Development of a Web Application for Students with Dyslexia and Dyscalculia based on Teaching Experience

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Abstract

Nowadays in the educational classrooms there are children who have some difficulty in their learning. Generally, these cases are overlooked because they are thought to be somewhat slow to understand. However, there are cases of dyslexia, dyscalculia or dysgraphia disorder within the classroom. These disorders cause some problems such as the physical act of being able to write, difficulty in reading, difficulty in making sense of mathematics. Therefore, propose the implementation of a Web site to help children suffering from these disorders to improve their learning. The purpose of the website is to help them through the recreational and didactic games presented. In addition, educational materials are available in PDF format for quick and easy printing. Also, you can find graphical reports on the student's continuous improvement. On the other hand, it is also proposed the implementation of a forum in which parents can resolve their doubts regarding these disorders. Thus, they can be connected on any device, whether tablet, laptop, computer, smartphone or other. Therefore, the research involves the implementation of a Web Application that will benefit the child in his school learning.

Keywords: Web Application; Learning; Dyscalculia; Dysgraphia; Dyslexia; Forum; Children.

1. Introduction

In the last few years, can see how children have been taking their classes in a normal way, either virtually or in person. They are talking about children at the primary level, such as first, second and third grade, there are circumstances where children have difficulty in writing, reading and calculating basic operations. Generally, in the basic courses such as communication and mathematics. The children have some learning problems in reading and writing, as well as in understanding mathematics. And parents think that it is normal for them, since they are just starting school, and let these cases go unnoticed [1]. However, this may be the beginning of a learning disorder, known as dyslexia, dyscalculia, which occurs in children at the primary school level [2].

In Peru, see how many of the students at the primary level have some learning difficulties, and also look at the students who do not have any difficulties. This does not only happen in Peru, in many countries see how students at the primary level suffer this disorder, as in Brazil, Portugal, Spain, and others. Dyslexia and dyscalculia is a learning disorder that is generally affecting primary school children [3]. With this in mind, there are teachers who pay more attention to these students so that they can understand the classes as well as their classmates. However, there are cases where teachers fail to notice these students [4]. For this, technology can be a

great support for these students, since there are videos, games that benefit the student for a better understanding of reading and writing, mathematical calculations, and so on [5].

In households there are economic problems,

which make it difficult for family members to help children with cell phones, computers, tablets, among others. Of course, in order to help a child with learning difficulties, you don't need technological equipment. However, there are many parents who do not know how to help their children or because of their work schedule do not spend much time with them. Another reason for relatives not being able to support their children is the issue of the Internet. Because there are families with few economic resources, they do not have internet service. This is also reflected in virtual classes, as children do not log in because of this problem. There are cases where they have dropped out of school, either because of the Internet or because they do not have a technological device, such as a cell phone or a computer [6].

Taking into account the problems of children who have and are going through dyslexia disorder, this research work is presented. The objective of this project is the implementation of a Web Application for children to interact on the site, but also to have educational materials in PDF format at hand. And family members can download it free of charge to help them understand reading, writing and calculating operations. In this way to understand the classes, both virtual and face-to-face.

As mentioned above, this research is conducted on children with dyslexia disorder and how to help them learn [7]. The article is structured as follows: Section I, already seen, presents the Introduction. Section II defines the Methodologies, which were applied in the project. The tools used for design, prototyping and development. Section III presents the results and discussions of the project. Finally, Section IV defines the respective conclusions following the research of this project.

2. Methodology

For the elaboration of this project, two methodologies were used. Both are Agile Methodologies, also known as a Hybrid methodology, which are Scrum and Kanban. However, in this project made changes already defined in this Scrumban Hybrid Methodology. It could be said that the Scrum Methodology is more widely used throughout the project. Since the Kanban Methodology is used only in sprint development, with its User Stories, prototyping, among others.

2.1 Agile Kanban Methodology

This methodology means card or sign in the Japanese language. Its purpose is to go through the activities to be carried out by the individual in stages, such as starting, in process and completed [8]. The graphical representation of the Kanban Methodology is shown in Fig. 1.
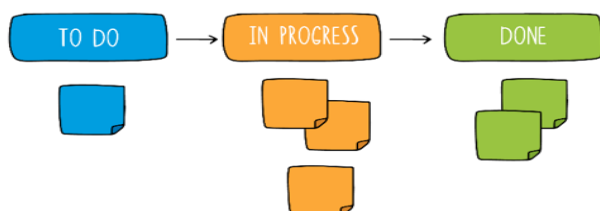

Fig. 1. Kanban Methodology. Adapted from [9]

2.2 Agile Scrum Methodology

The Scrum methodology is well known and used in most cases with the development of a Mobile Application or a Web Application. Being an agile methodology, projects are developed quickly and safely taking into account the Scrum processes [10]. The process of this methodology can be seen in Fig. 2 below.
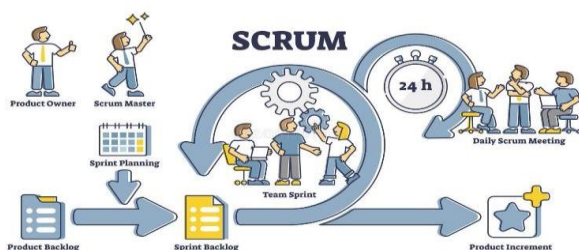

Fig. 2. Scrum Process. Adapted from [11]

2.3 Design and Prototyping Tools

The tools used in the elaboration of logos, icons, images, and also in the elaboration of the prototypes presented to the Product Owner. They are the following.

- Corel Draw: A tool widely used by designers, and thanks to its easy-to-use tools, good graphic projects can be carried out.

- Balsamiq Mockups: One of the best tools for the creation of prototypes, sketches, among others. Balsamiq is widely used by developers in order to deliver prototypes to the client, either mobile applications, web applications, among others.

2.4 Development Tools

Finally, have the tools used in the development of the Sprint, the programming languages that were used, and a database manager that was used to manage the information of the web application.

- Visual Studio: It is a software integrated by Microsoft, a development environment compatible with different programming languages. As in this case it is used to accompany it with the C# language for the elaboration of a Web Application [12].

- Language C#: A programming language known to developers, object oriented. Compared to the C++ language, this language is simpler. It is a modern language that allows the creation of secure and robust applications that run on the .NET framework [13].

- SQL Server: A database management system known to developers. It has support in transactions, administration of stored procedures, among others. This database manager was used for this Project [14].

2.5 Methodology Development

Following the proposal made through Survey No. 1, it was determined that all respondents would like to have a website that helps children suffering from this disorder. The survey provides definitions of what these disorders are and how they affect a child's education in the early school years. Following this, have the main question of our research, which is the proposal to start with the implementation of a Web Application. The results of this first survey show that all of them, with 100% of votes in favor, consider that it is necessary to implement a Web Application for these children.

- Identification Phase: After a thorough analysis of Survey No. 1, a list of questions is proposed for the same and new respondents through Survey No. 2. In which you will find a series of questions with the purpose of knowing the requirements that the users of the Web Site have. Table I shows the series of questions in the survey, which total 7 questions. In addition, there is an additional question in the survey that asks if the respondent has an additional requirement for the Web Site. As mentioned above, Table I shows the questions that were asked to the general public regarding the research that was proposed. The questions are identified by the letter "P" followed by a number. In addition, there is also the additional question that was asked in the survey, this is identified with the letter "P" and the letter "A".

Table 1 List of Survey No. 2 Questions

USER REQUIREMENTS	
P1	¿Would like each child to have his or her own account?
P2	¿Would like the home page to show educational and recreational games?
P3	¿You would like children to have a score at the end of a game.?
P4	¿Would like to have a scoring record on the games that you have?
P5	¿He would like to see graphically how the children are progressing?
P6	¿Would like to have educational materials available for printing in addition to those available online?
P7	¿You would like to have a support forum to tell us about your questions?
PA	¿What else would you like to find on the Web Site?

On the other hand, the results of Survey No. 2 are shown graphically as follows. Fig. 3 shows the analysis of the results of this survey, the purpose of which is to identify the requirements of the respondents with respect to the Web site. The graph shows the results in percentages of the 7 questions shown in Table I.

Start with the percentage of P1, which is 57.7% of people who require each child to have a personal account within the platform. Following this, P2 has a higher percentage than P1, P2 has 73.1% of people who would like to find directly the didactic and recreational games when entering the Web site. P3 shows 61.5% of people who would like children to have a score at the end of a game. P4 53.8% who want to have a record of scores for each of the games.

On the other hand, in P5, 69.2% of respondents said that they would like to observe the progress of children through statistical graphs. In P6, 69.2% of people would like to have a section with educational cards for children. The purpose of this section is that parents can download these cards in PDF format and print them so that their child can practice in addition to the online games.

Lastly, P7 shows 57.7% of people who require a forum within the Web site. This forum is intended to help parents who have questions regarding the use of the application and also have any doubts regarding dyslexia or dyscalculia disorders. In the forum you will find the participation of registered users and also of personnel specialized in these issues of disorders.

As mentioned above, Fig. 3 shows the results of Survey No. 2. Which determines the user requirements, this helps us to make the user stories that correspond to the development of the Agile Scrum Methodology.
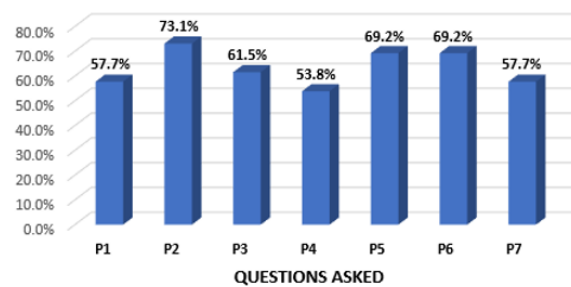

Fig. 3. Requirements results

After a thorough analysis of the results of Survey No. 2, Table II is presented below. This consists of the definition of user stories corresponding to the project. With a total of 10 user stories defined by the development team, can start dividing up the deliverables of our project. It should be clarified that following the development of Scrum, these stories are prioritized as follows. This will help us to divide the deliverables that our project will have, having a total of 3 deliverables.

Table 2 Product Backlog Management

ID	USER HISTORY	P.
H1	I as a user want to log in to the platform to interact with the platform.	5
H2	I as a user want to register with an account to access the platform.	7
H3	As a user, I want to see the games on the main page for quick access.	7
H4	I as a user want the system to count my score for each game so that I can record my score.	5
H5	I as a user want to see my scores for each of the games to see my progress.	5
H6	I as a user want to see graphically an overall analysis to see how I am improving.	7
H7	I as a user would like to see a ranking table to see the scores of other boys and girls.	5
H8	I as a user want to have access to educational materials for downloading and printing.	7
H9	As a user, I want there to be a help forum to indicate any doubts I may have.	7
H10	As a user, I want support help to resolve doubts regarding the use of the web page.	5

Development Stage: In this section you will find the development of the sprint or deliverables of our project. Before starting with the presentation of the Sprint Development, Fig. 4 shows the general diagram of the basic process that the user goes through from entering the Web Site to leaving it.
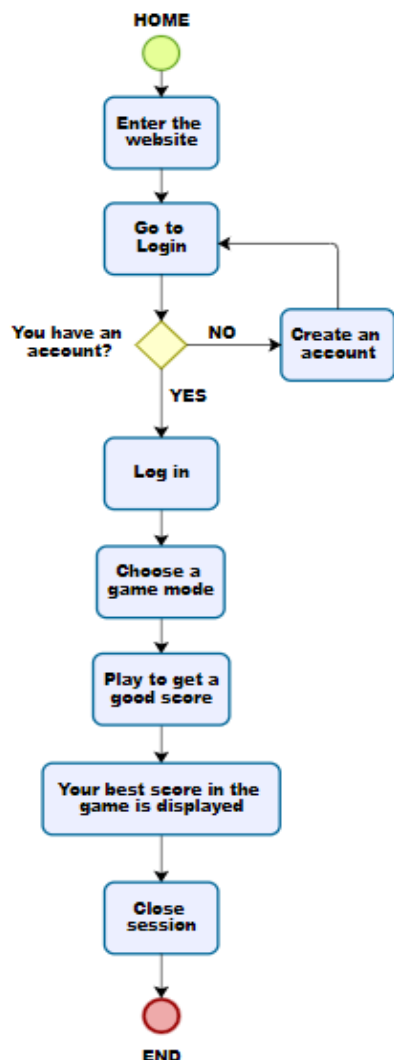

Fig. 4. General Project Diagram

On the other hand, the architecture of our web application is presented in Fig. 5. It starts with the child in front of the computer. The first thing you do is to go to the indicated website, then, if you do not have an account, you register. The data is stored in the site's database so that the user only has to log in with his user name and password. Once logged in, if the user wants to download files in PDF format, he/she is directed to the download section. If not, go to the games section, where you will find different game modes and select one of them. After that, it is normal to start playing and at the end of the game you will be shown your score. You will be able to see the weekly ranking of the game and thus know how you are doing in each game. Finally, have the presentation of the help forum where the user or parent

will enter to make their queries within the forum.

Fig. 5. Web Application Architecture

First Sprint: In the development of this Sprint, four items are presented. The stories are H1, H2, H3, H4 corresponding to the first sprint. The main page of the website is shown in Fig. 6. Where he shows us a short explanation of what dyslexia is. The website has a main menu where you can see the games section, PDF files, the forum, help and support, and finally the login. H1 and H2 of this sprint correspond to the presentation of the login and registration of a new account. With this, the child will be able to enter the platform and start playing, in this way it will be possible to keep track and see how they are improving day by day.
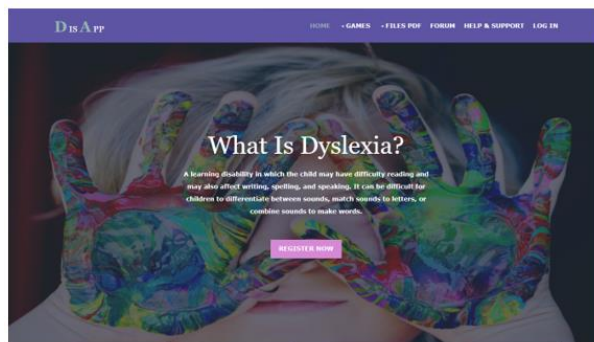

Fig. 6. Web Application Home Page

Following this, there is the development of H3. This corresponds to the main view after logging in to the web application. Fig. 7 shows the main sale of games, which is

divided into two, Educational Games and Recreational Games. Within each one there are a variety of games oriented to the continuous improvement of the children who are using the web application.
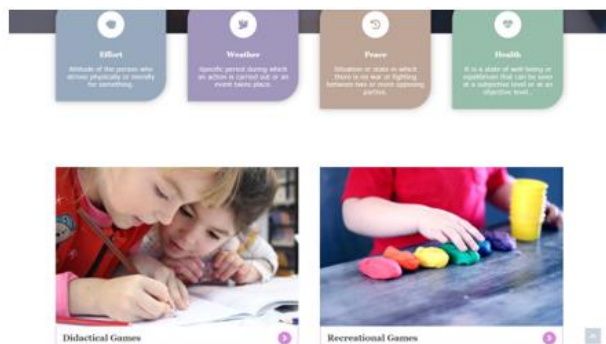

Fig. 7. Games Section of the Web Application

The games mentioned above are based on education for these children, so that they can constantly improve themselves. Each of the games at the end of the game shows a score which is helpful for the child. In addition, it shows the best score that the child has in the game and this is shown in order for him or her to improve day after day. The development of H4 is that at the end of each of the games the system shows me the score that has been obtained by playing one of the modes that are available.

Second Sprint: In the development of this Sprint, there are 3 items to be presented. The first of these is H5, which consists of displaying all the scores recorded in a game. Whatever the game is, the system displays the scores obtained from this selected game. Following this is the development of item H6, which shows graphically how my results are for each of the games. With this, the parent or specialist in charge can see how the child is improving with the use of the web application. Finally, have the presentation of item H8, which tells us that the user must have access to educational materials.

The files are in PDF format, so that the user can download them quickly and easily. After that, if you wish, you can print it out so that the child does not need to be sitting at a computer. As shown in Fig. 8, there are 6 booklets that the user can download in PDF format. This way you can print it and solve it without the need of coverage, since to access it from a computer or a smartphone you need the internet and the coverage of the operator.
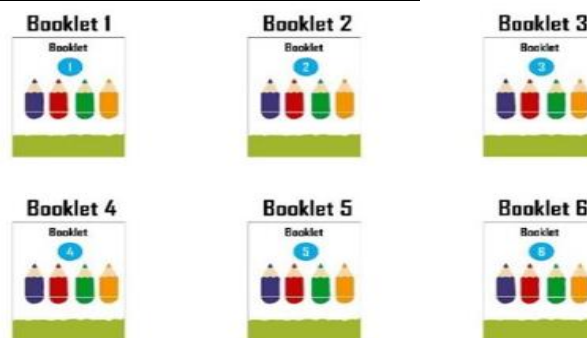

Fig. 8. Educational Materials in PDF format

Third Sprint: In the development of this last sprint we have the presentation of 3 items. Starting with item H7 which tells us that the user should be able to see a ranking table showing the scores of all users. The Top Ranking is intended to generate competition among children so that they can continue to improve day by day. But also, with it, the children can socialize more with the children around them. For this purpose, Fig. 9 shows the table of all users who played the game.

Fig. 9. Full Game Ranking

On the other hand, have the development of item H9, which mentions that there should be a help forum section within the platform. In which users, parents or specialized personnel can interact with other users. This way you can get rid of your doubts by entering your comments in the application's help forum. Fig. 10 shows the design of the forum and how users have been commenting on the application and also making their queries regarding dyslexia, dyscalculia and dysgraphia.
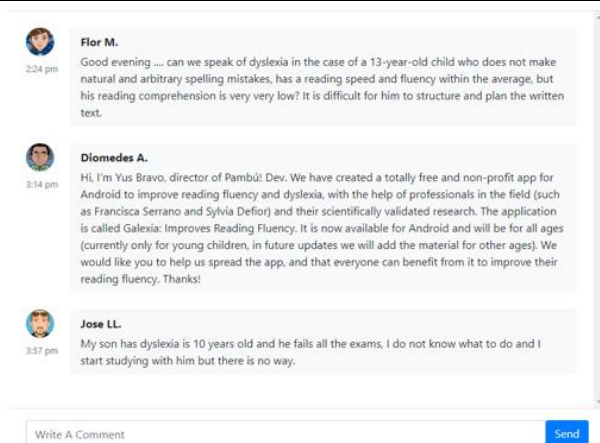
Fig. 10. Web Application Help Forum

Finally, the last item corresponding to the sprint is presented. Item H10 is intended to help users if they have any doubts regarding the use of the online platform. In addition, a user help manual is included in this section. In this way, the user can solve their doubts without having to ask for help on the website As mentioned above, there is a forum where you can ask questions regarding this disorder or your child's improvement.

3. Results

The results of the proposal proposed in this research are the results of Survey No. 4. In which the respondents' choice of a question is shown. Fig. 11 shows the results of the survey, the respondents answer the question, "Can advances in children's learning be achieved with this application?". In which there are two options, Yes or No, 77.1% of people consider that progress can be achieved after the implementation of this application. On the other hand, 22.9% of respondents do not believe that learning progress can be achieved for these children.
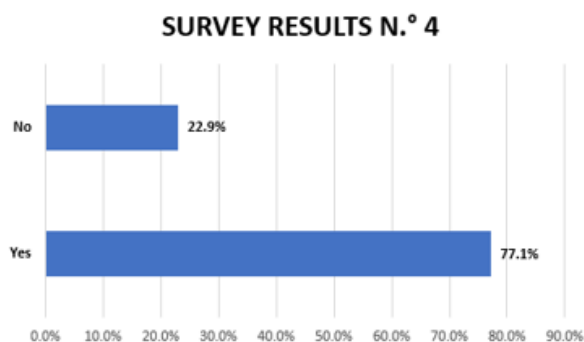

Fig. 11. Web Application Initial Feedback Results

This is followed by the results of Survey No. 5. Which corresponds to the final survey of the question asked in Survey No. 4. In which he talks about whether the implementation of an application can achieve progress in these children who have these disorders. Survey No. 5 asks, "After observing the prototypes, ¿do you think that progress can be achieved in children with the use of this Web application? Fig. 12 shows that 93.8% of people agree that with the implementation of this application the desired results can be achieved.

Following this, there are those who still do not believe that progress can be achieved by means of an application. The votes of these people correspond to 6.3% of the total number of respondents. It can be seen that the majority of votes are in agreement with the implementation of this application. However, there are people who do not believe this is possible. This is the reason why this research is presented, so that people can observe the progress made in children.
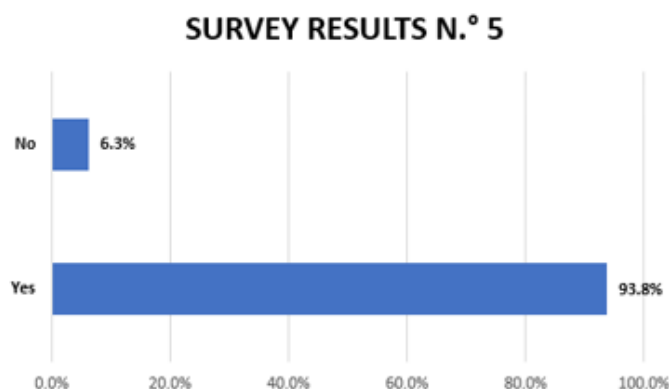

Fig. 12. Final Application Feedback Results

On the other hand, Survey No. 6 corresponds to an improvement in the application, a suggestion. Which says they would like to see the Web Application also in a Mobile Application. Fig. 13 shows that 81.3% of people agree that there should also be a mobile application. On the other hand, it was obtained that people who disagree with this improvement. 18.8% disagreed with this implementation.
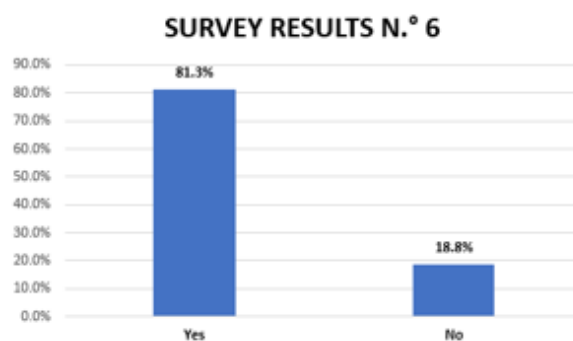

Fig. 13. Results of a cross-platform application

As final results of the proposal proposed, the results of the last survey of the public initially surveyed were obtained. Fig. 14 shows the results of the survey, with respondents answering a simple question, "Do you expect to see more about this project?". In which, 92.3% of respondents would like to see more about this research.

On the other hand, you have the people who are not sure about seeing more of this research. With the vote of these people, 3.8% are not sure they will see more of the project. And finally, 3.8% do not want to see anything about this project. With these results, seek a continuous improvement of the research in order to reach those people who are in doubt and people who do not want to see more of this project.
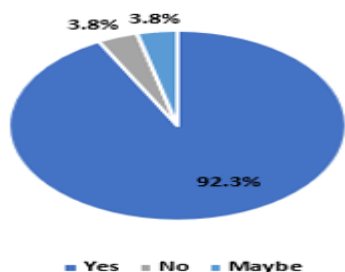

Fig. 14. Continuity results

4. DISCUSSIONS

With respect to the investigation of [15], shows the implementation of a mobile application for children suffering from dyslexia. The games have an archeological design, however, the application does not have many options compared to the web application. The game is displayed directly for the user to start the game, but definitions and explanations of these disorders are available on the website when the user enters the page. In addition, there is a help forum to resolve parents' doubts and concerns. The forum has the participation of personnel specialized in these cases. Another section that cannot be found in the mobile application is a ranking table, with which the student can incentivize himself to get a better score every time he plays.

On the other hand, unlike the mobile application, the website shows a graphical report section on the user's process. Finally, the site offers educational learning materials in PDF format, so that the parent or user can download the file to be able to print the teaching documents quickly and easily. This web application has many options as already mentioned, however, the implementation of the application on cell phones is also proposed so that users have greater ease of access, since it is more tedious to sit in front of a computer. In this way, to be at the same level as the aforementioned project, and to be able to access the mobile application quickly and easily using a smartphone or tablet.

5. CONCLUSIONS

At the end of this research, it was possible to conclude that the implementation of the web application for the benefit of the children of the educational centers was carried out. The Web Application includes the Consultation Area corresponding to the Forum indicated in the development. In addition, there is a Downloads section that shows the files available for children according to their level of education. Like the Forum, Downloads are indicated in the research. Within the application it is possible to observe the continuous improvement of the children in the games, and as a result of their learning is observed day by day when they go to their educational institution.

As future work, present the implementation of a mobile application that will also help children suffering from these disorders. The results of this proposal can be found in the Results Section of this research work. On the other hand, it was also proposed to improve the application so that it can also help adolescents and in the future young people and adults to show progress in their education.

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