

Attention Deficit and Hyperactivity: the use of gamification as a strategy in mobile development in Brazil

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ABSTRACT : Given that individuals with Attention Deficit and Hyperactivity suffer the consequences caused by this disorder, it was proposed to enable a study on the essential characteristics for an application that can assist in these deficiencies. To do so, it became necessary to carry out a bibliographic research as well as to elaborate the application of a free participation questionnaire in which people with this disorder discuss their symptoms and how the ideal task management application would be. Based on gamification, the researchers developed strategies and instruments capable of improving and assisting volunteers in these characteristics. As an object of its applicability, we used the mobile development scenario in Brazil, which through systematic analysis, selected the applications that met the necessary requirements raised by this study. In view of this, it is verified that the main gamification strategies to be applied in mobile applications are the goals, constant feedback, rules and free participation, and therefore, according to the case study conducted, the applications that met these requirements were Focus ADHD, Forest and Focus To-Do, which imposes the finding that they contribute significantly to the cognitive performance of these individuals and attenuate the symptoms caused by this disorder. With this, it is also considered the development of an application that can remedy the deficiencies that some of the above mentioned presented.

KEYWORDS Attention Deficit Hyperactivity Disorder, Gamification, Mobile Development.

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I. INTRODUCTION

According to the Brazilian Association of Attention Deficit [1], the Attention Deficit with Hyperactivity (ADHD) is a disorder of neurological origin, of genetic causes that appears still in childhood, remaining with the person throughout his life. The symptoms caused by Attention Deficit are restlessness, impulsiveness and extreme inattention to activities and the environment in which the individual lives.

Thus, through scientific studies, it is estimated that between 2.5% and 8% of the world's population has an Attention Deficit and Hyperactivity [14]. Based on this assumption, the following study intends, through the state of the art, to present the main tools of gamification and its instruments in order to propose their application in the mobile development scenario in Brazil, seeking to expose strategies that work in favor of the cognitive performance of ADHD carriers.

As [5] point out, gamification comprises the application of game elements in non game activities. This raises a question about what benefits gamification can offer to people with Attention Deficit, since it has the ability to stimulate concentration through motivational instruments.

In view of this, one can see the relevance of this study, in which the strategies and instruments of gamification will be presented, and how its applicability on mobile devices can contribute significantly to the cognitive performance of individuals with attention deficit, in addition to a documentary analysis of applications available on PlayStore and how they meet the demands raised.

II. REVISION OF LITERATURE

• GAMIFICATION

Gamification had its threshold from the English term gamification and is characterized as a model in which one makes use of the systematics of games in activities and situations of daily life, as stated [19]. According to [10], the term gamification appeared in mid-2002, through the British researcher Nick Pelling, being adopted by the academic public only in 2010.

Thus, gamification is perceived as a set of practices that share elements from games to elucidate problems and challenges in activities, in order to generate public engagement and commitment to its execution, [18]. In view of this, gamification employs instruments of motivation and attention that are intrinsic to games in order to attract and retain concentration.

Therefore, gamification aims to develop and leverage the individual's engagement in an activity, in order to make it pleasant, stimulating strategic thinking by promoting concentration, also contributing to the individual's cognitive performance, as highlighted [6].

• OBJECTIVES AND SYSTEMATIC OF GAMIFICATION

Gamification or gamification has interactive systems with the purpose of solving problems, since it "catches the attention" by leaving a more interesting activity to the individual. Many of these systems are derived from games and their scenarios, because it was discovered, according to [19], that games enchant, motivate and stimulate the engagement of people.

The corporate landscape adopted gamification as a strategy to combat the low performance of its employees. Monotonous activities, training for new roles or adapting to different situations can be handled with the tools of gambling, which increase employee engagement and motivate them to learn in less time and perform their responsibilities effectively [17].

However, in the school and educational environment, gambling is also applied. As [8] state, gambling is a great ally for school learning. Its tools motivate, enchant, awaken and retain the attention and concentration of students and stimulate their cognitive functions.

It is possible to affirm that games have proven to be an essential element to awaken the commitment of individuals. According to [4], they provide people with the chance to experience a story as a protagonist, as well as to immerse themselves in the most fantasy and dreamy scenarios present in our collective mind.

Participating in a story, not only as a listener, but as a protagonist, gives us the aptitude to learn, absorb knowledge, reason in an agile way and stimulate the whole cognitive sense. As [16] say, the system of games acts directly on the motivational aspect and the learning of the individual.

Therefore, as one of its main objectives, gamification seeks to sensitize the individual, moving him positively by offering an experience in which one receives rewards for the fulfillment of a certain task, as cast by [18].

Gambling was created especially to solve the most diverse problems and challenges in an intelligent and engaged way, as stated by [18]. This means that its instruments focus on the way they guide people to productively reach the elucidation of the problems willing for them.

Its systems are derived from the tools used in games, giving importance to the feeling that a person has when performing a certain activity, with the aim of providing high engagement and satisfaction by focusing on what they are doing, as highlighted by [19].

Consequently, gamification can be an excellent strategy to engage and promote the fulfillment of tasks, develop the focus on the execution of activities and stimulate personal organization in people with Attention Deficit Hyperactivity Disorder.

• ATTENTION DEFICIT HYPERACTIVITY DISORDER IN BRAZIL

According to the Brazilian Association of Attention Deficit [1], ADHD or Attention Deficit Hyperactivity Disorder is a neurobiological disorder, which manifests in early childhood and can last throughout the individual's life. ADHD is also known as Attention Deficit Disorder or ADD. The main consequences in the life of its carriers are the symptoms of inattention, restlessness, impulsiveness and dispersion [13].

Often these symptoms are treated with the application of prescribed drugs and cognitive behavioral therapy [1]. Still according to the Brazilian Association of Attention Deficit [1], about 5% of children who receive psychological care have ADHD.

As previously mentioned, the main symptoms of this disorder are inattention, impulsiveness and hyperactivity [3]. The origin of this disorder is not cultural, since many individuals have similarities in symptoms in different countries and regions. It can therefore be said that ADHD modifies the frontal region of the brain and alters its connections.

In this way, the carrier has an arduous routine in which he is unable to maintain concentration in his activities, nor to have control in the face of restlessness, anxiety, dispersion and nervousness felt.

Having observed this problem, this study proposes a literature analysis in order to recognize the motivational instruments derived from gamification as well as a detailed study of already existing applications in which carriers of Attention Deficit and Hyperactivity Disorder can use with the objective of improving their cognitive capacity.

• **GAMIFICATION TOOLS AND INSTRUMENTS**

Gamification fosters the use of tools and systems that encourage engagement, motivation and concentration in activities. [18], points out that gamification enables the encounter of the individual with pleasant emotions by exploring skills through rewards when a certain task is performed.

Thus, its premise is characterized by the use of rewards, feedback and constant monitoring. Together, these strategies when applied in mobile development can rescue the engagement and commitment in the execution of tasks.

The games were the pioneers to put these strategies into practice. Playing provides pleasure and is an act of fun. In addition, the individual is encouraged to develop his or her reasoning and cognition, as [16] state. In view of this, gamification uses these instruments to bring the means present in games into our physical reality, beyond the fantasy scenarios.

For this reason, it is possible that those with attention deficit and hyperactivity, who have extreme attention difficulty, may be able to take advantage of these systems in order to intensify their commitment to their work, studies and daily life.

Gamification uses systems derived from games, as mentioned above. Therefore, as highlighted by [18], there are four essential characteristics of games that are essential for the application of gamification, they are:

- **Goal:** is defined as the main objective of the activity. That is, it is the central purpose that the individual will have to execute in order to advance to another phase.
- **Rules:** the rules define the behavior of the individual in the gambling scenario. They are what shape the functioning of the activities and control how they will be executed. In addition, they promote the awakening of strategic thinking and creativity.
- **Feedback:** it is the accompaniment of the individual in the execution of the activity. It is the information he has access to about his performance in the form of reports or not.
- **Freeparticipation:** the person has to accept to participate in the gambled activity. This means that the person must accept the rules imposed and their systems.

Therefore, the use of these strategies may be able to minimize the dispersion caused by ADHD and to engage its carriers to perform tasks, remember important information and improve concentration. Therefore, for [15], experiments, increasing the level of difficulty, different ways to discover a response, recognition and reward are crucial to motivate learning and retain attention.

With this, it is possible to combine the development of mobile applications with the use of gammatized systems in order to increase the cognitive performance of the target audience, which in this case are the ADHD carriers [19].

• **MOBILE DEVELOPMENT**

As technology has advanced, communication has evolved to connect people in distant locations through the phone. With the arrival of the internet, the technological leap has allowed the web to integrate with the cell phone, transforming the way of life and bringing people closer together [9]. In view of this, the scenario of mobile application development has consolidated with a significant increase, since most people currently use a smartphone and have access to applications from various segments [12].

It is known that the main factor for the creation of an application is due to the supply of some specific need. Thus, when identifying it, the application is modeled by choosing a programming language, along with its development environments and database service manager, and a prototype of the screens is designed according to the requirements collected and analyzed from the target audience.

Therefore, through the data collected through a survey with carriers of Attention Deficit and Hyperactivity, it is possible to notice that about 70% of respondents use the mobile phone quite frequently. Below is figure 01, exemplifying the result of this survey done in a social network, from specific ADHD groups, in which volunteers accessed a link from Google Forms and thus contributed to the identification of the items they consider important in an application, in order to help them in their daily organization.

HOW OFTEN DO YOU USE THE PHONE?

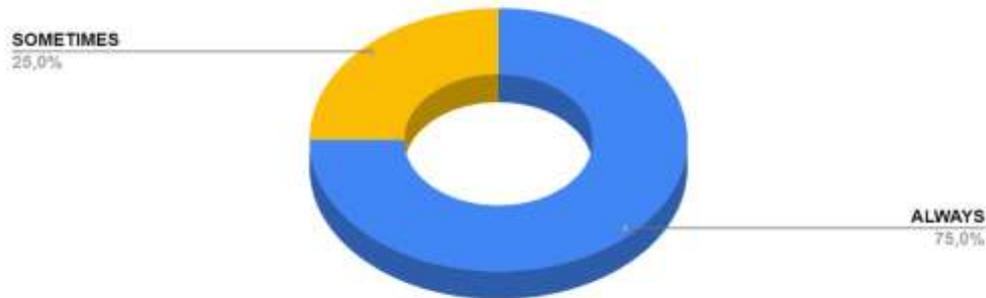


Fig.01: Frequency of Use of the Smartphone

This provides an important opening so that, with the help of specific applications, those with this disorder can have their lives and their daily lives improved. Programs that retain concentration through reminders of important events, dates and tasks, can avoid overloading the memory and consequently improve the cognitive performance of these people.

In view of this, gamification can be applied to specific functions in mobile development for people with Attention Deficit according to the research conducted by this article. In fact, the individuals who were interviewed for this study stressed that they often forget important information and would like to be reminded of their commitments. Figure 02 confirms this information:

DO YOU USUALLY FORGET IMPORTANT EVENTS, DATES AND TASKS?

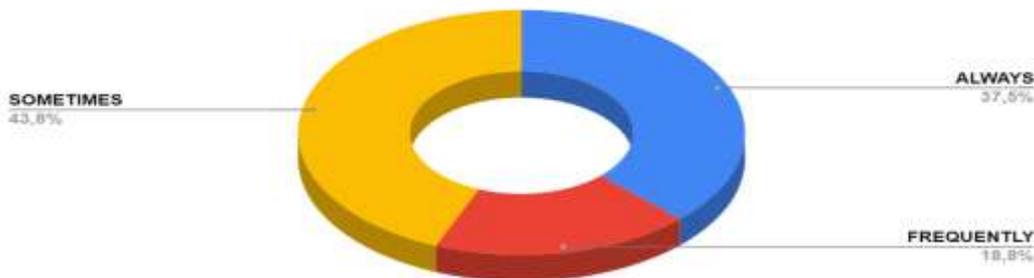


Fig. 02: Incidence of the symptom of forgetfulness in ADHD sufferers

As shown in the graph above, about 37.5% of respondents often forget important dates. Thus, a mobile application, developed under gambling strategies, can attract the attention of this audience and motivate them to enter their tasks and complete them.

In view of this, it is known that the Attention Deficit and Hyperactivity disorder causes several symptoms, such as inattention, forgetfulness, impulsiveness and difficulty of concentration [11]. Thus, by using the tools of gambling as goals, feedback, free participation and rules, sufficient elements are gathered for the creation of applications that can help the daily lives of individuals with ADHD.

III. MATERIALS AND METHODS

To conclude this study, the state of the art of the themes presented was carried out, in which the origin of gamification and its strategies are exposed, as well as drawing a parallel with the Attention Deficit Disorder and how it can help cognitive performance through the development and use of mobile applications. For data collection, a specific questionnaire with eleven questions for people with this disorder was designed and applied to groups on ADHD in a given social network.

Finally, the analysis of existing and available applications was carried out based on the criteria established by the survey conducted with these individuals. From the requirements collected, it was possible to select the applications that used the gamification strategies presented here and contributed significantly to the cognitive performance of these people.

IV. RESULTS AND DISCUSSION

For study purposes, the relevance of identifying applications that can significantly contribute to the cognitive performance of individuals with ADHD is seen.

Therefore, the objective of this analysis is to present mobile applications that use tools derived from gamification, helping the cognitive performance of people with Attention Deficit and Hyperactivity Disorder. In view of this, functions such as sending reminders about important dates and events, medication intake times and the end of tasks to be accomplished, corroborate to alleviate the symptoms of this disorder, since, according to the research carried out by this article, one of the greatest symptoms is in fact, the forgetfulness that, in turn, causes the lack of attention and difficulty in finishing the activities. Right below, figure 03 clearly presents one of the main needs of volunteers:



Fig. 03: Incidence of acceptance regarding reminders

According to the graph above, it is possible to see that the interviewees were unanimous in saying how important it is for them, that they receive reminders and warnings so that they do not forget important information, since this disorder favors these symptoms.

As evaluation criteria, several applications were researched and installed in mobile development virtual stores, in order to evaluate them based on the requirements defined by the interviewed carriers, as well as selected according to the gamification instruments and tools used.

In view of this, the following criteria were considered for the study objective, presented in the tables below:

Functional Requirement			
Name: Reminders		Code: F1	
Description: The application should provide reminders to alert users of the deadline for tasks, remedies, events and important dates.			
Non functional requirements			
ID NF	Description	Category	Priority
1.1	The reminder should use notifications and alarm sounds.	Usability	Important
1.2	The reminder must have notification setup options with programmable date and time interval.	Usability	Important
1.3	The reminder must have different alarm sounds.	Usability	Desirable
1.4	The reminder should be sent via a pop-up message in the mobile application.	Usability	Important

Table 01 - Functional Requirement (F1)

According to the chart above, you can see that the function of offering reminders is kept as the main objective of the application. This way, users with Attention Deficit and Hyperactivity Deficit can register tasks, deadlines, events, dates of appointments and medication intake, besides being alerted through specific sounds and messages on their mobile phones screen. With these functions it is possible to alleviate the frequent forgetfulness highlighted by the volunteers interviewed.

Functional Requirement			
Name: Interface			Code: F2
Description: The application should offer a simple interface, with objective and clear functions, as well as be distributed by colors to encourage use.			
Non functional requirements			
ID NF	Description	Category	Priority
1.1	The interface should have a light color scheme around the tone of blue.	Interface	Important
1.2	The application interface should be designed so that it is more fun than formal.	Interface	Important
1.3	The application interface should present, in addition to the functions, a mini calendar for the insertion of reminders.	Interface	Desirable

Table 02 - Functional Requirement (F2)

Chart 02 shows, based on the requirements collected through the free participation questionnaire, that those with Attention Deficit Disorder were very brief in describing what the ideal task manager application would look like. Thus, it was discovered that the most voted for color is the blue tone. It is also specified that these individuals prefer a more fun than serious and formal interface. Therefore, by applying gamification by bringing in colors, buttons, and a more youthful and interactive interface, there is a stimulus for ADHD sufferers to use the application on a recurring basis.

Functional Requirement			
Name: Reminders/tasksregister			Code: F3
Description: The application must offer the registration of reminders / tasks with simple functions and distributed by colors.			
Non functional requirements			
ID NF	Description	Category	Priority
1.1	The register of reminders/tasks must have colors and categories in order of importance/urgency.	Usability	Important
1.2	The registration of reminders / tasks must also be done by voice command.	Usability	Desirable

Table 03 - Functional Requirement (F3)

According to chart 03 it is possible to notice that colors are of extreme importance for those with Attention Deficit and Hyperactivity. They help to select the level of priority of the reminders while stimulating the participation and fulfillment of tasks, thus applying gamification and, consequently, providing engagement and motivation.

Functional Requirement			
Name: Implementation of Gamification Strategies			Code: F4
Description: The application should make use of the strategies and systems of gamification presented in this article in order to encourage the use by individuals with Attention Deficit and Hyperactivity.			
Non functional requirements			
ID NF	Description	Category	Priority
1.1	The application must have a friendly and gambled interface.	Interface	Important
1.2	The application must allow constant feedback through performance reports.	Usability	Important
1.3	The application must have goals, challenge and stimulate user focus.	Usability	Important

Table 04 - Functional Requirement (F4)

In accordance with table 04, the main strategies of gambling recognized in order to stimulate the free participation of users are summarized in: the application must have a friendly interface, simple and fun to use; it must promote constant feedback of user performance through reports, such as how many activities were accomplished before the deadline, etc.; moreover, the application still needs to stimulate the use through goals or challenges imposed on the user through the fulfillment of what was registered.

Functional Requirement			
Name: ApplicationFunctions			Code: F5
Description: The application must offer the certain functions so that its usability is simple and uncomplicated for use.			
Non functional requirements			
ID NF	Description	Category	Priority
1.1	The application must have a data backup.	Integrity	Important
1.2	The application must offer data synchronization with other devices, email and/or others.	Usability	Desirable
1.3	The application can offer the option of sharing task/reminder lists, queries, dates and important events.	Usability	Desirable

Table 05 - Functional Requirement (F5)

Chart 05 presents in general, other functionalities that the application needs to offer to its users in order to facilitate its use. Therefore, one can mention the application's data storage service, because the user may need to rescue it in case of a loss; as well as provide some kind of synchronization to other devices and cloud storage service; and finally, offer the option of data sharing.

Based on the requirements raised, seven applications were selected, arranged on PlayStore, being free and having versions for both Android and IOS systems, which can significantly contribute to the cognitive performance of people with Attention Deficit and Hyperactivity Disorder.

The initial analysis sought to understand what gamification strategies these applications use in their construction. Based on the items already mentioned, they presented the result of figure 04 below:

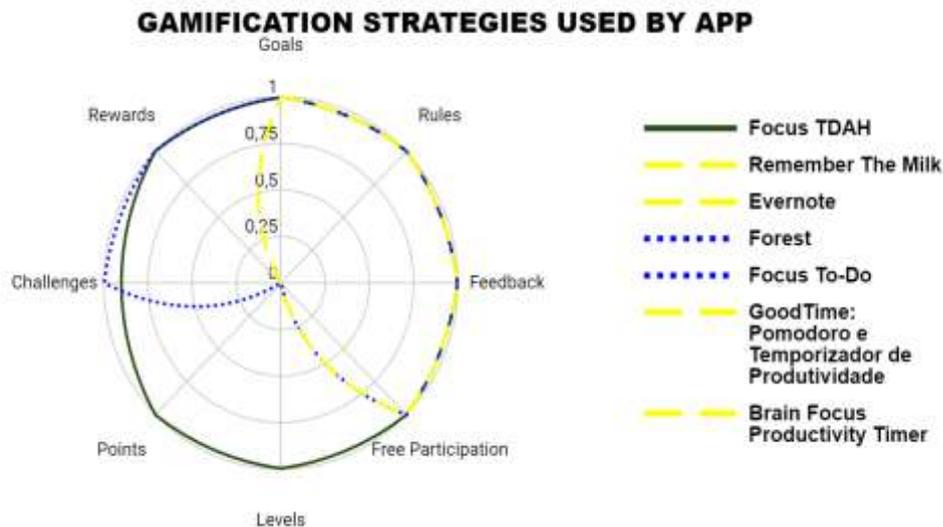


Fig. 04: Gamification Strategies Used by Applications

It can be observed that the first three strategies are consensual among all applications. Therefore, everyone uses the strategies: goals, rules, feedback and free participation. Two applications also added the strategies: challenges and rewards, thus implementing their interaction with the user. Only one application, Focus ADHD used all the strategies listed, which in addition to those already mentioned, applied the strategies: division by levels and score for the activities developed.

With this first analysis it is verified that 57.14% of the tested applications use only 50% of the strategies considered, showing that it is necessary a good research and a deeper understanding of the subject to choose an application that reaches 75% of the strategies, being these only 28.57% of the available and only 14.29% of the applications adopt 100% of the requested strategies.

Figure 05 presents another analysis, taking into account the functional requirements of each application.

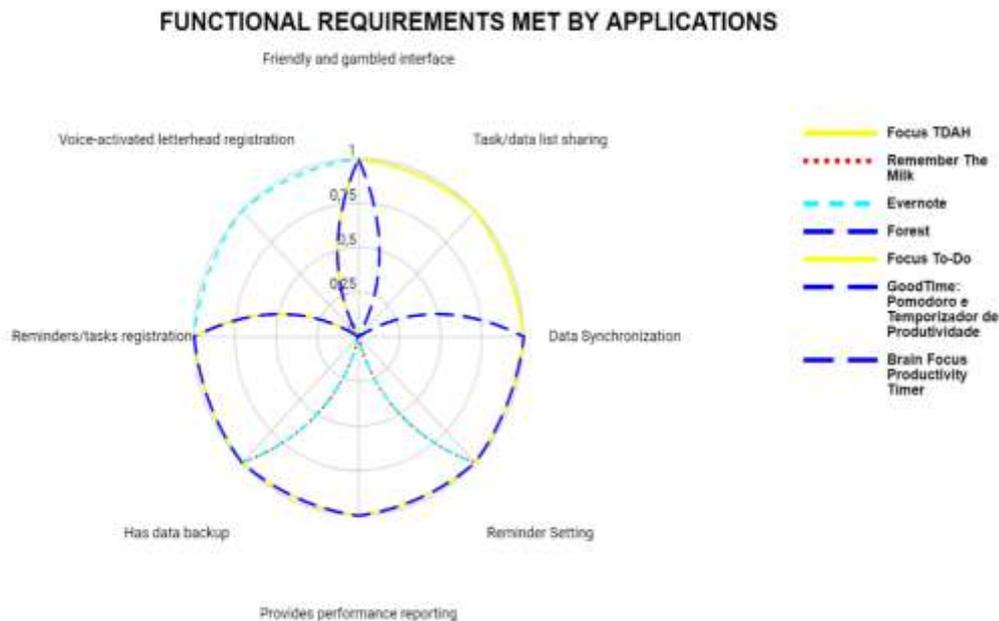


Fig. 05: Functional requirements met by applications

In this criterion, no application with excellence was obtained. In this requirement, Focus ADHD and Focus To-Do have the same functional requirements, which represent 87.5% of those surveyed, the same percentage shown by Evernote, but does not have the same, but shares the same proportion. The other applications that represent 57.14% have in their functionalities the percentage of 75% of the listed requirements, and Forest, GoodTime and Brain Focus have the same aspects and Remember the Milk differs from both.

There are many benefits to installing a monitoring system — some of which strongly interrelate with each other. A properly designed and installed monitoring system offers a deeper understanding of the operational parameters of the system. A close appraisal of the data generated by a monitoring system can reveal a variety of overt and subtle opportunities, including:

V. CONCLUSION

In conformity with the study developed by this research, it was possible to understand through the data collected through the free participation research for those with Attention Deficit and Hyperactivity, that the main consequences of this disorder are forgetfulness and difficulty in concentration.

Thus, in the search for a solution that could alleviate these symptoms, we sought in the systematic analysis of the literature strategies of gamification that could enable the engagement and motivation to retain the attention and concentration of individuals with ADHD. In view of this, the mobile development scenario in Brazil was used as an object for the applicability of such tools and strategies.

Therefore, as a result of this study, it was discovered the best task and productivity management applications available, so that individuals with Attention Deficit and Hyperactivity are motivated to use them and consequently, to improve their daily lives, receiving stimuli to fulfill and remember their commitments and tasks.

Thus, it was found that among the applications analyzed, which were: Focus ADHD, Remember the Milk, Evernote, Forest, Focus To-Do, GoodTime and Brain Focus; three of them were highlighted: Focus ADHD, Focus To-Do and Forest. These applications used the largest number of gamification strategies and met most of the requirements raised by this study. For this, Focus ADHD is the most complete application and full of features that go beyond simply registering reminders and creating task lists. Focus To-Do and Forest, use challenges and goals as motivation to engage the user, and are simpler to use.

In view of this, it can be said that these applications can positively influence the routine of those with Attention Deficit Disorder, contributing to the increase of their cognitive performance by stimulating concentration and decrease of forgetfulness.

Thus, the opportunity will be given to the development of a task/reminder management application, which, applying the gamification strategies demonstrated by this article together with the software requirements

collected, will be able to agglutinate all the functionalities mentioned in its development, supplying the deficiencies presented by the best classified, thus contributing to the improvement of the activities of those with Attention Deficit and Hyperactivity Disorders.

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