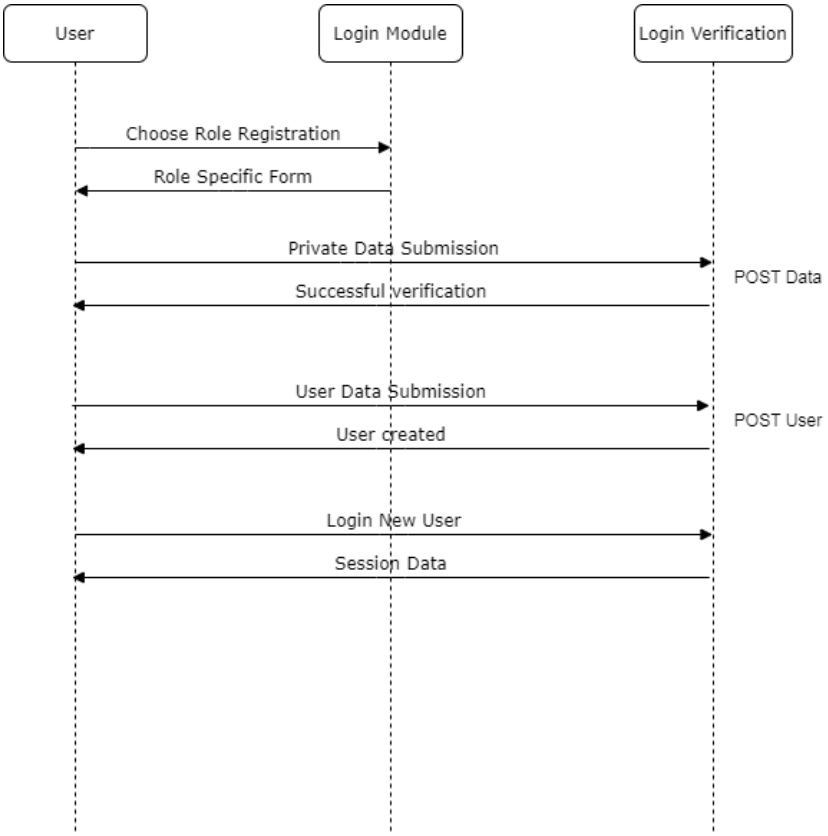

Figure 4.4: Sequence Diagram of login and registration process

4.5 Survey System

Our platform includes a survey system that aims to collect data from the students of the school. The survey system is designed to make the students feel they are in a friendly environment where they can really be sincere and expose their fears and concerns.

According to the studies we have made, we have created 5 or 6 questions to gather useful data that we will alter use to generate reports of the position of each student in class and that will help us detect any problem of exclusion or bullying without needing the students to actively write us through the messaging service of the platform.

The survey we have elaborated is divided in two main parts: the first part is focused on the relationships the user has with other students in his schools. We will ask them about his friends, the people they don't get along with, which partners are good to work with or who does the user think suffers bullying and why. The second part is more focused on finding trends in the interests and habits of the students. In this part we will ask them about social media and the use of mobile phones.

For the first part, there are mainly two types of questions: selection of students and

ratings. In the first type, the student that is completing will be asked about which students he thinks fit in the category of the question by selection, first their course and class and then choosing between all the students of that class. The results are dynamically displayed. This means that the list of students of a class is not loaded until the user selects that class, which solves what could be a big issue if the platform had to process all 200 students of a school at the same time, for example. The other type of question consists on the rating of students previously selected and goes from 1 to 5 being 1 the minimum and 5 the maximum. Depending on the topic of the questions, there may be more related questions and these two types. To offer a practical example we are going to explain the flux of the survey when being asked about bullying in the school:

- Bullying question 1: which students do you thing that suffer bullying?: As we have explained, the user will select all the students he wants that he considers that suffer bullying or any other abuses. In case the student does not want to answer, he can skip the current question and jump to the next one.

- Bullying question 2: rate the selected students from 1 to 5 the intensity of the bullying they suffer: A list of the previously selected students is displayed with a rating system for each of them.

- Bullying question 3: What type of bullying do they suffer?: using the previous list of students selected, a table will be displayed and the user can mark all the types of bullying he thinks his partners suffer, from being hit to being left out, made fun of or any other thing.

- Bullying question 4: What are the reasons these students suffer bullying?: Again, the user will be able to select the motives are drive the aggressor to bully the victim: gender, appearance, religion, sexual preference...

The first part of the survey also include similar questions to the first 2 but regarding friends and people who is good to work with. With those questions, we help to create a sensation of safety to the student so he can talk about positive aspects of his class and not only focus on the bad things and problems or his friends may have.

As we can see, we have tried to cover some of the most important information we found out of bullying in the state of art chapter and the study of Unesco [1]. We want to give the schools tools to be empower and prevented when a situation appears as well as giving voice to everyone involved in the school's activities: teachers, students and counselors.

The second part of the survey is based on the use of technologies and the internet by the students. Firstly, they are asked if the have a phone and, if the answer is yes, what

do they use it for: learn new things, watch videos, listen to music... Then, they have to rate how much do they use a selection of social media that are proven to be very popular amongst teenagers and children at schools. With this data, we want also to provide the schools with information about the habits of their students and to help them being alert in case a problem may show up related to any of the social media they use.

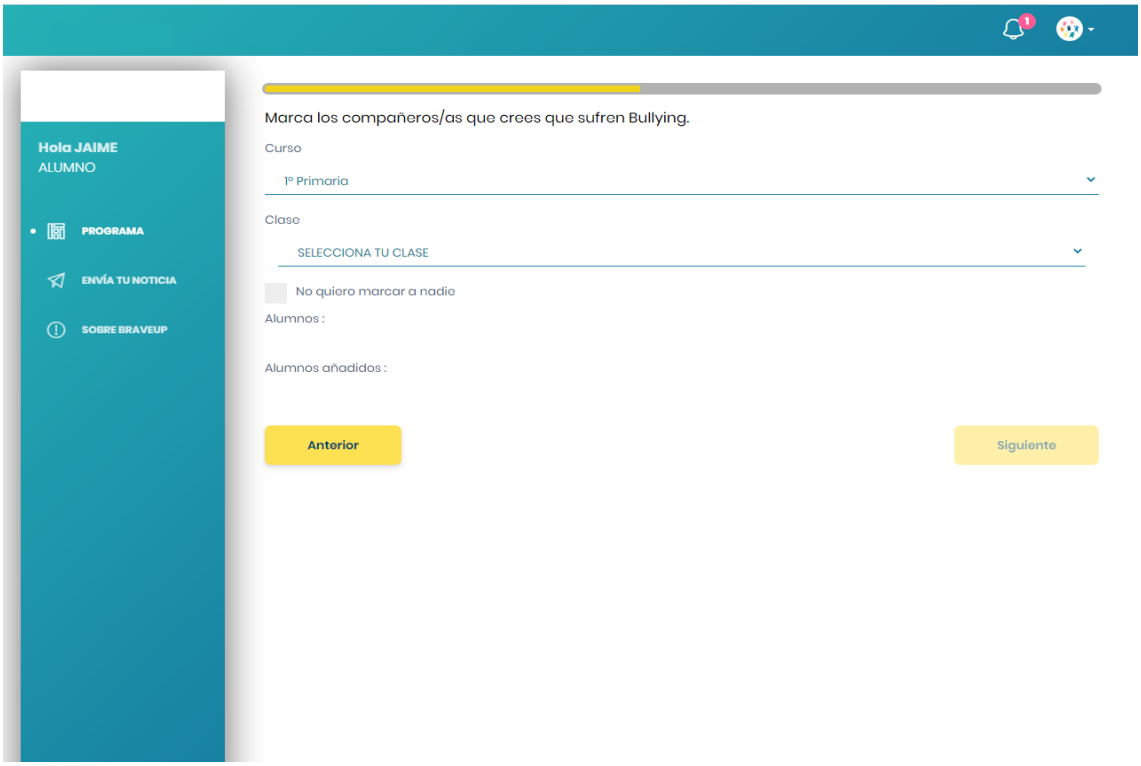

Figure 4.5: Survey Question Example

All this information is very sensible, it includes names and surnames of students and cannot be stored in any way. To ensure the integrity of the data and that it is stored safely, we have encoded the results in our data base so, in case any unwanted person tried to analyze the data or retrieve personal data from the students in the survey, he would not be able to get any personal data. Thanks to the database structure and system we have created, each student is related to a unique private number in the database that is used to unequivocally identify that student.

Once we have the results stored in the database, we are going to perform a deep analysis on this data in order to create reports that can be displayed to the schools and that is basic for them in order to be able to perform actions to solve problems and to monitor the behaviours of the students. To do so, we will download all the information in a CSV file that will look essentially like the next figure:

fecha	colegio_id	colegio_nombre	clase_id	clase_nombre	curso_id	curso_nombre	alumno_id	sufren_manera	sufren_motivo	movil
2019-12-04 11:51:53	6	Colegio Nuestra	17	B	4	4º Primaria	294	4:17:303:4, 5;	4:17:303:5;	No
2019-12-10 16:15:29	6	Colegio Nuestra	17	B	4	4º Primaria	296	4:17:296:1, 7;	4:17:296:6;	No
2019-12-10 16:20:29	6	Colegio Nuestra	17	B	4	4º Primaria	309	4:17:309:1, 3;	4:17:309:5;	No
2019-12-10 16:20:30	6	Colegio Nuestra	17	B	4	4º Primaria	309	4:17:309:1, 3;	4:17:309:5;	No
2019-12-10 16:33:12	6	Colegio Nuestra	17	B	4	4º Primaria	303	4:17:298:2, 3;	4:17:298:2;	Sí
2019-12-04 12:29:16	6	Colegio Nuestra	16	A	4	4º Primaria	286	4:16:269:3;	4:16:269:5;	No
2019-12-04 12:31:50	6	Colegio Nuestra	16	A	4	4º Primaria	277	4:16:277:1, 2;	4:16:277:1, 2;	Sí
2019-12-04 12:35:03	6	Colegio Nuestra	16	A	4	4º Primaria	268	4:16:279:1;	4:16:279:1, 2;	Sí
2019-12-04 12:36:10	6	Colegio Nuestra	16	A	4	4º Primaria	272			No
2019-12-04 12:36:19	6	Colegio Nuestra	16	A	4	4º Primaria	266			Sí
2019-12-04 12:36:30	6	Colegio Nuestra	16	A	4	4º Primaria	267			Sí
2019-12-04 12:43:16	6	Colegio SEK Alb	16	A	4	4º Primaria	284			Sí
2019-12-04 15:37:30	6	Colegio SEK Alb	16	A	4	4º Primaria	274	4:16:274:2, 5;	4:16:274:2;	Sí
2019-12-04 15:38:20	6	Colegio SEK Alb	17	B	4	4º Primaria	295			Sí
2019-12-04 15:39:06	6	Colegio SEK Alb	16	A	4	4º Primaria	271			Sí
2019-12-04 16:16:08	6	Colegio SEK Alb	17	B	4	4º Primaria	305	4:17:309:1;	4:17:309:6;	No
2019-12-10 9:48:16	6	Colegio SEK Alb	17	B	4	4º Primaria	308			No
2019-12-10 9:48:16	6	Colegio SEK Alb	17	B	4	4º Primaria	308			No
2019-12-10 14:33:15	6	Colegio SEK Alb	16	A	4	4º Primaria	287			No
2019-12-10 14:42:32	6	Colegio SEK Alb	16	A	4	4º Primaria	285	4:16:269:1, 2, 3;	4:16:269:5, 6;	Sí
2019-12-10 14:45:40	6	Colegio SEK Alb	16	A	4	4º Primaria	270			Sí

Figure 4.6: Codified CSV Survey Sample

As we can see, we have access to the date, the school, the course and the class of the student that completes the survey but we don't now either his name, his surname, his date of birth or any other personal data with which we would be able to identify him. The same way, we can't know who has he selected in each question thanks to the same system. The responses are structured so the data can be retrieved properly. The structure is: *id of the course of the student:id of the his class:id of the student himself: score; repeat for another student.*

The selection of this structure is not trivial since, once we have the coded reports, we will run a Python program to create a more detail statistic with relational information between students of the whole class and the relationship between them. It will also include an individual report of every student where we will study his own answers and the answers from other students that include him.

These reports will be available for the schools and the counselor with the intention of helping them detecting abuses of any kind and bullying cases and showing them how they need to act in order to correct the situation and preventing it of happening again.

4.6 Development

We will divide our project in three parts:

- **Admin Area**: a private area where the admin user will be able to manage all the information, from posts to schools and users inside the platform.

- **Web Platform**: the main part of the project, where all users will access and see all the information uploaded in the admin area depending on their role.
- **App**: it will allow the users to have the platform installed in their smartphone and have easy access to it anytime and anyplace.

4.6.1 Admin Area

Before starting the design and development of the online platform we had to create a first version of a private area where all the actions regarding the insertion, deletion or modification of all the data of the platform to the database.

In order to be able to do all these actions, we first had to create a configuration file that manages all the databases created in our server to have all the information well classified and we are able to perform operations with it anytime we need. The configuration file is where all the global variables of our platform are created as follows:

```
// Database configuration
define('DB_SERVER', 'localhost');
define('DB_USERNAME', 'speakup');
define('DB_PASSWORD', 'password');
define('DB_NAME', 'bullying_platform');

//Database Tables
define('DB_MB_USER_TBL', 'users');
define('DB_MB_POST_TBL', 'speakup_posts');
define('DB_MB_CONVERSATION_TBL', 'mb_conversations');
define('DB_MB_MESSAGE_TBL', 'mb_messages');
define('DB_MB_STUDENT_TBL', 'speakup_alumnos');
define('DB_MB_TEACHER_TBL', 'speakup_profesores');
define('DB_SCHOOL_TBL', 'speakup_colegios');
define('DB_CLASSROOM_TBL', 'speakup_clases');

//OTROS DATOS
define("DEBUG","true");

// Email settings
define('SENDER_NAME', 'speakup');
define('SENDER_EMAIL', 'noreply@speakup.eu');

// SMTP configuration
define('SMTP', TRUE); // Set TRUE if want to use SMTP server to send email
define('SMTP_HOST', 'speakup.com');
define('SMTP_USERNAME', 'noreply@speakup.com');
define('SMTP_PASSWORD', 'password');
define('SMTP_SECURE', 'ssl');
define('SMTP_PORT', 465);

?>
```

Figure 4.7: Config File

The configuration file, we include all the databases that will be used with the name of

each variable to call them along the project and the credentials to access the server where the databases are stored as well as the SMTP configuration for the email sending service that will be used.

Then, we have created two files for each different element that is included in each database: class and functions. For example, for the *Posts* database, we have created a *postClass.php* and a *postFunctions.php*.

The ***postClass.php*** file includes all the functions used to retrieve the data from the database. At first, this file had many different functions and a new one was created when we needed to get a certain field from the database.

That way of working made the class files very complex so, while we continued working and learning about PHP and MySQL, we came up with a much simpler way. Instead of creating many specific functions with restricting conditions, we created only three functions with some parameters:

- getRows($conditions = array())
- insert($data)
- update($data, $conditions)

Passing those parameters to the getRows function allows us to create filters using PHP, before executing the function. That way, we optimize the queries to the database and we consume fewer resources. This decision is much more important that we can think at first, but we are preventing future problems when we have a great number of elements in the database and getting all of them is untenable.

On the other hand, the ***postsFunctions.php*** is used when an action is performed inside the platform. The file gets the data from the HTML form submitted and performs the corresponding actions, insert a mew post, edit an existing post or deleting a post.

These two files will do the connection with the database and will be responsible of updating the data, but for them to work, we need the HTML part, which is the base of the online platform and the admin area.

When creating the HTML forms to insert the data of the posts, we will include on the form declaration the Functions file route and a submit button with the name of its action so the Functions file can use that name to determine the action to be performed.

With all of these connections, we now can perform any action we desire and register all of them in the databases we have prepared.

The admin manages a lot of information of many types, so we needed to determine and define all the actions he has the power to perform and which information can he access in order to start with the programming of this part.

- Posts: the admin can create new posts and classify them in blocks in order to organize the content that will be used by the teachers and the students to learn everything related to bullying and respecting one another. Each post will have a name and a featured image and will include text and, additionally can have a dynamic associated to it as well as a game and a video. Obviously, he can also edit or delete any posts he needs to.
- Dynamics: the dynamics are files that the teacher can download and use inside the classroom with the students to prove in real life everything the have learned with the rest of the content in the post. These files will be uploaded and reviewed by the admin before making them public. Again, he can edit or delete any dynamic he needs.
- Users: the admin user can register new admin users as well as school counselors which are the contact between the school and the administration of the platform.
- Schools: when a new school gets hires the program, it will be register into the platform by the administrator, who will indicate the region and city where the school is located and the teaching cycle the have hired: Primary, Secondary or both.
- Classes: the duty of creating new classes, teachers and students is theoretically assigned to the school counselor but, in order to keep track of their actions, the administrator has the power to create new classes, import students and teachers or deleting any of them.

With all the cases defined, we proceed to program the HTML and the PHP files related to each of them. We must mention that developing the admin area has served us to start with the design of the online platform we will develop next.

4.6.2 Online Platform

One of the most important requirements of our platform is that it needs to be responsive in order to be able to use it in a computer, a tablet or a smartphone of any size. However, not only we want it to be responsive, but we want it to look as a native app in each of the devices with its own features. Due to this crucial characteristic, the design phase of the platform became one of the principal concerns when starting the project. As we explained in Chapter 3, CSS, Bootstrap and jQuery are some of the most important technologies we are using alongside the project and it is because they give us great control over the layouts and the dynamic change of its display.

Once the design phase finished, we focused on the different roles the app will have and the determination of the actions they will be able to perform. After studying again the purpose of the app and the business model, we concluded we will need 5 roles:

- Admin: as we explained in the last section, the admin user is the one in charge of the moderation of the platform and the upload of new content and courses for the schools. He has power over every publication inside of the platform and manages all the schools, classes, students, teachers and users. He grants access to the platform to all the school counselors.

- School counselor: he is the person inside the school in contact with the admin. He is in control of all the information of his school and is responsible of importing all the lists of students and teacher and assigning them to their classes in order to grant them access to the platform. He is also the person who receives all the messages sent by students and teachers concerning any problem that may appear in the school.

- Teacher: this user only can access his classes' data and the students in them. He moderates the posts that will be published in the My Class section that the students upload regarding what they do in class with the goal of avoiding the publication of inappropriate content. The messaging system is enabled for him in order to notify the counselor any problem that might be getting out of hand.

- Student: the student can access all the contents inside the platform regarding the education part and he is able to send new posts that will only be published if the teacher approves them. All of the students are to fill a survey about their situation in class and the evaluation of the environment with the rest of their partners. They can contact the school counselor either anonymously or providing their user data if they have any problem or need to tell him anything.

- Family: the family members of each student has the option of registering to the app in order to have a more detailed view of what is being treated in class and the activities they do. The user has the possibility of contacting the school counselor in case of an emergency.

As we know, our project is based on bullying, how to act against it and how to prevent any abuse inside the school. Our platform has three main modules that help us in doing so: the bullying surveys destined to the students, the messaging system and the bullying lesson program.

The bullying surveys are aimed to students and, as we have seen in **Section 4.5**, they try to feel the student safe while he is responding to achieve better results thanks to sincerity and trust. With these surveys, we can analyze the problems inside a class, the situation of each student and the role they take in certain situations. We can also monitor the measures that have been implemented and the effect they are having in the behaviour of

the students. The elaboration of reports that are handed to the school also gives extra value to our system. We have found here a possible future enhancement to this section by creating a system where each school can create its own, customized surveys. We will talk about this in **Chapter 6**.

The messaging system is the one that makes possible the direct communication between students and the school's counselor. Through this channel, students can inform the counselor about any problem they have detected in class as well as their own problems and concerns. With this communication channel always opened and available, we want to establish a trust relationship between students and teaching staff so they can work together in making everyone feel safe and sound inside the school thanks to a healthy environment. The counselor cannot start a conversation, he needs to first receive a message from a student to start the conversation. The student can write either normally or anonymously in case he does not want the counselor to know his name and feels safer that way.

The bullying lesson program covers the education part we are aiming to cover in this project. With a set of lessons including games, dynamics or videos regarding bullying and other topics related like respect or self-esteem, we want to make everyone aware, from students to teachers and families, of the importance of educating everyone in the values of respect and tolerance in order to tackle such a big problem as bullying. We will talk more about this module in **Chapter 5.1** in one of the case studies.

4.6.3 App

Since we had a reduced time period to create and develop the whole project, we decided to focus in the development of the admin part first and the online platform second instead of creating the app. This decision is motivated by two main reasons:

- The admin platform is the key part of the development because it allows the admin to create all the content of the app like the lesson program. He is also in charge of creating the new schools so the admin needs to be the first one to have his area available.

- A great part of our project is based on the education of the students and teachers and the dynamics and activities they do together. This means that our platform will be mostly used in class where the teacher will use his computer to display and explain the lesson to the students. For that reason, we placed this part as the second one.

- The online platform we have developed is fully responsive, so, in case of an emergency, it can be displayed in a mobile phone without the need of a native app. This places

the development of the app as the last thing to do after everything else is up and running perfectly.

The solution we have come up with is to create an app that displays the exact same thing as the online platform. To do so, we have created a React Native project with only one screen. Here we have used the WebView component of React Native and have passed the URL of our online platform.

However, the development of the app is meant to continue, as we will explain in **Chapter 6**, as one of the most important future lines of work. This means that, even though we won't have a full native development of the app, we need to set the foundation to let our app grow as quickly as possible to have a second version of the app in the next months and with the same functionalities as the ones in the online platform. In the future development, we will use Redux as the architecture to guide us. We have selected Redux because we are familiarized with it and we have used it in previous projects so the learning process that it requires is shorter.

Redux allows us to completely separate the components of the application from the logic operations that are carried out when the user interacts with it. This means that our interface only loads what is necessary depending on the state that it receives. The state is defined in a json object and is inside a unique store. When an action is performed, the three main components of Redux, actions, reducers and store, start to work. When a user interacts with the applications, triggers actions, which are JavaScript objects capable of modifying the state of the app. The actions are related to a reducer, which is the key part of this architecture. They use the current state of the app and perform the defined changes for that situation. The store is the object that gets the state and the reducers together and allows us to access it without modifying it.

Here we have an schema of the architecture of the app:

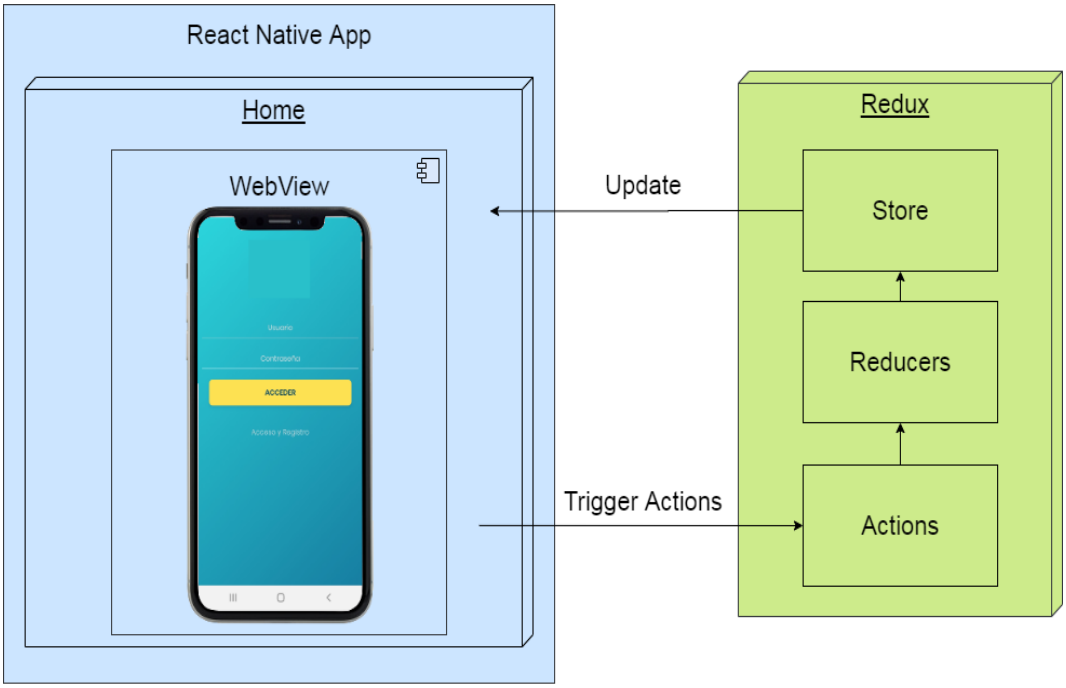

Figure 4.8: App General Architecture

We also must note this architecture does not include the logic to send and retrieve data to the database because it is the exact same architecture as the one from the online platform.

In the preliminary version of the app, all the logic is performed in the same way as in the online platform. We must remember that we are only displaying the website through a WebView component, so the app is not performing any processing of the logic.

Thanks to React Native, we have been able to use the same code for the Android and the iOS app and to upload it to the store. We are aware that, once the app gets more complex, we may need to use platform-specific component for Android and iOS but, overall, it will allow us to use mostly the same code. The only difference between both processes until now, has been the building of the app and the generation of the keys necessaries. Then, the app was uploaded to the Store and made available for everyone.

We know this solution is not an optimal solution, but is just a temporary solution in order to have an operative application running from the beginning. However, all the structure is set to make the future development easier. This means we only have to gradually add new variables to the state of the application, create the full views in each page and implement new actions and reducers to continue with the development of the next version of the app.

Therefore, as we will see in the last chapter of this document, our immediate future goal is to continue with the development of a full independent app without needing to load the online platform. To do so, we will take advantage of the preliminary version we have

created and continue with its development using React, Redux and React Native.

CHAPTER 5

Case study

In this chapter we are going to describe some interesting use cases. We will review the login and registration of a user where we will deeply analyze the logic behind it and the security implemented; and the creation of a new school, which will cover the hole process that needs to be followed when adding a new school and its classes.

5.1 Creation of the lesson program

Before launching our platform and installing it on the schools that hire the services of the program, we firstly need to upload all the content related to the lessons that will be used by the teacher to explain new and fundamental concepts and behaviours to his students. This content has been exhaustively analyzed taking into account the main things we have learned from the studies we consulted before starting the project.

Thanks to this previous study, we know better which areas we need to target in order to create a change in the children's behaviour towards themselves and the rest of the people that surrounds them.

Through these lessons, we will teach very different things such as concepts like friendship, emotional intelligence, positivity or respect where the students will get familiar with how this concepts interact with their daily and how they can use this concepts to help everyone feel better and more involved in the dynamics. After some of this concepts and values are rightfully explained, we will move on into the main problem and the goal of our platform. These block of the program will explain bullying, school violence, cyberbullying or sexting and will explain the main first signs that appear, how it manifests in someone's behaviour, how to prevent it and what actions need to be carried out in order to stop this types of abuses.

All the lessons in the program will include different types of activities and testimonies that will help us explain everything regarding the topic. The post can, therefore include:

- Videos: videos have been recorded where someone explains his case and gives a very powerful testimony about his experience. This type of videos aim to create a big impact on the students and make them realize that all this concepts are very real and that people needs of them to have a complete life.

- Dynamics: the dynamics are documents that the teacher will use in order to let the students play around the subject of the lesson with different activities. In these activities, the students will need to interact with each other and explain to each other their point of view. With these types of routines, the student will understand how the concepts work and how the way they behave regarding these concepts affect the people around them.

- Games: we have reached an agreement with a company named Cerebriti that is responsible of creating online, interactive, educational games. This games have been created related to each of our lessons and are individually use by the students. The games are very different and can have tests with multiple choice questions or can consist on categorizing statements related to the concept explained in the lesson.

All this different ways of learning will make possible to maintain children interested in all the topics covered over the program. In addition, a certain amount of sane competition with the scores and results of the games will make them more invested in participating of all the activities. We must also note that there are two slightly different programs. One is for the primary cycle and other for the secondary cycle. This is due to the fact that teenagers and kids have specific problems related to their age apart from the common concepts that are taught.

Now we are going to take a deeper look into the primary program. To create it we have taken into account all the information we have learned in **Chapter 2** where we took a look at the problem and the solutions that have been created recently. We have specially focused on what the UNESCO report [1] considers as the main reasons and targets of bullying. The categorization of bullying provided by some of our sources have helped us in separating the topics of each lesson and posts like the ones from the Anti-Bullying Alliance and All Together [13] have helped us in creating the different blocks that our program will have.

Again, having in mind all these possibilities while creating each lesson and using all the references we consulted, we have divided our program into 7 main blocks. Each block will have a number of lesson related to it:

- **Block 1: Self-knowledge**: In this block we explore the beginning of the course and we look to set the tone for the rest of the year in terms of expectations, team work and group dynamics. We also talk about friendship and the importance of treating the rest of the students well, class' rules created by all the students in consensus and cohabitation rules. By the end of this block, we take a look at the concept of self-esteem and start introducing the next block.

- **Block 2: Emotion Management**: this block is fully focused on emotions: what they are and what they tell about us. We also dedicate a chapter to the control of rage and another to the multiple intelligences present in everyone. We must remember this program is dedicated to primary school children, so they may not be very familiar with all this concepts.

- **Block 3: Empathy**: the empathy is probably one of the most important characteristics in human beings. This feeling allows us to think how other people may feel about us and our actions and is one of the keys to stop children from treating their peers in a bad way and that could lead to abuses.

- **Block 4: Conflict Resolution**: in this block we will teach children about the importance of knowing how to act and to be brave when something goes wrong. We will also talk about the roles inside a class, from the leaders to the rejected and the

importance of making everyone feel like they belong by having respect for each and every partner.

- **Block 5: Bullying**: once the students have understood all the previous concepts about their behaviour and their relationships with the rest of their peers, we will deepen in the term bullying by studying how it appears, what are the main signs of it, how to act against bullying or if someone witnesses a case of abuse. We could say this is the most important chapter of the program since it talks about the main concept we are discussing in this project, but it is also true there are a great amount of things that surround bullying that need to be addressed if we aim to make it disappear.

- **Block 6: Cyber-bullying**: the results of our investigation showed that the cases of cyber-bullying have increased a lot in the last years because of the popularization of smartphones and social media amongst not only teenagers but even younger children. In the lessons of this chapter we discuss the concept of bullying as well as grooming and sexting, which are the most frequent types of harassment related to these abuses.

- **Block 7: School environment**: the goal of eradicating bullying is to create a healthier environment in the school. However, this also has a lot to do with the parent-children relationship, the motivation of the students and the cooperation between families, students and teachers, so it takes all the actors to achieve a good dynamic inside and outside the school.

Once this block system has been defined, we now have created all the system by which the admin users will be able to create and modify all the lessons and the links to the games, dynamics and videos. To do so, we have created a section inside the admin area where all this data is displayed and new ones can be created.

The creation of a new post will include a variety of fields that will be used later to classify each lesson into its block and the cycle it is assigned to.

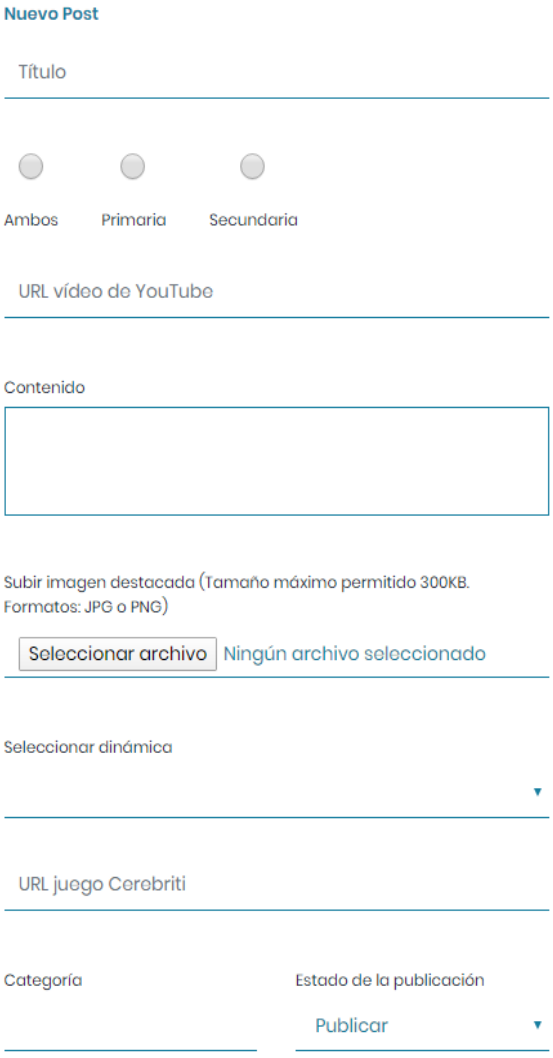

Figure 5.1: Program Lesson Creation

First the user introduces the name of the lesson and the cycle to which it is applied. As we have explained previously, the programs for both cycles are slightly different so each post can be assigned to the primary cycle, the secondary cycle or both of them. Then we input the URL of a video from YouTube, the text describing the activities and the information related to the lesson as well as the image that will appear on the full view of the program. To end up, we can select a dynamic we have previously upload as we will explain later, the URL of the video created on the Cerebriti platform, the category of the post that will serve as order to the block system and the state of the post in case we want to upload it as a draft before publishing it.

In this same section, we have a general vision of all the the posts in the platform either

they are published or just uploaded as a draft. Thanks to this, we are able to modify anything from each post anytime we need.

Finally, we will display all this posts organized as our program in the main view of the platform. The division of the program in cycles is made because the schools can hire our program for both primary and secondary cycles or for just one of them. In case the school only has hired the primary cycle program, it will only have access to those dynamics related to that cycle.

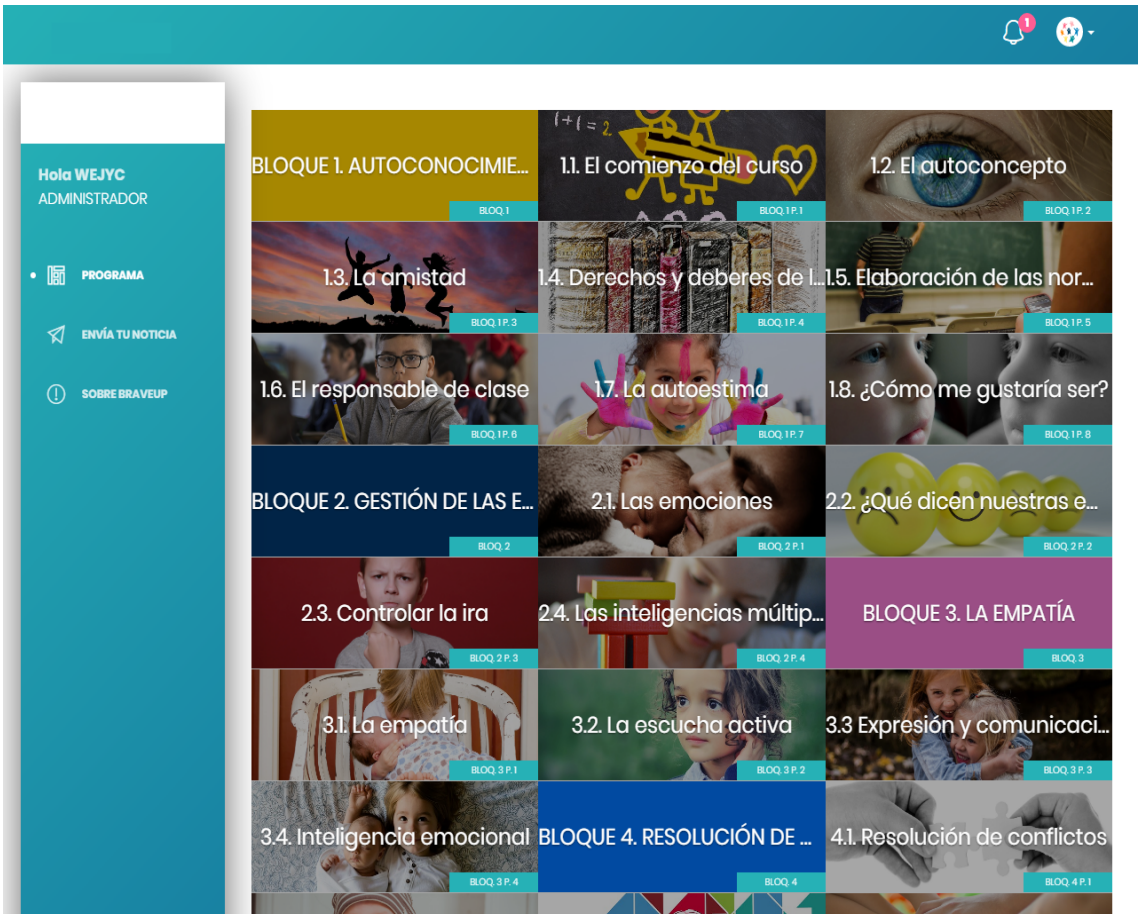

Figure 5.2: Program Lesson Overview

5.2 Admin creates new school

At first, the platform will only have admin users. When a new school hires the program, these users will be in charge of creating it in the platform and of teaching the school's counselor what he needs to do to make sure everything regarding his school is working fine. With this in mind, the admin will create a user with the role of counselor for the school with a manual explaining the first steps.

The counselor accesses the page and has now full access to his school. As we can see in the next figure, he has a control panel of his school where he can manage every aspect.

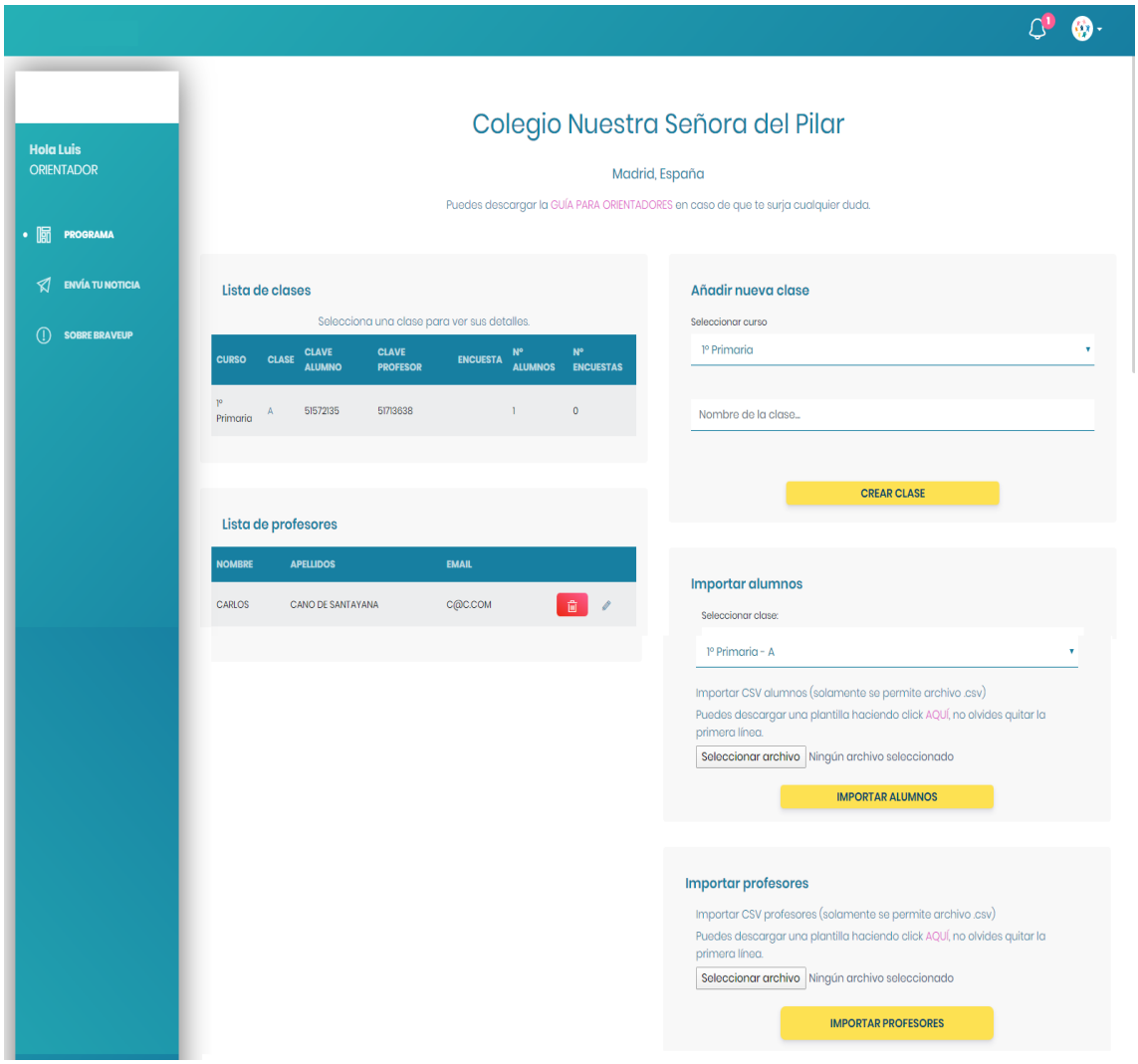

Figure 5.3: Counselor View: School

First, he can download the guide file in case he has any doubts. The first thing he has to do is create all the classes in the school. On the right side of the page he has a form to select the course and write the name of the class. These classes will appear on the first table indicating the curse, the name, the student key and teacher key, if the survey is active for that class, the number of students inside of it and the number of surveys submitted.

After this, he will have to import all the students to their respective classes. To do this, he has on the right side a second form where he can select the class and upload a CSV file with a certain format as for each student, the file should have only four columns: name, surname, date of birth and sex. If this information is not correct, the student will have

some information missing and the process needs to be repeated.

Once every student is uploaded and assigned to his class, the counselor will import the teachers of the school. Again, he will do so by uploading a CSV in the third form the right side where, for each teacher there will be 3 columns: name, surname and email. All the teacher will then appear on the second table on the left side. He will have the chance of modifying their data or deleting them.

To assign all the teachers to their respective classes, the counselor needs to enter each class. This is also done to ensure and review that all data has been successfully imported.

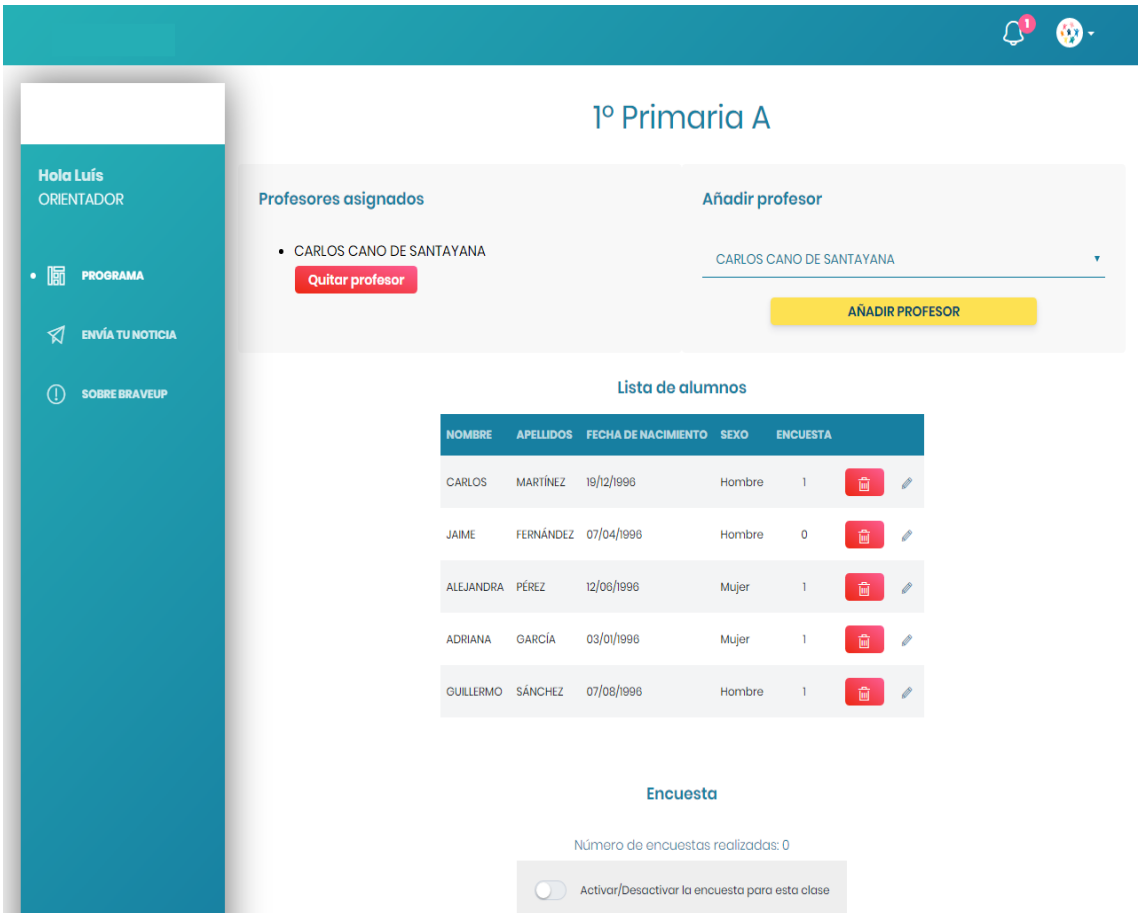

Figure 5.4: Counselor View: Class

In this area, the counselor can assign teachers to the class by the form on the top part. He can also edit or delete any student and see which of them has completed the survey and who has not done it yet. In the bottom part, he can activate or deactivate the survey for the class and delete the class.

Once everything is configured, he will provide both the class and the teacher code to each teacher so they can register and give the code to the students of each class. From this point on, the counselor work consists on keep track of the activities that are carried out in

the classes and to answer any message that a student send through the messaging platform. He will know he has new messages thanks to the bell on the top right corner of the page.

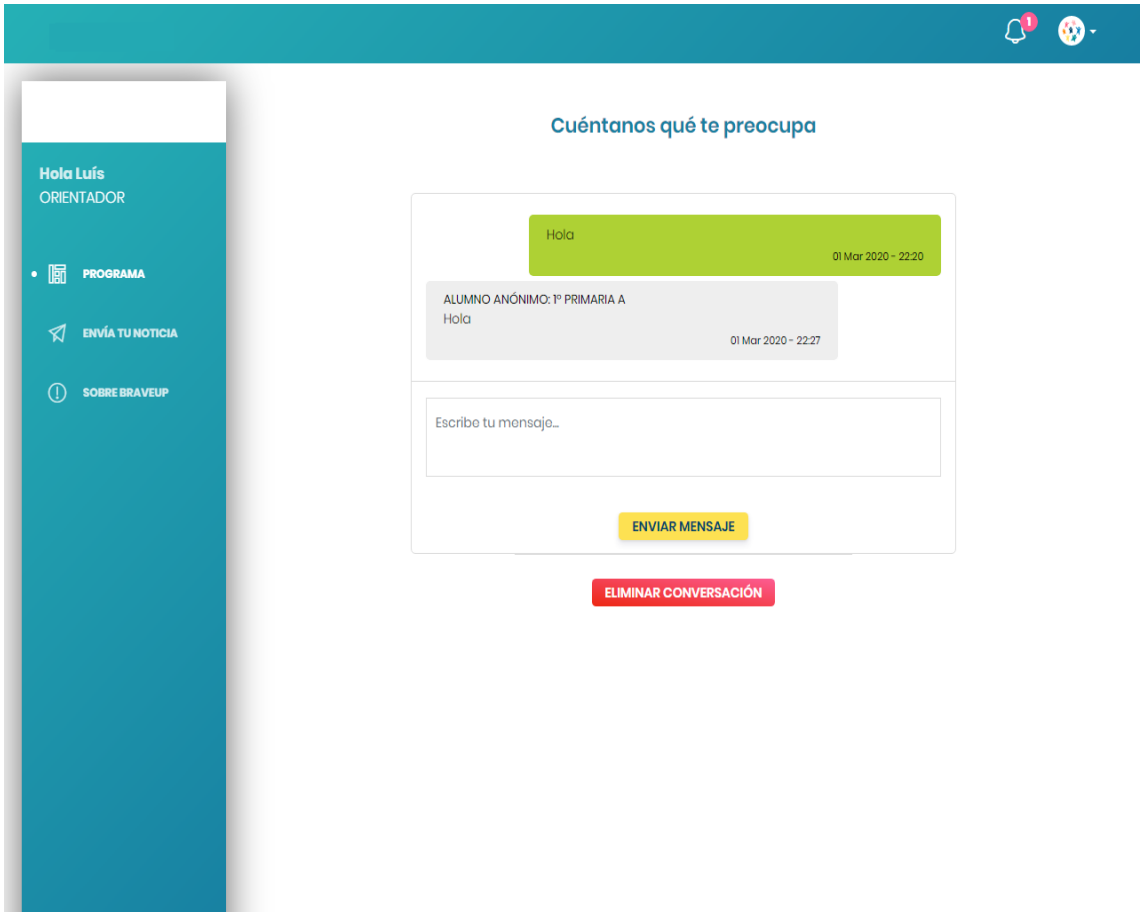

Figure 5.5: Counselor View: Conversation

Inside this part, the counselor has access to a register of all the conversations he has had and the users with he has talked. Some of them will appear as anonymous students where only the class and the course will be displayed and with other he will have their full name. It is important to note that the counselor cannot start a new conversation with anyone. His role is to be the receiver of all the messages in the school, both from students and teachers and council them and trying to coordinate with them to solve the problems that are reported. He must be the person who manages and supports everyone and he is in charge of the environment that is generated around the school.

Students, however are the ones who can start conversations whenever they want and regarding anything they need to tell to the counselor. As the counselor, they will also have a bell in their dashboard where a red button will pop up when they have unread messages. Teachers also have this function enabled just in case they need to report something extraordinary to the coordinators and in order to have everything centralized. Even the families

will have this feature, but it is only to be used when an extreme problem appears on the situation has escalated beyond their reach.

5.3 Login and registration of a user via App

The other case study we are going to explain is the registration and login process to access the app and the extra security we have included in order to prevent any undesired login. Each user has its own unique way of creating its profile since each role has its own unique circumstances. Thanks to both admin and school counselor new users being created by the admin user, they don't need an extra security system. These users will be closely monitored as there are just a few admins and one counselor for each school.

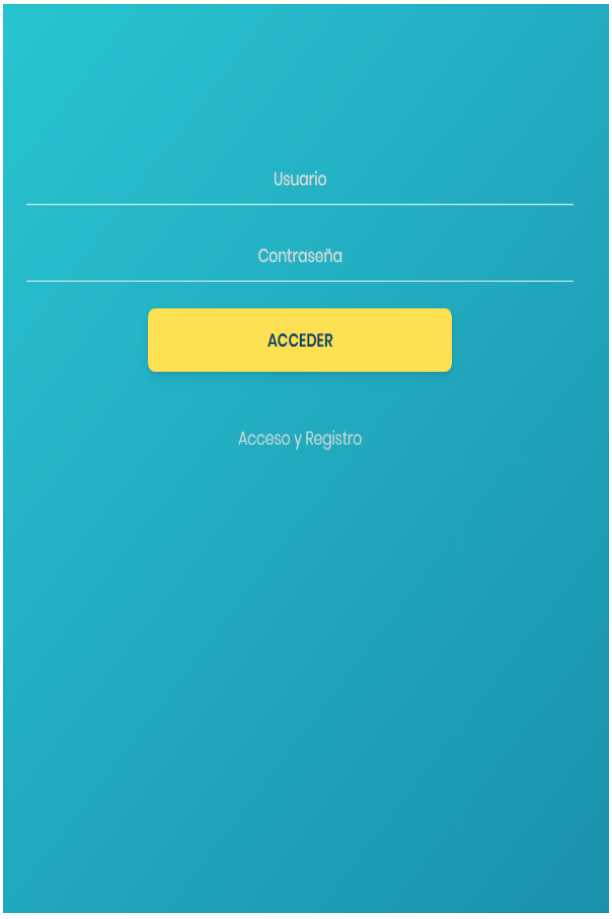

Figure 5.6: Login

However, both teachers and students are created by the counselor and the process of entering the platform for the first time needs to be more controlled.

For a teacher to register in the platform, he firstly needs the unique code created for his user that will be provided by the school counselor. Then, he needs to introduce this code

and his email, which has to be the same as the one uploaded in the CSV file.

This makes it almost impossible for anyone to impersonate a teacher and access to the platform in an unauthorized manner. Knowing the teacher's email is not enough and the attacker would have to guess a random generated code based on the date of creation of the class and the upload of the teacher. As we stated previously, security is a very important goal for us in this project, so we try to make sure that all accesses are controlled and our users and their data are protected against any cyber-attack.

Once this first identity verification is made, the teacher can continue with the process and proceed to create his account by using a username and a password of their choosing. Once he has accessed the platform for the first time, he can see his classes and the posts made on each of them as well as the platform's program including all the dynamics.

Figure 5.7: Teacher Registration

The registration of the students follows the same idea but has more added security. When a student wants to register, he first has to introduce all the fields that were used to upload his data to the platform. This means that name, surnames, date of birth and sex have to be written exactly as they were provided by the counselor. To add an extra

security layer and avoid any undesired registration by someone that could steal the CSV files imported, the student will also need to provide the code assigned to his class that was generated when the counselor created the class. With all this security we try to make it impossible to register in the platform illegitimately or by guessing someone's data.

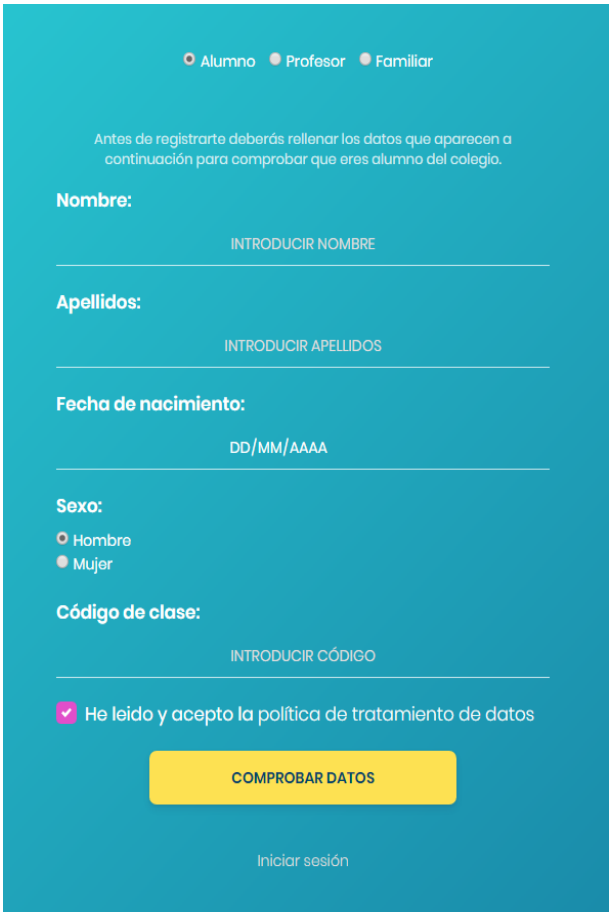

Figure 5.8: Student Registration

After this verification is successful, he will create a username and a password that will be used anytime he wants to access the platform.

The goal of this project is to provide schools, teaching staff, students and families the tools to create a better environment in the school free of bullying and other abuses. Because of this, families will also have an access to the platform in case they ever need to contact the counselor because they detect a problem and to follow what their kids are doing in class and upload to the platform. Each student has a family code assigned to his profile that can be seen inside the platform. This code will be used by the families when registering before creating a new user.

As well as the previous cases with students and teachers, once this first verification is made, the family member will be able to insert his new username and password and login

to the platform.

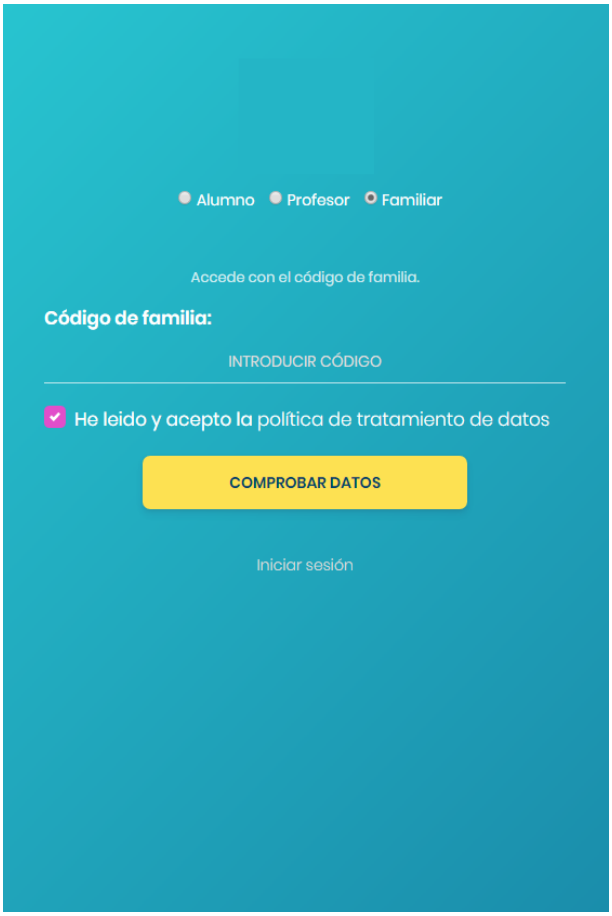

Figure 5.9: Family Registration

Families will have access to the same data as the students except the survey which is private and meant to be filled exclusively bu the student. This means that parents that register to the platform have access to all the program's posts, dynamics and games to also get to learn more about the problems their sons face in their life and that can affect them in so many ways. They also can see the My Class section where teachers and students can upload what they have done in class or at home and that are related to the activities presented in the platform. The implementation of this section is motivated by the creation of a space where all the students in class can review and have access to contents and memories they have created together.

In addition, the family user will be able to send a message to the counselor of the school. However, as it is advised in the platform, this type of messages must not happen unless there exists an extreme situation where the parent really need to intervene. The idea is that the students are the ones that manage their problems to some degree and that they are the ones who become brave and are able to speak up when an unfair situation, a case

of bullying or an abuse of any type appears in the school or near them. Parents need to support they children and help them in anything they can, but the students also need to be reasonably self-sufficient, depending on their age, obviously.

In many occasions along this document we have highlighted the importance of security in this project. Specially, we have implemented a great security system in everything related to the login and registration of users. To verify all the logins that are made in the platform, we have created a file called *userAccount.php* in the middle layer where all the actions related to the login and register processes are administrated. This file catches the name of the form that has been submitted and, after checking that all mandatory fields are filled send the a query to the database with the submission. In case the verification is successful, an affirmative response is sent back to the middle layer that orders to load the next page of the registering process. This file is thus the key of our security system of the login and register part. In the case of a new registration of a student, for example, this document is called twice. Firstly, the student fills all his data and the class private key and submits the data to the server. This query is only a check that the values that were input by the user are the same as the ones stored in the database. Once this verification is made, the student creates a username and a password and the *userAccount.php* file is now in charge of sending an insertion order to the database in order to register the new user. Once all this process is successfully ended, the user can access the platform by using the username and password he has just registered. The session data is stored in the file once the login is made as well as the user role and all the data related to him. This file is also in charge of the URL redirections and ensures that a user can only access the URLs he is allowed to and can only see certain information.

5.4 Teacher and students interact with bullying functionalities

The previous cases have been focused on the set up of the platform and the way the users will start interacting with it. However, our project is focused on bullying and it is a tool that is to be used by teachers, students and families to learn about bullying, what circumstances surround it before it happens, while it takes place and after the aggression has been committed; and for the schools to track the problems that appear and perform effective actions to stop them. If we look at the general architecture in **Chapter 4**, we can see that the online platform has five main modules. One is related with the login and registration to the platform and we have seen a practical example in the **Section 5.3**. Another one is related to classrooms where students and teachers will have access to content generated and uploaded by themselves to have a place to share their experiences. The other three modules are the ones bullying-related and that really make our platform valuable:

lesson program, messaging system and surveys.

The lesson program will mainly be used for in-class activities. The teachers will login to the platform and access the lesson they are going to teach to the students. When they access it, they will have information about it and some other optional resources like videos, dynamics and educational games.

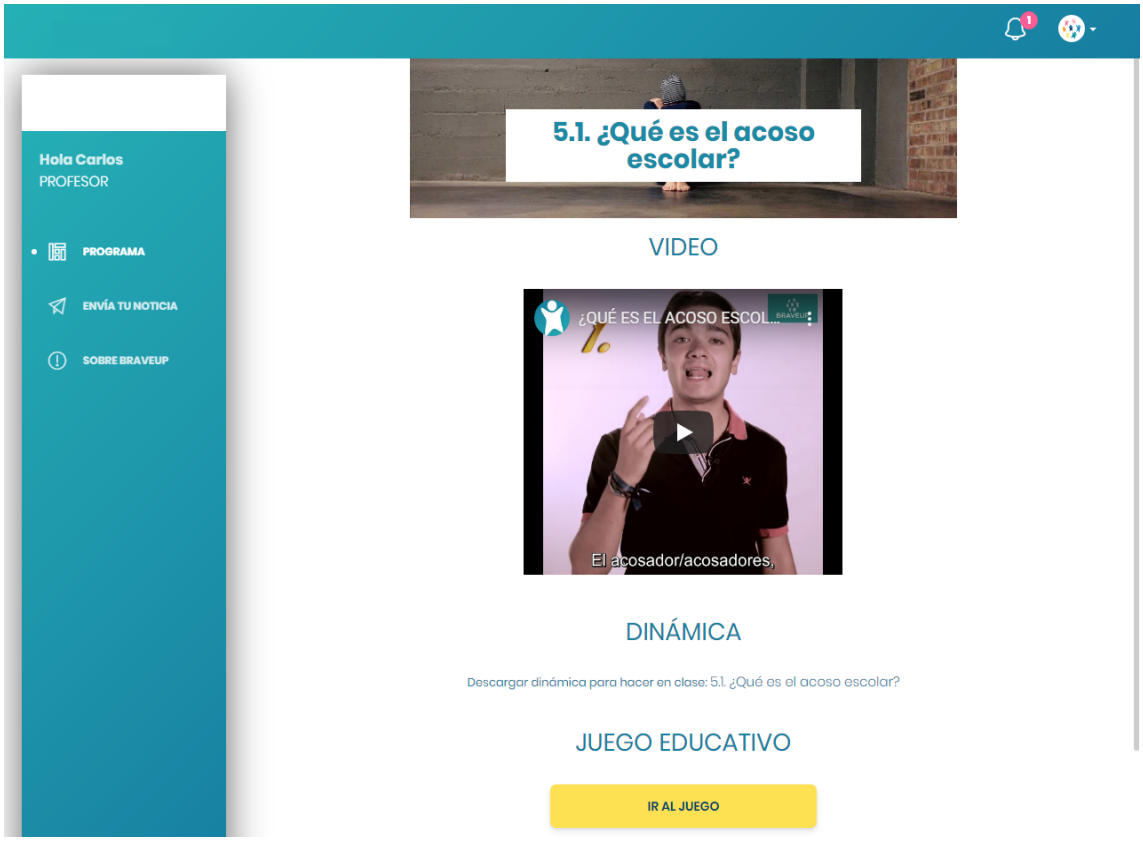

Figure 5.10: Lesson Information

The video is common to both the students and the teacher. The teacher will play the video in class and explain the meaning of it and the students will be able to watch it anytime they need to in order to study again the lesson or for deeper understanding. The only difference between what the student and the teacher see is the dynamic, that can only be seen by the teacher. He will download it and direct the activity that is described in the PDF file. The students won't have access to the dynamics so they do not know what they have to do beforehand and they can genuinely learn what the dynamic is trying to teach. The game is destined to the students and the button leads to an external website where the games have been developed and the results are sent to the teachers to check how the students have made.

Another very important part of the platform is the messaging system. Thanks to it we

are able to offer the students an always opened communication channel with the counselor of the school. Through it, students can privately talk to them and share the problems they have to face or that they detect in the classroom. The option of being anonymous grants the student the security that he is protected and is a way to encourage them to speak up.

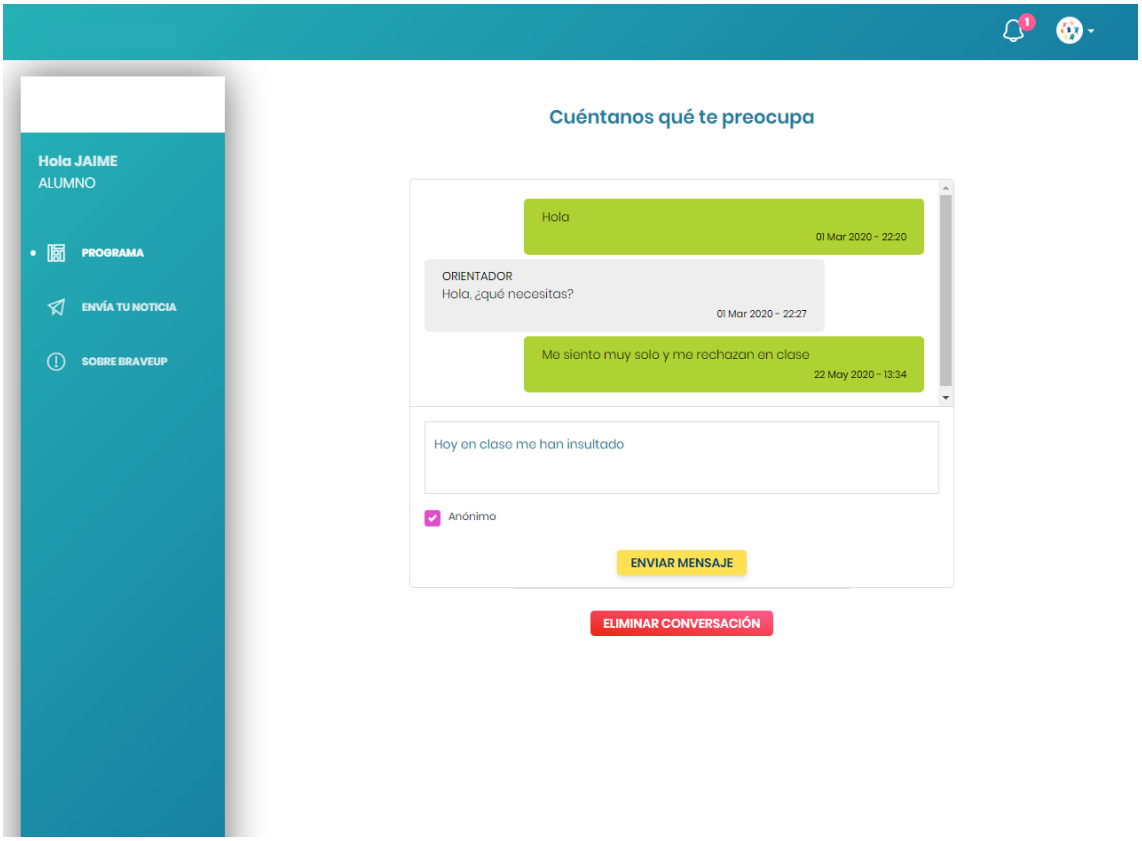

Figure 5.11: Student Conversation

As we explained previously, the only one who is able to start a conversation is the student. The counselor can only respond to messages of conversations created by students. In case they chose to be anonymous, the counselor will see the class and the course of the student to locate the problem but won't know his name. Both have the option of deleting conversations as an extra safety measure.

The other crucial bullying related module was the surveys. This surveys can only be filled by students. The counselor has the power over enabling the surveys to the different courses and classes and they notify the teacher when they activate it. The teacher then proceeds to ask the students to fill the survey in class to control that everyone is taking it seriously. Once all of the students have ended, the teacher can check in the classroom module if all the students have indeed completed the survey.

As we stated in the previous chapter, the questions that have been selected for the survey

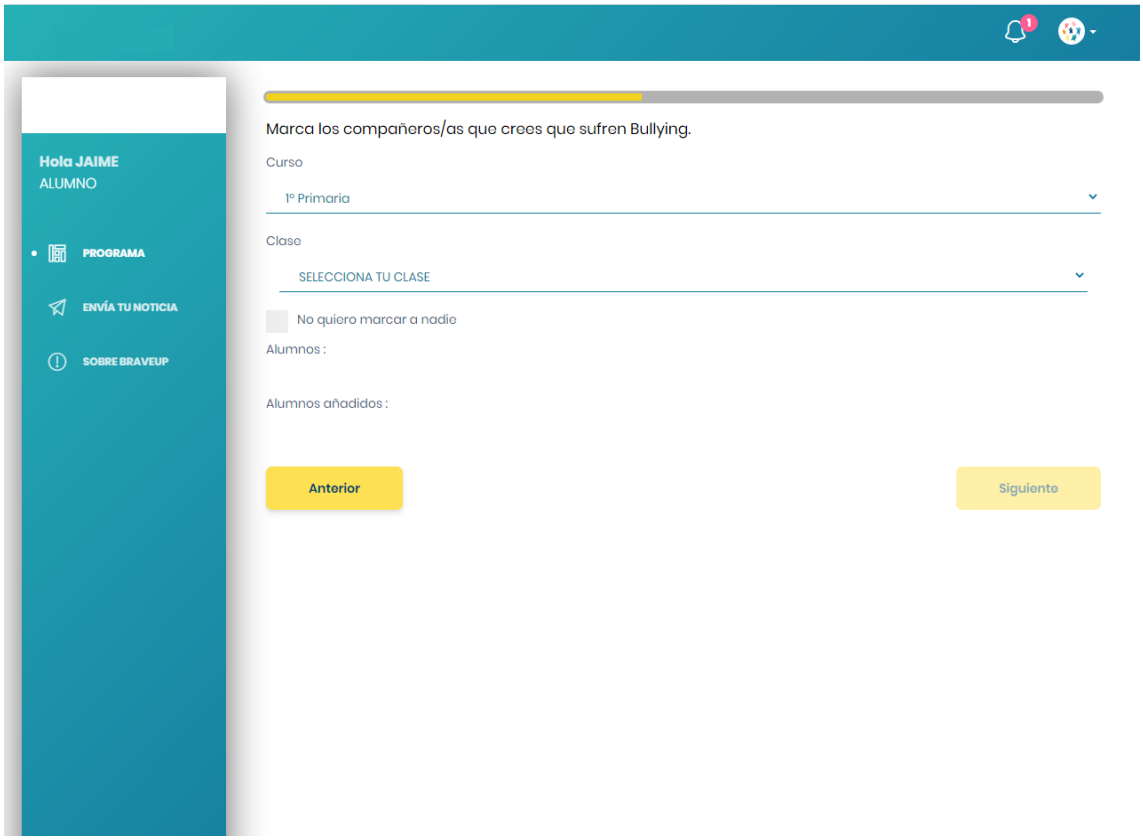

Figure 5.12: Student Survey

aim to cover two main fields: relationships between students and the use of technology and social media. The first one allows us to create models of the relationships between the students, detecting who is being left out or who is an aggressor or a victim of bullying. The second part of the survey allows us to study the presence of technologies in students of different ages and to detect possible cases of cyber-bullying. All the data collected is treated and sent to the school so they can have a better idea of the situation and intervene in an effective way.

5.5 Summary

These four are the most significant case studies of our platform. They cover the most important actions the users can perform inside the platforms we have developed. As we have seen in the first case study, the admin is in charge of the elaboration of the lesson program and the state of the whole platform. He is also the one who creates a new school in the platform and grants access to the counselor to the online platform. The counselor is in charge of creating all the classes in the school and uploading all the class lists and

teachers, as it is explained in the second case study.

The third case is aimed to the registration of users of the school after their data has been uploaded to the platform. The login process is very similar for students, teachers and families but with slight differences. The student not only needs his personal information but also a code provided by the teacher and that was automatically generated in the platform before creating a user. The teacher needs also a class code and the email that appears in his personal data.

The fourth case study is the most important one in our opinion since it gives the real value to the platform. With all the functionalities described in this case study, our project would only be a platform to manage the data of the school and everyone inside of it. However, our main goal is to stop bullying and to do so we have attacked as many approaches as possible with the same solution. We start with the prevention thanks to the lesson program that shows the students and teachers real-life cases and has them participating in role dynamics and games to understand the situations from an inside perspective. The intervention and alert is covered principally with the online chat where students can contact the counselors to talk about personal problems or conflicts in class. The monitoring is also covered with the surveys that can be periodically performed in all the classes to have updated data on the situation of each student and class.

CHAPTER 6

Conclusions

This chapter will describe the achieved goals following some the key points developed in the project.

6.1 Overview

To summarize this project, we are going to highlight the concepts that have been explained throughout the document. Bullying is a very complex problem that affects most of the students in schools both directly if they are victims or aggressor and indirectly if they are just witnesses of abuses. All cases end up creating a certain environment around the class and the school and, even if there are just a few cases, this type of behaviours are sometimes extended in a certain degree to the rest of the school.

We have conducted studies in two main directions. Firstly we investigated about reports and statistics both global and regional to try to understand the extent of the problem and the way it is affecting people short-term and long-term. One of the main advantages of the field we are approaching is that, as it is one of the main concern inside families, there is a great literature around it. Organizations such as Unicef or Unesco have written a number of reports with updated data that has allowed us to understand the problem in a more complete way. We have been able to deepen in the roots of bullying, what types of bullying exist, which are the main reasons why a person is bullied, regarding what aspect of his life is used to inflict bullying or what are the consequences of suffering bullying, from immediate consequences like worse scores to long-term problems such as drug abuse or social isolation.

Also, the study of the current technologies and solutions has revealed us that bullying is considered one of the most important problems for parents and the approaches are somewhat different depending on the philosophy being adopted. While some companies focus on providing the students and their families a platform where they can feel safe enough to talk to professionals and people that can help them inside or outside the school to take care of these abuses; others try to cover the field of the education of the children and their families to instill in them values such as respect, self-confidence or team work to attack bullying at its beginning and prevent the appearance of new cases.

Thanks to all this and with the help of technology we know how to control, like HTML, CSS, PHP or MySQL, we have planned the creation of an online platform destined to school where they will have a repository of activities, dynamics and texts about different aspects such as emotion management, empathy, how to solve conflicts or school violence. In addition to this formation they will receive aiming to educate them on the respect for everyone regardless of their social, sexual or economic conditions to name a few; we will also provide them with a messaging system to communicate in case anything happens or a case of abuse of any kind is detected. The students will also have the opportunity of participating in surveys so the schools possesses much more data about the situation in the school and can detect cases of bullying that are manifested or underlying cases of exclusion to certain students, apart from many other conclusions.

This application and platforms will be available for everyone who belongs to the school that hires our services and will be multi-platform, which means that we have not only created a platform accessible through the internet in our computers but also the users can download a native app we have created with the help of React Native and Redux to access the platform on their own smartphones.

6.2 Achieved Goals

With this project, we have achieved a number of goals we planned when we started and some new ones that have appeared during the development of the project:

- **Interactive platform**: the content uploaded to the platform and that will be accessible by teachers and students will be accompanied by dynamics that will be done inside the classrooms and videos that will help everyone get to better understand what kinds of abuses do the children suffer, how they appear and why are the motivated. This activities will help them learn about very important values for their life like team-work, respect or self-acceptance.

- **Useful tool for students, teachers and schools**: we have created a platform that will help all the teaching community with the elimination of bullying, a problem that is one of the top concerns of the families nowadays.

- **Multi-device platform and native app**: thanks to the technologies we have used during the project such as HTML, CSS and Bootstrap or React Native, we have been able to create a responsive platform with its own app versions for Android and iOS that can be seen in any device, from smartphones to computers, natively.

- **Cybersecurity improvement**: we have created a very security-based tow-step login process to ensure that all the users that register in the platform are registered in the school's lists. A student that wants to register is not able to access by only using his personal data, he also needs to use a unique code attached to his class and that has been previously provided by the teacher. With this extra step, we bet on the improvement of security to protect the school and specially the children inside and their personal data.

- **Online chat**: we have created a messaging system from scratch where the users can interact inside the platform. The students or their families can contact the school's counselor anytime if the need to talk about any problem that may show up. To make the student feel safer, we also can write anonymously.

- **Survey system**: the teachers and counselors of the school will have control over the availability of the surveys and, when they find it necessary, they will be able to enable the survey system to certain classes. Students will then be able to complete the survey and provide the teaching staff with very valuable information. The survey covers two main fields: firstly it explores the relationships between the user and his partners, who are they friends with, who is good to work with and who suffers bullying, what are the reasons they are bullied and how are those abuses inflicted. The second part deepens on the habits of the students regarding their personal life: do they have a phone, what do they use it for and which social media are part of their day to day life.

6.3 Future work

The project has fulfilled most of the goals and objectives that were set at the beginning and some new others that appeared along the way but, in order to continue growing and reaching more clients, we need to keep enlarging our offer and complement our services with new ones.

As we mentioned in Chapter 4, the creation of a full app is one of the most immediate lines of work in order to provide an even better experience to the users. To do so, we will deepen in the React Native language and will create with the help of React and Redux a web app and native app that allows us to offer the users even more customization and functionalities. We have already developed and created a first functional version of the app that has been published on Google Play and the work is now centered on expanding this new version of the app by using the structure with firstly created.

Another very interesting line of work is expanding our platform by hiring more schools inside Spain and, once our results are extensive and well-founded, start the internationalization of our platform to other countries in South America, where Spanish is the main language too, and Europe, where cultural differences and results are more close to the ones in Spain. As we could see on the Unesco report, all countries suffer a considerable amount of bullying cases and our intention is to change the mindset towards it to prevent and intervine as efficiently as possible.

Nonetheless, apart from this lines of work, we have come up with some interesting future features. The most interesting aspect we have discovered during this project is the prevention and awareness of how bullying can present itself and how this and many other abuses are present in every school, affecting a large number of students and families. With this in mind, it would be interesting to start working on courses and online webinars that would educate teachers and families in the prevention of behaviours that could lead to

bullying and how to act in case of finding out it is affecting the school's environment.

This webinars and live online courses would be integrated in our platform, where we would have the option of watching a course in streaming or to access a repository with a list of past videos. This could be achieved by using streaming engines and servers such as Wowza Streaming Engine, which is a platform we have worked with in the past; and using what we have learned about platform development and PHP to include it inside our platform.

Regarding the platform developed on this project, we also have some future ideas to work on with the goal of improving the services we already offer. In a near future, counselors will be able to create their own customized surveys and substitute the predefined one we have created for the deployment. They would be able to change the active survey in order to get different data. Our intention with this is to give the schools the opportunity of collecting more data in specific questions and to change the survey when they need to.

One more future work would be the improvement of the online chat. Right now, users can only send text messages but the next steps would be to enable the sending of files or images through the platform to make the information more complete.

APPENDIX A

Appendix A: Impact of the project

In this appendix we will explore the possible impact of our projects in different areas such as economy, society or environment. We will also study the ethic responsibility and the law enforcement.

A.1 Environmental

While our project is won't have an immediate impact on the environment, the variety of the posts published in our platform covering many different topics such as respect, collaboration, sexuality, friendship, conflict resolution or bullying can be extended to educate also in terms of respect for nature and the environment in order to create a better tomorrow.

A.2 Social

As we have stated throughout the development of this project, its main goal is to create a change in society starting from schools and children. A better education regarding respect for each other needs to be delivered and this can't be done by teachers and schools on their own. They need help from experts in the field that can help them understand the complexity of these problems and how to prevent, detect and act.

A.3 Economic

This project does not aim to have a big economic impact, but the consequence of its success could be a change in conduct of families and their children when it comes to its education and the support they need to have a healthy time during their pass through the schools.

A.4 Ethic

Together with the social aspect, this project tries to generate a change in how people, but specially children, interact with each other and behave. It does not speculate with a topic as serious as bullying but looks to prevent it by teaching important and healthy values and by giving everyone a tool to understand the problem and inform of any new case that may show up. It looks to enhance the communication between families, students and the school to make social relationships easier for all of them.

APPENDIX B

Appendix B: Economic Budget

In this appendix we will take a look at an example of an economic budget based on the devleopment of this project.

Horas por ECTS	30			
Número de ECTS	30			
		Horas	Precio/hora	**TOTAL**
COSTE DE MANO DE OBRA (coste directo)		900	17,50 €	15.750,00 €
COSTE DE RECURSOS MATERIALES (coste directo)				
	Precio de compra	Meses de uso	Años de amortiz.	**TOTAL**
Ordenador personal (Software incluido)	1.000,00 €	6	5	100,00 €
GASTOS GENERALES (costes indirectos)	15%	Sobre CD		2.377,50 €
BENEFICIO INDUSTRIAL	6%	Sobre CD+CI		1.093,65 €
MATERIAL FUNGIBLE				
Impresión y encuadernación				80,00 €
SUBTOTAL PRESUPUESTO				19.401,15 €
IVA APLICABLE			21%	4.074,24 €
TOTAL PRESUPUESTO				23.475,39 €

* La duración del proyecto se ha planificado basándonos en el desarrollo que nosotros hemos llevado a cabo en los últimos meses

*El coste de impresión y encuadernación ha sido consultado en el servicio de publicaciones de la ETSIT

*El precio por hora ha sido obtenido como estimación del sueldo de un ingeniero técnico de telecomunicación

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