Girassol: A Mobile App to Measure Levels of Nomophobia in Adolescents and Young People

By Karlla Danielly de Souza, Mônica Ximenes C. da Cunha & Eike Duarte Santiago

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Keywords: technological dependence; mental health; mobile applications; teenagers; young.

GJCST-G Classification: D.2.m

GIRASSOLAMOBILEAPPTOMEASURELEVELSOFNOMOPHOBIAINADOLESCENTSANDYOUNGPEOPLE

Strictly as per the compliance and regulations of:

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Karlla Danielly de Souza [α], Mônica Ximenes C. da Cunha [σ] & Eike Duarte Santiago [ρ]

Abstract- This article presents an application to measure levels of technological dependence in adolescents and young people. The first phase of this research consisted of a Systematic Literature Review (SLR) to collect data on the detection and risks of excessive and harmful use of digital technologies. The data collected in SLR became the base for interviews with 05 psychologists and a survey with 566 individuals between 12 and 21 years of age. Based on field research and the "Internet Addiction Test" (IAT), which was adapted for this public, the Girassol application was developed. The first validation with 05 health/education professionals and 07 adolescents/young people was 83.3% positive, and the second validation had a positive evaluation of 98.49%.

I. Introduction

A research [4] presented Brazil as the fourth country with the largest number of internet users. The daily use of the internet causes family conflicts resulting from the lack of dialogue, in addition to leading to superficial relationships, learning difficulties and anxiety disorders [6]. In recent years, virtual relationships are not only present as a means of communication, but also as an alternative in the demands of work and as entertainment during leisure time. It is demonstrated that technological dependence is easily perceived among adolescents, who maintain frequent contact through messaging on social networks sent by cell phones or computers. Additionally, the advances in technology have made traditional toys obsolete, and hindered the development of synesthetic experiences [5].

Digital technologies are increasingly affecting society, culture and the interaction between individuals, both positively and negatively [2]. Although feelings of anxiety, dependence and loneliness have not been confirmed in social media users, adolescents are sensitive to social influence [3]. This influence can also occur in virtual social networks, even indirectly, as the opinion of others is also manifested through comments on posts, and conversations in online chat rooms. Among the impacts and risks to mental health are: anxiety, depression, nomophobia, bullying and cyber bullying.

Therefore, this research concerns the new needs of adolescents in a virtual environment, the emotional problems sometimes caused by its use, and possible mental disorders caused or accentuated by games and online chats that influence adolescents and young people in carrying out risky activities. The objective was to carry out a SLR and, based on the results, propose an application (app) to assist in the identification of psychological problems caused by the overuse of technology. The empirical basis for the artifact was a field research to survey the impacts of digital technologies on the mental health of adolescents and young people.

II. Research Methodology

The research was exploratory in nature, with a mixed approach, considering that the data obtained is qualitative and quantitative.

Initially, a SLR was carried out where the keywords for the research were defined, and thus the strings were formulated. Ten databases were selected for the SLR, which were Google Scholar, Scielo, Bireme / VHL, Pub Med, Science Direct, Repository of the Federal University of Uberlândia, Repository of the University of Porto, Repository of the University of Lisbon, Repository of the University of Brasília and Pepsic. Inclusion and exclusion criteria were defined. The entire SLR followed a review protocol that is available at: https://drive.google.com/open?id=151Iz FY 84RlEGphnMHf4Y6djSEZs1oACa. The review aimed to answer the question "What are the impacts of the overuse of digital technologies on the mental health of adolescents and young people?", And to answer this question, three other research questions were elaborated:

- What are the risks of the excessive use of social networks in the lives of adolescents?
- How to detect mental health problems through postings and behaviors?
- What are the scales for detecting depression?

Then, interviews were conducted with five psychologists chosen by a referral who work in a support center, a social project, educational institutions (public and private) and a private clinic.

The third stage consisted of a survey, the sample of which consisted of 566 adolescents and young people, aged 12 to 21 years old, who study in 03

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different public educational institutions (Municipal, State and Federal).

The data collection instruments used in the second and third stages of the research were, respectively, a questionnaire for psychologists (QP), composed of 12 open questions, and a questionnaire for adolescents (QA), with 25 closed questions. Both questionnaires were based on the results of the SLR. The free will of each individual was respected, and those who were not interested in providing data for the research were free to stop participating during the interview or survey.

The selection of psychologists was made using the snowballing technique. In the survey with students, a link to the online questionnaire (in schools where there were computers in the classrooms) were distributed, in addition to printed questionnaires when necessary.

The responses of the psychologists were examined using the content analysis technique, and the responses of adolescents and young people using basic statistics.

Due to the scarcity of related works, only six applications were selected: Depression Self-Assessment (AD), Break Free (BF), Hygia (H), Menthal (M); Nomophobia (N), and Phone Addict Free (PAF). The only one of these found through academic literature was the prototype Hygia, which is a concept for a proposed system to monitor the individuals' depression levels. The others were found through more extensive research on Google and Play Store (app store for smartphones with the Android system). In the Play Store, it was possible to find several test apps with different themes, but the "depression self-assessment" was selected, where so far it has been the closest to the initial proposal of Girassol, the app presented in this work.

The apps classified as related were compared in seven (07) aspects:

- Monitoring tool - whether the app monitors or detects;
- Alert/notification feature - states or denies the existence of alerts;
- Test Application - whether the app uses any type of test to comply with its functionality;
- Indication of dependency/depression level - whether the application presents data on the individual's level of dependency or depression, in view of the monitoring or test applied;
- Test validity and reliability - for applications that use tests, whether the applied test has any approval for it to be used;
- Web application - whether the application is available in a version for online access; and
- Mobile application - whether it is an application for mobile devices, such as tablets and smart phones, for example.

After making the comparison between Girassol and the six similar apps, it was noticeable that all of them are mobile applications, only the Hígia prototype fits as both mobile and web applications. Of the seven applications, five are monitoring tools, one does not have this functionality, and Girassol can be classified as a partial monitoring tool, as it classifies dependency through tests and not by observing posts and activities performed on the smartphone or any other device. It was also notable that only two of the applications (Self-assessment of depression, and Girassol) offer tests validated by qualified professionals, making them reliable applications. Chart 1 presents the comparison between the applications. The left column shows the aspects analyzed, and the top row shows the applications represented by their initials. The letters Y, N and P respectively mean: yes, no and partially.

Aspects x App	AD	BF	G	H	M	N	PAF
Monitoring tool	N	Y	P	Y	Y	Y	Y
Alert/notificationfeature	N	Y	N	Y	N	Y	N
Test Application	Y	N	Y	N	N	N	N
Indication of dependency/depression level	Y	Y	Y	N	P	P	P
Test validityandreliability	Y	N	Y	N	N	N	N
Web application	N	N	N	Y	N	N	N
Mobile application	Y	Y	Y	Y	Y	Y	Y

Chart 1: Application comparison

The Girassol app was developed based on the findings from the three initial phases of the research, along with the authorization and support from the Delete Institute represented by director Anna LS King, for the use of the "Internet Addiction Test" (IAT), and a questionnaire prepared by psychologist Kymberlly Young. Its main objective is to assess the levels of nomophobia of adolescents and young people.

The research design illustrated in Figure 1 presents the steps of the methodological procedure, from SLR to application development.

Figure 1: Research Design

III. Results and Discussions

In this section, the results of each stage of the research carried out are presented and discussed. The literature review was carried out between the years 2016 and 2017, where 37 papers were selected; the interviews with psychologists and the survey with teenagers took place in the second half of 2018.

a) *Systematic Literature Review (SLR)*

After reading the 37 papers selected in the SLR, cyberbullying and depression (or its signs and symptoms, such as psychological distress, anguish and suicidal thoughts) are highlighted as the main risks of the excessive use of social networks, as it can be seen in the word cloud shown in Figure 2, resulting from question 1 in the survey.
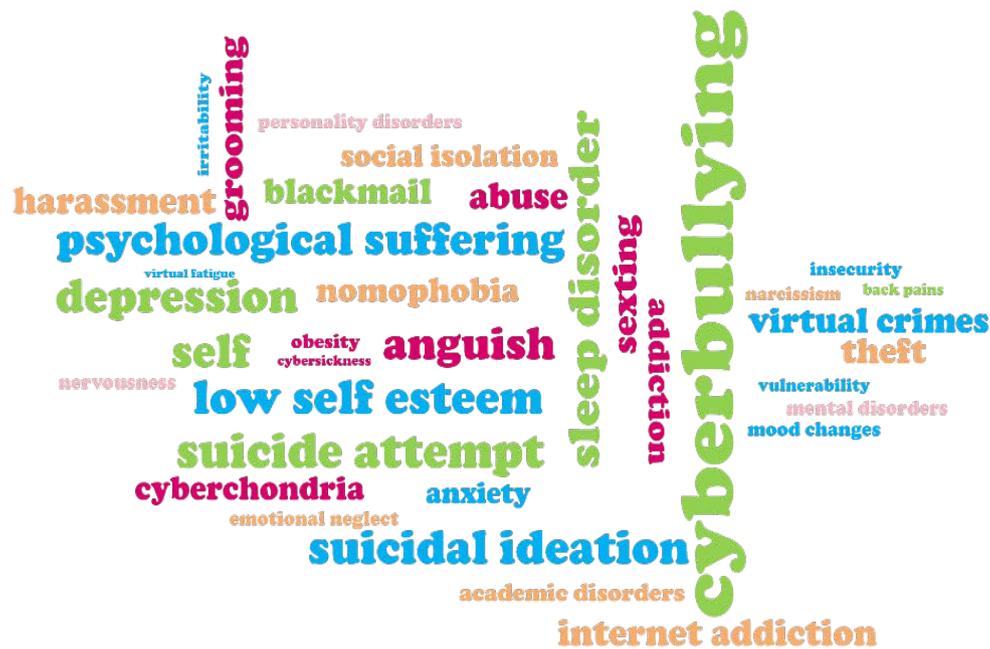

Figure 2: Word cloud - risks of overuse of technology

The main signs mentioned in response to question 2 were the sudden changes in mood and behavior, coupled with the need to stay connected, using profiles that are always up to date, seeking more and more followers. Chart 2 displays the results found in the SLR for the 2nd search question.

Detection	Numberofcitations
Spend more time online, higher predisposition to attack and reduced academic performance.	1
Loss of ability to concentrate.	2
Long online evening sessions; lie to family and friends about the number of hours spent connected.	2
Negative social interactions; post negative content; use of emoticons in a written conversation to report their real emotional state.	2
Depressive symptoms when you have nothing to post.	2
Show riskybehaviors.	2
Interacts only via the web; may start to develop schizophrenia by living in isolation.	2
High emotional problems, uses the internet to regulate mood, gain social support and release emotions.	4
Cannot disconnect from social networks or go offline; the time dedicated to the tool increases and the level of control over it decreases.	4
Anxiety for likes and comments; make posts without thinking first; impatience when they run out of Internet access; has abstinence and its effects; anguish and discomfort when use is not possible.	4
Compulsive internet use; need to be connected 24 hours a day; being obsessed and compelled to constantly check the phone; quickly seek to connect to the Internet anywhere.	4
Greater difficulty in overcoming challenges; being aggressive and socially dominant.	4
Have few or no real friends; see safer and less threatening online communication; hide in the anonymity of cyberspace.	5
Describe specific methods of suicide within the context of other topics.	9
Performnarcissisticpostings.	9
Oversharing[1], stressed posts and preview trigger[2] posts.	9
Being vulnerable as to the opinion of others; dependent on likes - feel the need to "cure" one's profile.	9
Complaintofsituationalproblems.	9

*Chart 2:* Detection of risks and problems for mental health

[1]Excessivesharing
[2]Addingcontacts

Among the works selected in the literature review to answer this question, two of them [6] [1] pointed out eight signs to help identify dependence on the Internet/Digital Technology: excessive concern with the internet, need to increase the connected time (online), the presence of irritability and/or depression, exhibiting repeated efforts to decrease the time of internet use, when internet use is reduced, presents emotional lability, remain more connected than scheduled, work and social relationships at risk from overuse, and lying to others about time spent online.

The Beck Depression Inventory (BDI) emerged as the most cited to detect depression, related to question 3. Graph 1 shows the scales found during SLR surveys.

The results and references for the Systematic Literature Review protocol are available in the link presented in section 2 of this article.
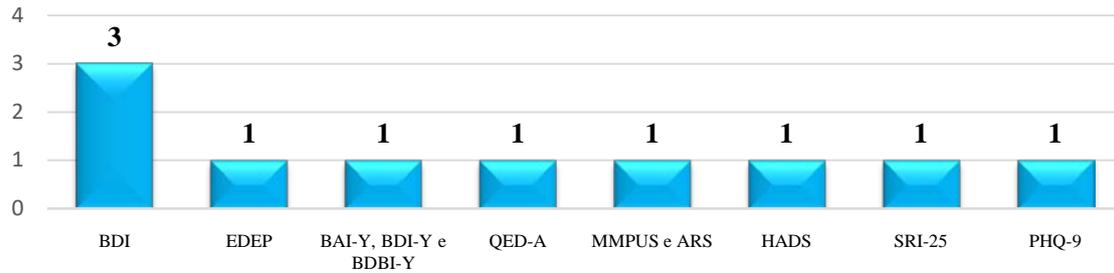
Graph 1: Scales for detecting depression

b) *Interviews with psychologists*

The interview with psychologists aimed to analyze the results of the SLR and its veracity, identifying how close the contents found in the SLR are to the current reality. And after the interviews, it was possible to recognize the relationship between the behavior of young people on the virtual network and the relationship with the real world, helping in the development and adaptation of questions for the survey and for the test.

Relevant results obtained in the interviews signaled the fact that the majority of psychologists interviewed have received adolescents/young people with problems arising from the excessive use of digital technologies. The drop in school performance was mentioned as one of the main problems. Social isolation is one of the behaviors presented that signal the risk of depression in adolescents. Bullying/cyberbullying cases were mentioned as unpleasant experiences lived by adolescents/young people. The complete questionnaire and the psychologists' answers to this research are available through the link: https://drive.google.com/open?id=12y9qCebxQsClejGuWw2WzMSskbzUYqzg.

c) *Survey with Adolescents and Young people*

This research had 359 part-time students (morning), 152 part-time students (afternoon), and 53 full-time students (morning and afternoon) participants. Graph 2 shows the number of students participating, per shift, in each grade.
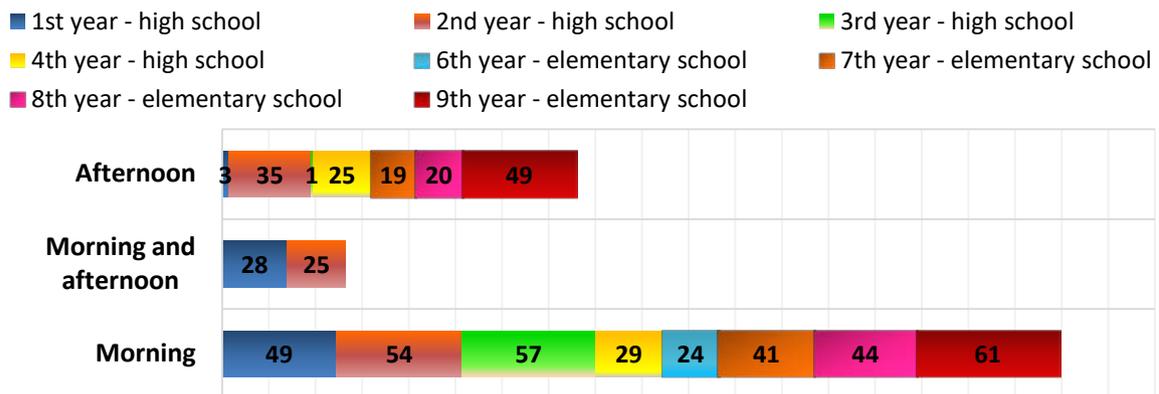

Graph 2: Number of student respondents per grade and shift

Among the results obtained in the survey with adolescents and young people, 21% indicated that when posting a photo, the most important thing is to achieve many likes and comments, as shown in Graph 3. The achieve this, 273 (48%) of the participants allow strangers to have unrestricted access to their profiles on the networks, according to Graph 4.
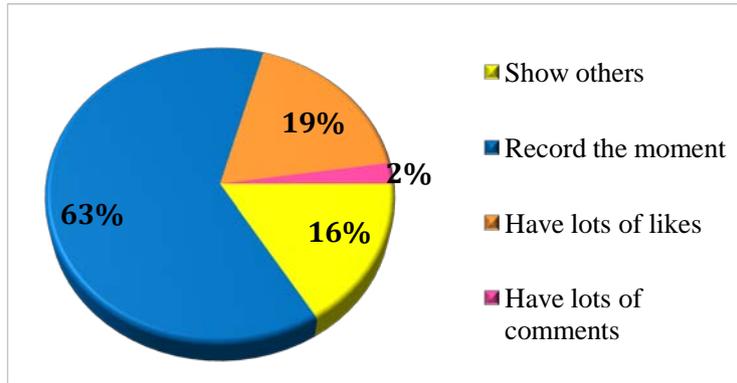
Graph 3: What is more important when posting a photo?
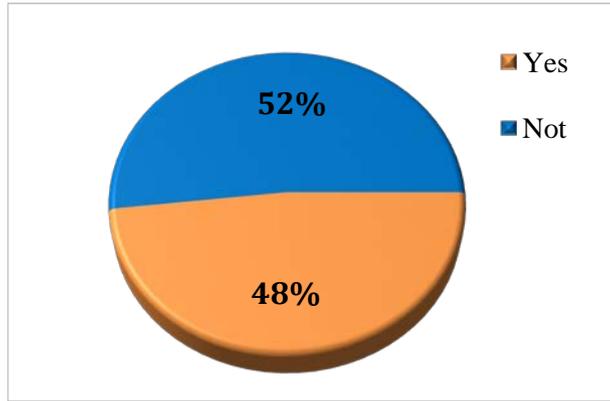
Graph 4: Allow strangers to access posts?

Another relevant fact was that only 8.3% never received complaints due to the time connected, as shown in Graph 5, althou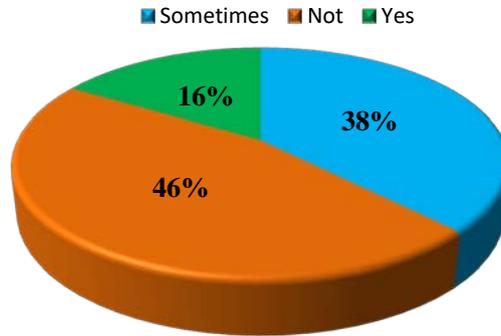gh 42% stated that they spend five hours or more accessing social networks daily and 23% confirmed that they spend all the time on the internet, according to Graph 6.
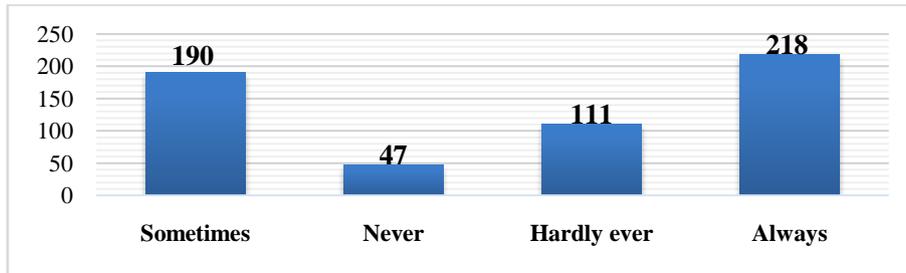
Graph 5: Complaints about connected time
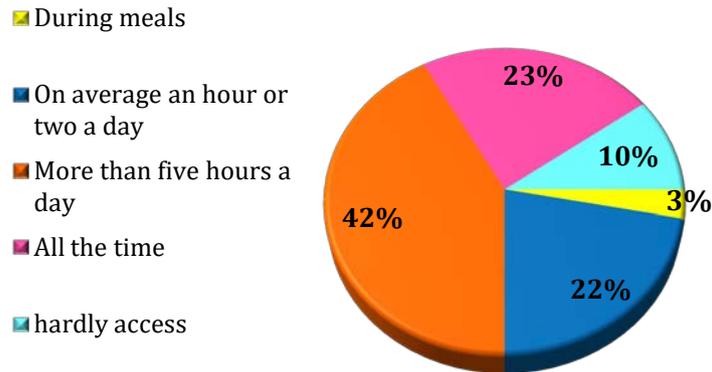
Graph 6: Frequency of social media use

Graph 7: Feeling of loneliness when offline

The worrying factor is that, of 566 adolescents and young people, 93 (16%) expressed feelings of loneliness when there is no internet access, according to Graph 7, and only 10% denied that they spend more time than planned on social networks, according to Graph 8. 22% confessed frequent delays in their appointments due to the connected time, according to Graph 9.
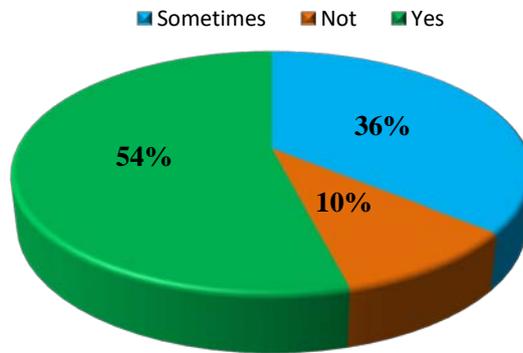
Graph 8: Internet usage longer than scheduled
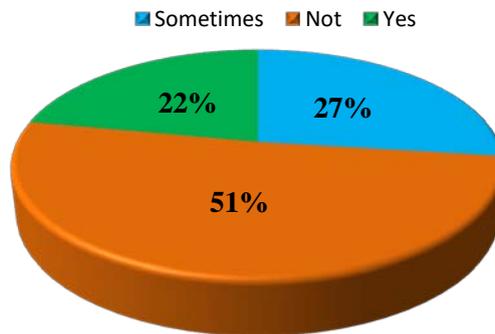
Graph 9: Delays caused by use of social networks

All results obtained in the survey (online and printed) are available through access to the following links: https://drive.google.com/open?id=1W_m_7MVZ lYCB-oLVHo8E8kNRhRrpfy46 and https://drive.google. com/open?id=1ObB9NQcBUAvpTmec_-Z2jg-lwdK6o A_S.

d) Application Girassol (Sunflower)

Girassol was developed with the intention of detecting the exact moment to intervene and treat problems caused by the overuse of the internet and other technology derivatives. It consists of an application with 18 questions adapted from the "Internet Addiction Test" (IAT), with the due written authorization from Delete Institute. The app aims to assist parents, educators and health professionals in detecting a possible technological dependence, which is often disguised as a leisure activity, hobby and means of communication with other people.

The IAT is the first validated and reliable measure in this matter. The changes made to the questionnaire were linked to the results of the SLR and the interviews with the psychologists, with the

collaboration of the psychologist, doctor in mental health and director of the Delete Institute.

Figure 3 shows the flow of all planning and contact with the Institute for adapting the dependency test.

The test identifies the level of dependency, which varies between "normal user" and "dependent user". Each question has a score from 0 to 5, which generates a final score, which fits into some level of internet dependency. In the total score, values up to 18 mean that the individual has no dependence, 19 to 33 is an average user, 34 to 63 is a risk user, and above 64 points strongly suggest that the individual should seek professional help. Figure 4 presents some screens planned for the application prototype, while Figure 5 presents the screens already implemented and updated for the Girassol application, which is available for download in the play store, through the link: https://play.google.com/store/apps/details?id=com.santiago.girassol.
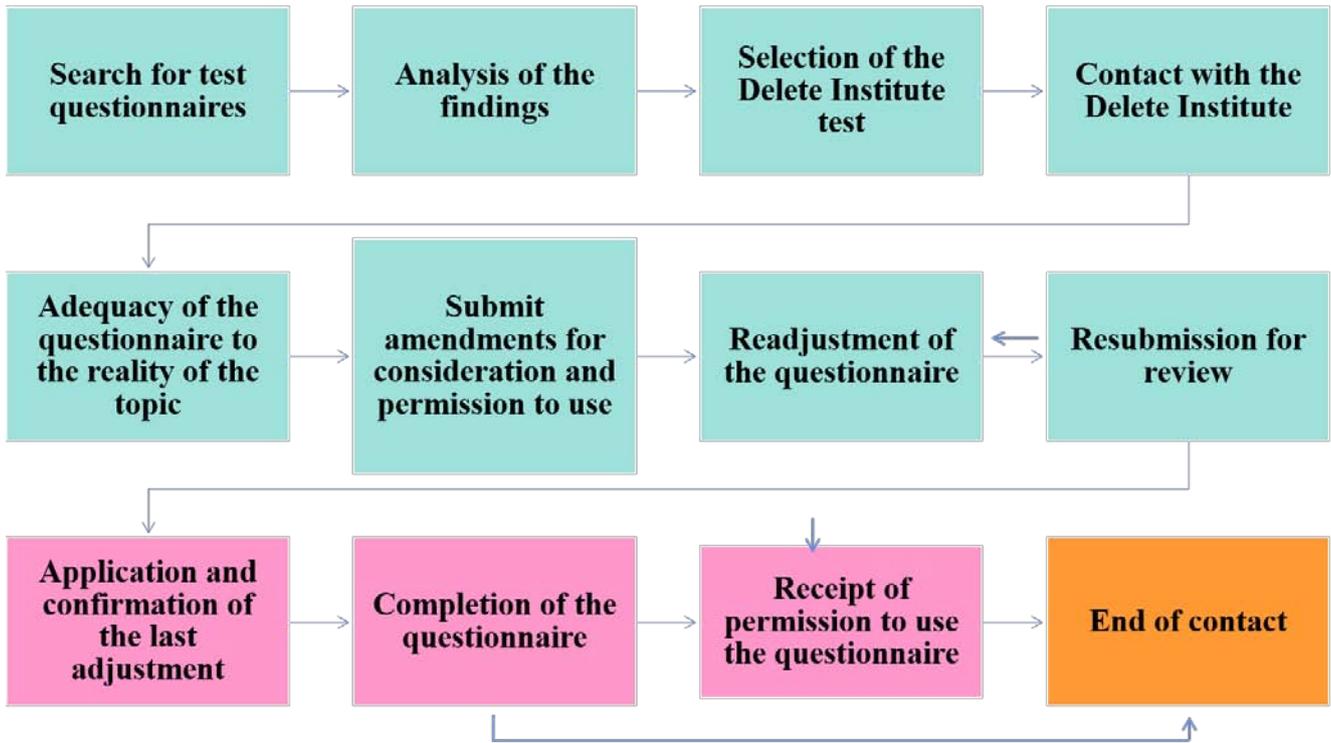
Figure 3: Flow of adaptation of the questionnaire

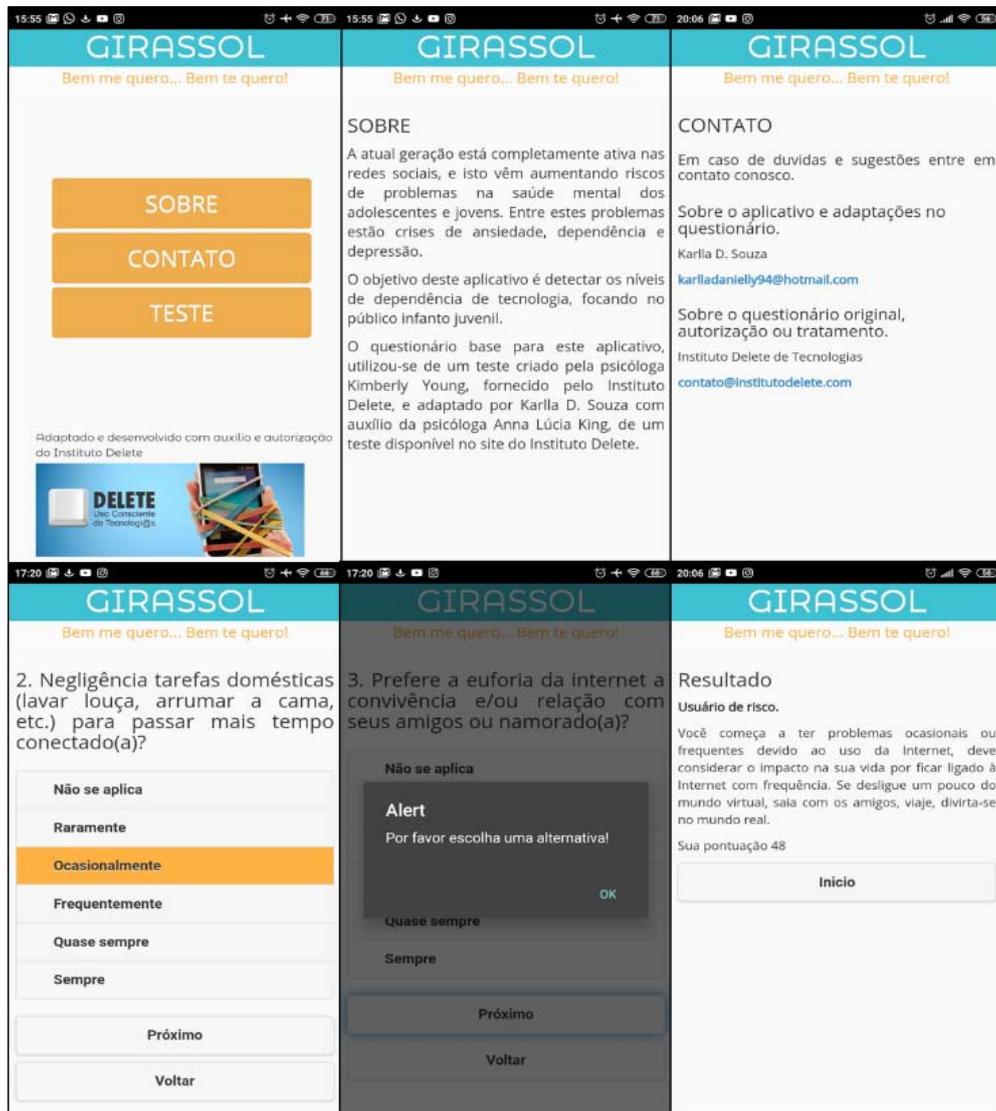*Figure 4:* Screens planned for the prototype

Figure 5: Girassol Application Screens

When opening the application, the user is directed to the home page of the app which features 3 buttons - about, contact and test -, below the buttons, there is a banner redirecting to the Delete Institute website, which provided support for the adaptation of the questionnaire. On the "About" screen, there is information about the app, such as the problem that encouraged its development, purpose and adaptation of the IAT questionnaire. In the contact screen there are 02 e-mails for contact, one to seek information about the work developed, and the other to contact for questions about the original test, authorization, and treatment of technological dependence. On the test screen, the questions and six answer options are presented, where the respondent must mark the one that most represents his or her practice or behavior. When selecting an answer, the individual must click on "next".It is possible to return to the menu or previous question by pressing "back". If the respondent tries to advance to the next question without answering the current one, the app displays a message asking for the answer. At the end of the test, the result screen displays the respondent's score. It contains the type of user, a short explanatory phrase, and the score obtained on the test.

The architecture follows the MVC model (model-view-controller), divided into a view layer, which presents the screens to the user, and two controllers; one responsible for collecting the views and the other responsible for the test (this captures the responses and generates the results). The model layer was not necessary in the implementation because the test is already loaded into the code. Figure 6 illustrates the app Girassol architecture.
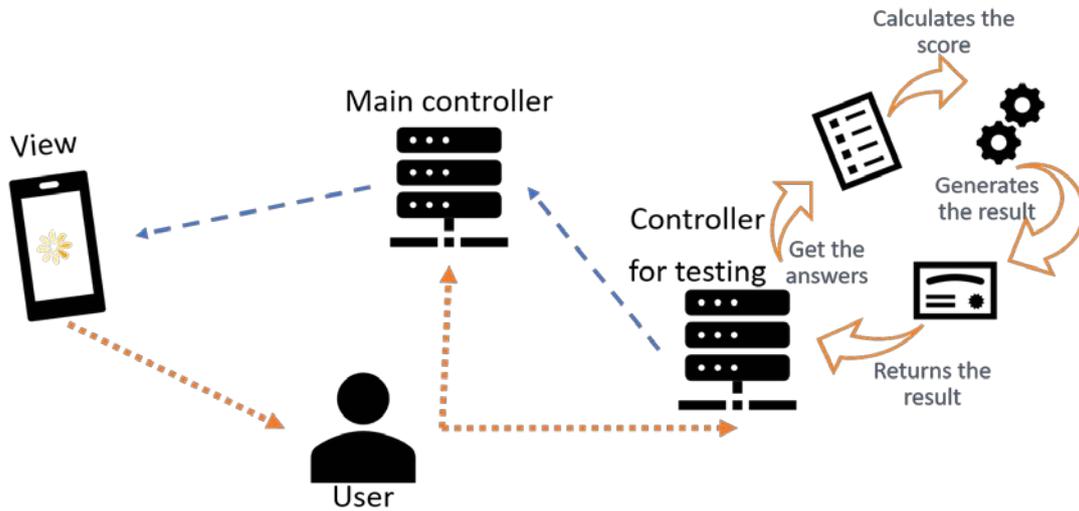
Figure 6: Girassol Application architecture

The questionnaire was stored in a json - light format for data exchange -, which is loaded in the application when the user selects the test option. In addition, the app has only an internal database, so no data is stored.

i. *Validation*

Two validations were carried out for the Girassol application. The first took place in January 2019, and the second took place in December of the same year.

a. *First Validation*

The first validation saw the collaboration of two professionals in the field of education and three in psychology. This assessment was signed 100% positive by the experts. Everyone said that it would be an appropriate tool to use in schools and one of them indicated its use in offices, serving as a way to perform a screening and identify possible patients.

For the validation by the specialists, three affirmative sentences were produced:
1. The application is able to detect cases of technological dependence.
2. The application can measure an individual's internet addiction levels.
3. The application is appropriate for teenagers / young people.
4. In addition, a question about where the app could be used:
5. Would you indicate the use of the app in: schools, offices, both or none?

The answers are found in Chart 3.

	About the utility of the app			
User	**1**	**2**	**3**	**4**
educ01	Yes	Yes	Yes	Schools
educ02	Yes	Yes	Yes	Schools
psy01	Yes	Yes	Yes	Both
psy02	Yes	Yes	Yes	Schools
psy03	Yes	Yes	Yes	Schools

Chart 3: Evaluation of the app from the experts' point of view

User psy01 agrees that the app is able to detect cases of addiction because, through punctuation, the teenager sees what he does not want to hear, since he usually does not care when people around him say that he is spending a lot of time on his cell phone; it can serve as a "reality check".

The first validation also counted with the collaboration of seven individuals, aged between 15 and 21, with the individual score ranging from 5 to 67 points. All adolescents and young people approved the benefits brought by the application, highlighting its ease of use and the usefulness of the proposal, as well as contributing with suggestions.

The questionnaire for the adolescents and young people consisted of six phrases to be answered with 'Yes' or 'No'. The phrases elaborated were:

1. All fields on the screens are clear and easy to understand;
2. The interface provides all functions for the operation of the application;

3. The interface is simple, pleasant and clear;
4. Considering my real actions and the data that the prototype collected, it can be said that they are coherent and in this why the presented result could help in some way;
5. I would make the result generated in the application available for a more complete evaluation with psychologists or psychiatrists;
6. I consider it important to make these results available to a psychologist / psychiatrist who helps the young public, facilitating the recognition of crises or treatments of technological dependencies.

User 02 indicated that he would not make his result available for analysis with psychologists or any other mental health professional. User 06, on the other hand, only mentioned the lack of a 'back' button to return to the main menu, since every time it was necessary to close the application to go to any other screen, making the app tiring and stressful to use. Analyzing the questions, it was possible to notice that the app obtained a 71.4% positive evaluation by the monitored users.

The responses of the monitored users' evaluation are shown in Chart 4, where in the first column the users are identified by numbers, and the first full line presents the numbers referring to the evaluation phrases. Chart cells highlighted show negative responses.

| User	Usability Questions			Usefulness Questions		
	1	2	3	4	5	6
01	Yes	Yes	Yes	Yes	Yes	Yes
02	Yes	Yes	Yes	Yes	No	Yes
03	Yes	Yes	Yes	Yes	Yes	Yes
04	Yes	Yes	Yes	Yes	Yes	Yes
05	Yes	Yes	Yes	Yes	Yes	Yes
06	Yes	No	Yes	Yes	Yes	Yes
07	Yes	Yes	Yes	Yes	Yes	Yes

Chart 4: Evaluation of the app from the point of view of adolescents and young people

b. *Second Validation*

The second validation of the application was done through online Google forms. The questions were the same as in the first validation, but the software was updated.

Eight young adults aged between 18 and 25, and 11 professionals in the areas of mental health, education, technology and public safety participated in this validation.

Graph 10 presents the respondents' areas of activity, through which it is possible to see that most specialists work in the areas of education and technology. It is worth mentioning that in the first validation, only psychologists and educators evaluated the application. The specialists in the second validation provide a new perspective to this research, especially for future works.
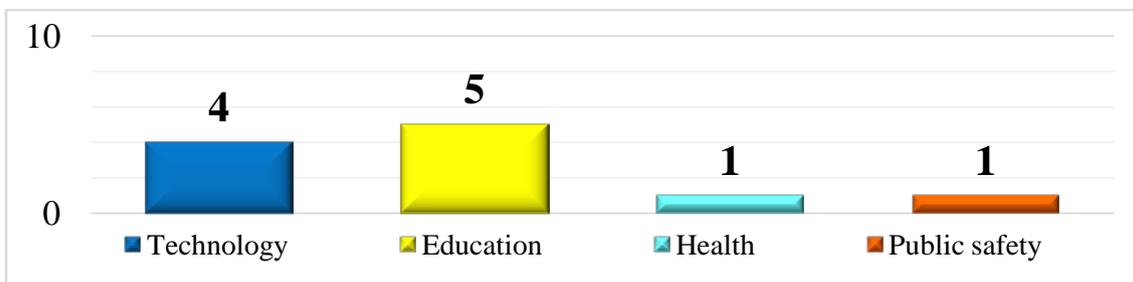
Graph 10: Expertise area

Chart 5 displays the second expert assessment of the application's usefulness. In this evaluation, the application achieved a 96.97% positive evaluation. The only negative assessment was in the matter of detecting a case of technological dependence.

	About the utility of the app			
User	1	2	3	4
Specialist01	Yes	Yes	Yes	Schools
Specialist02	Yes	Yes	Yes	Both
Specialist03	Yes	Yes	Yes	Both
Specialist04	Yes	Yes	Yes	Schools
Specialist05	Yes	Yes	Yes	Both
Specialist06	Yes	Yes	Yes	Both
Specialist07	Yes	Yes	Yes	Schools
Specialist08	Yes	Yes	Yes	Schools
Specialist09	Yes	Yes	Yes	Both
Specialist10	Yes	Yes	Yes	Both
Specialist11	No	Yes	Yes	Both

Chart 5: Second app review from the experts' point of view

Some of the comments made by the experts in the second validation are: "Innovative Work. It will contribute a lot to the education of young people. Congratulations.", "I am consciously leaving dependency and returning to the habit of reading, which was lost due to the time spent on social networks". "A great application for measuring the hazard index in the use of technologies by children and adolescents" and "Working more with usability."

Half of the young adult respondents were between 20 and 22 years old. As it can be seen in Graph 11, they had a final score between 34 and 63, which indicates that it may be necessary to mitigate the use of technologies, for they strongly suggest a form of dependency. Two of the eight respondents had scores above 64, which indicates the need for them to seek professional help to identify the cause of the technological dependence, and seek to treat it.
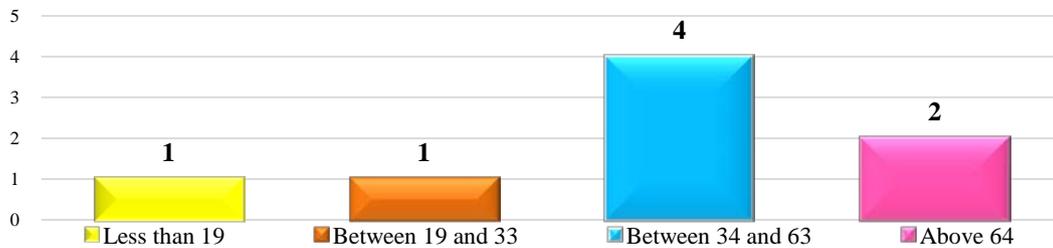
Graph 11: Test score count

After the changes suggested in the first evaluation, the application was again presented to young people, and they were asked about its ease of use and its usefulness. In the second evaluation, the app obtained a 100% evaluation by the young respondents, as it can be seen in Chart 6.

	About ease of use			About the utility of the app		
User	1	2	3	4	5	6
01	Yes	Yes	Yes	Yes	Yes	Yes
02	Yes	Yes	Yes	Yes	Yes	Yes
03	Yes	Yes	Yes	Yes	Yes	Yes
04	Yes	Yes	Yes	Yes	Yes	Yes
05	Yes	Yes	Yes	Yes	Yes	Yes
06	Yes	Yes	Yes	Yes	Yes	Yes
07	Yes	Yes	Yes	Yes	Yes	Yes
08	Yes	Yes	Yes	Yes	Yes	Yes

Chart 6: Second evaluation of the app from the point of view of adolescents and young adults

Two of the respondents mentioned that they liked the application, and especially the idea of alerting and offering the opportunity to identify when to deal with the problem of technological dependence.

IV. Final Considerations

The results of this research empirically proved the signs and problems arising from the overuse of digital technologies and brought as main contribution the Girassol application, which helps to identify the right moment to intervene in order to reduce the negative impacts of digital technologies on the mental health of adolescents and young people.

The app was evaluated twice. Between these evaluations there were several updates, among them: new function suggested in the first validation, on-screen data update, complementary information at the end of the questionnaire, presenting phrases for a better understanding after identify the dependency level, where professional help is indicated in case of risk.

This work is important to draw the attention of parents and educators to the way in which adolescents and young people are using technology and to help identify the moment when it is necessary to intervene to reduce the negative impacts on their mental health.
For future work, we intend to continue with the updates and follow the suggestions made by experts and improve the usability of the app.

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