Cognitive Behavioral Intervention for Depression through Digital Tools: Case Study in Adolescent

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Abstract

Depression is a global challenge that ranks second in years lived with disability. During adolescence, physical, cognitive, and psychosocial changes occur that are associated with an increase in de-pressive symptoms. These symptoms are often addressed by cognitive behavioral therapy (CBT) due to its proven efficacy. The advance of new technologies such as artificial intelligence and serious video games expanded the possibilities of including digital tools in intervention models, with CBT being the best adapted to new technologies due to its structure. In this context, the present study proposes the design of an intervention based on cognitive-behavioral therapy, using Beck's cognitive model of depression adapted to the use of digital tools such as artificial intelligence (ChatGPT), the development of video games (GDevelop) and the metaverse (Spatial) for the application of techniques and concepts described in the treatment of depressive symptomatology. For this, a study was conducted for External Psychological Support Service at Faculty of Psychology of the Autonomous University of Yucatan, with two adolescent volunteers with depressive symptoms according to the scores obtained in the DASS 21 and Hamilton instruments and the observation of negative thoughts and cognitive distortions by the therapist. For this intervention, ChatGPT was used to create scripts and elaborate children's psychoeducational videos adapted to girls and boys for the treatment of depression. It also made it possible to find free digital tools that could be used for psychoeducational purposes, such as Adobe Express (video animation), Narakeet (text-to-speech reading), Spatial (video exhibition) and GDevelop (video game development). During the intervention, a laptop with a word processor (Word) was used to present a serious video game developed in GDevelop and programmed to explain Beck's cognitive triad for depression. The results of this study indicate that the use of these digital tools for the treatment of depression are comparable to those obtained through the delivery of traditional therapy. At the same time, they can be applied to physical and/or virtual psychological therapies. Also, they can provide real-time feedback to the user during use, as in the case of serious video games. However, further research is needed on the use of digital tools in psychotherapeutic interventions and to know how effective these tools can be in reducing depressive symptomatology in adolescents.

Keywords

Depression, artificial intelligence, serious videogames, adolescence, cognitive behavioral therapy.

1. Introduction

The American Psychiatric Association (2020) mentions that depression is a common and serious illness that negatively affects the way you feel, think and act. Caused by genetic, biological, environmental, and psychological factors, it presents symptoms associated with loss of energy, decreased concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness, and thoughts of self-harm or suicide (Organización Panamericana de la Salud, 2023). Although, in adolescents' depression can present as irritability, boredom or inability to experience pleasure, aggressiveness, somatic complaints, et cetera. (Secretaría de Salud, 2018). In the 2022 world mental health report, WHO estimated that 28.9% of reported disorders were

due to depression, which in-creases the probability of death between 40% and 60%. In Mexico, this disorder is the second strongest pathology in child psychiatry, with a prevalence in adolescents between 0.4% and 8.3% (Secretaría de Salud, 2018). Universidad Nacional Autónoma de Mexico reported in 2018 that depressive disorder occupied 25.7% of the consultations of child patients seen for the first time at the "Dr. Juan N. Navarro" Children's Psychiatric Hospital.

Depression is treated with medication, psychotherapy or both for the management and reduction of symptoms (Society of Clinical Psychology, 2022). Behavioral activation, cognitive, interpersonal, and problem-solving therapy are the types of psychotherapy that have demonstrated effectiveness in the treatment of depressive symptomatology (National Institute of Mental Health, 2023). Cognitive therapy based on Beck's model of depression, which considers that depressive symptomatology is characterized by a pejorative self-concept, negative interpretation of one's experiences and pessimistic view of the future (Beck, Wynnendod, P, 1964) and is part of cognitive behavioral therapy (CBT), was used for this project. CBT has innovated in the use of new technologies such as the use of virtual reality, digital therapy, digitization of behavioral self-registers and development of applications to connect with the therapist (Universidad Autónoma de Valencia, 2017), apply and/or adapt intervention techniques.

There is now substantial evidence to support the use of digital tools to treat mental health problems, so much so that the Institute for Health and Care Excellence (NICE) recommends such tools as first-line treatment (Fleming, Lucassen, Stasiak, Sutcliffe, & Merry, 2021). Although, these tools have been tested in adults, Grist, Porter, and Stallar (2017) consider that there is still insufficient evidence to support the effectiveness of the applications in children, preadolescents, and adolescents. Given this, the following study of two adolescents is presented, which aims to design an intervention under the cognitive behavioral approach through digital tools such as: artificial intelligence (AI), AI-written and animated videos, metaverse and serious video game for the decrease of depressive symptomatology and answer the following questions: Can the depression techniques of Beck's model be applied through digital tools? How effective is the application of the cognitive triad of Beck's depression model through digital tools for the decrease of depressive symptomatology in adolescents? Are digital tools a way to increase adherence and interest to the therapeutic process in adolescents with depressive symptomatology? Also, it is expected to know different applications of emerging technologies from the viewpoint of psychology and the influence they have on the integration of psychotherapeutic care for the care of children and adolescents.

2. Methods

Two case studies were conducted as part of the first phase of the research process for the description, representation of events, circumstances, and person (Simons, 2011) with the purpose of exploring the use, application, efficiency, and effectiveness of digital tools to the psychotherapy process to make future intervention proposals with control groups with a larger number of participants. This research was conducted for External Service of Psychological Support (SEAP) at Faculty of Psychology of the Autonomous University of Yucatan where children, adolescents and adults are attended (Facultad de Psicología, 2023). A total of 15 sessions were conducted (3 with the legal guardians, one at the beginning, one in the middle and one at the end and 12 with the adolescent) given by a master's student of clinical psychology in the child and adolescent area with supervision, where each session lasted 45 min once a week.

In the SEAP, the patients with whom the research would be conducted were identified and the DASS 21 and Hamilton instruments to identify depressive symptomatology were applied in the diagnostic sessions. These consisted of 21 items and were applied during the diagnostic phase

and in session 13 of the intervention. The Hamilton was an observational instrument applied by the therapist, used in the diagnostic phase, and applied in sessions 6 and 13 of the intervention to know the case's evolution in the middle of the process. Participants who presented previous reports of video game addiction or previous suicide attempts were excluded.

The participants were two 13-year-old adolescents with moderate to extremely severe depressive symptomatology according to the DASS 21 instrument and moderate to very severe symptomatology according to the Hamilton instrument participated in this research. The first adolescent was a male adolescent (J), a high school student of low socioeconomic level, who came to the SEAP for poor grades, constant fights with his father, aggressiveness, behavioral problems, inadequate management of emotions and fraternal relationships. The second participant was a female (P), a high school student of lower middle socioeconomic level, who came to SEAP for academic difficulties, socialization problems, apathy, school problems and suicidal ideation.

In the diagnostic sessions (1 to 5), a semi-structured interview was conducted with the legal guardians following the SEAP interview guide and where the informed consent form was signed, mentioning that the data obtained in the sessions could be used for research. At the same time, it was explained that the confidentiality of the sessions is respected if no crime has been committed or the life of the patient or other persons is identified as being in danger. During the following 4 sessions, we worked with the adolescent to establish rapport and identify cognitive distortions, negative thoughts about himself, the world, and the future, where we applied the instruments for measuring depressive symptomatology. After these 5 diagnostic sessions, the legal guardians were informed that the adolescent was a candidate for voluntary participation in the research to reduce depressive symptomatology through sessions designed with digital tools. The legal guardians signed a form of acceptance and commitment to the application of the intervention, after which the participants were informed of the objective of the research and of the sessions as part of the therapeutic process and the establishment of goals.

Based on the information obtained during the diagnostic sessions (1 to 5), a series of 17 animated psychoeducational videos were created to explain the cognitive distortions within the metaverse (Spatial), which was used in sessions 4, 5 and 6. The script of these videos together with the examples adapted to the child population was created in ChatGPT 3.5 (2024), and then the text was converted to voice through Narakeet (2024), animated using Adobe Express (2024) and loaded into the metaverse within Spatial (2024) in a digital classroom called "Museum of Cognitive Distortions" for the visualization of these videos (Figure 1).

At the same time, we worked on the construction of a video game (Red) for the Beck's depression triad session through the video game engine GDevelop 5 (2024), which was used in session 10. GDvelop is a tool that allows designing video games without code through predetermined templates where enemies were designed to represent the thoughts commonly related to each of the dimensions of Beck's cognitive triad. These thoughts were generated through ChatGPT 3.5 (2024) and allowed participants to visualize the thoughts as a part of the game in which the enemies do not necessarily have to be defeated, but sometimes you just must let them pass (therapeutic metaphor). This video game consists of 4 levels, 1 for each dimension of Beck's depression triad and the last one, an evaluation level where the user puts into practice what was learned during the video game by classifying and identifying negative thoughts (Figure 3). This videogame can be used with other patients for the treatment of depression, as long as the therapist is nearby for the explanation of the video game, the narration of the story and the application of metaphors in relation to the negative thoughts (such as when the patient is told that negative thoughts do not have to be defeated, sometimes you just have to let them go and move on).
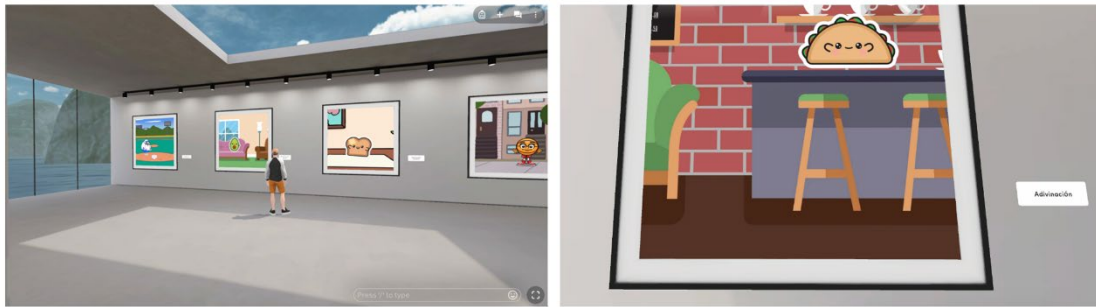
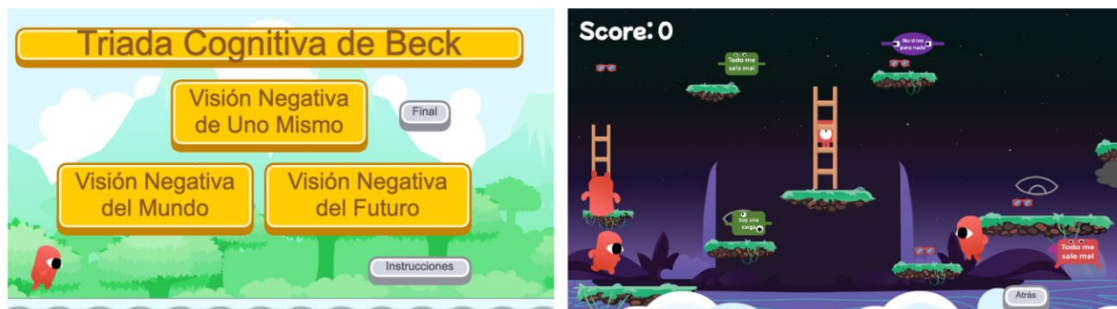**Figure 1**: Museum of cognitive distortions (animated videos)

Figure 2: *Videogame "Red"*

Figure 2: *Videogame "Red"*

2.1. Sessions

During the sessions we used behavioral techniques such as role-playing, coping techniques (relationship, breathing control and assertive training); emotional techniques such as limited talking about feelings, avoiding catastrophic internal verbalizations and responsibility analysis; cognitive techniques such as: guided discovery, retribution techniques and conceptualization of alternatives and following the next list:

- Session 1 Interview with parents.

- • Session 2 Initial assessment and goal setting.
- • Session 3 Identification of emotions and automatic thoughts.
- • Session 4, 5 & 6 Automatic thoughts and thinking errors (cognitive distortions).
- • Session 7 Session with parents.
- • Session 8 Identifying Thought Patterns.
- • Session 9 Thought patterns.
- • Session 10 Beck's model of depression.
- • Session 11 Coping skills.
- • Session 12 and 13 Problem Solving and Decision Making.
- • Session 14 Final interview with parents.
- • Session 15 Relapse prevention and closure.

In the sessions a laptop was used as a digital tool for the writing of information reported by the patient (such as experiences related to the intervention) and the presentation of animated videos and the videogame.

For the application of the animated videos, the patient was asked prior to the presentation of each video, "What do you think the cognitive distortion refers to? Then the video was presented, and the patient was asked if he/she had ever experienced something similar and was subsequently asked to explain an example that he/she had experienced or observed where the distortion or error in thinking was present. Here, it was necessary for the therapist to analyze whether the concept of the animated video had been understood according to the example given. For the application of the serious videogame (Red), the patient was told the story of how "Red" (the videogame character) had had depressive symptoms in the last few weeks and that to change this, he would have to be helped to get out of his thoughts during the 4 levels (this story could also be read inside the videogame).

After the end of the video game, a questionnaire was applied digitally, which was answered by the patient with the objective of supporting the patient in the identification of the negative thoughts presented and the creation of alternatives for each of these. Likewise, this questionnaire allows the identification of the most common cognitive distortions presented in the patient, reinforces techniques for thought change and allows using the videogame itself as a metaphor for the understanding of depressive symptomatology (Figure 4).

Figure 4: *Example of questionnaire applied and answered by adolescent*

3. Results

The results obtained in the intervention can be contrasted with the initial results. In this it can be observed that in the case of "J" (Table 1) the depressive symptomatology disappeared, while in the case of "P" (Table 2) it was maintained, this according to the results obtained from the DASS 21 and Hamilton scales. However, at a qualitative level, changes can be observed in both adolescents in relation to the cognitive distortions presented.

Table 1
Intervention's results "J"

Test	Pre-intervention	Post-intervention
DASS 21	Depression: moderate Anxiety: moderate Stress: mild	Depression: normal Anxiety: moderate Stress: normal
Hamilton	Moderate depression	Not depressed
Cognitive distortion	Labeling: I am a failure. Comparison: my cousin is better than me. Magnification: when I don't pay attention to school all the time, I think I'm going to fail.	Labeling: I'm not a failure and I can make it. Comparison: I am different from my cousin Magnification: just because I don't pay attention doesn't mean I will fail, if I don't do my homework I will fail.
Beck's cognitive triad (negative view)	Of oneself: I am a failure. Of the world: my family has no money, and they fight about it, school is hard and I'm failing. Of the future: I am going to fail	Of oneself: we are not all perfect Of the world: some people are despicable. Of the future: if I will make it

Table 2
Intervention's results "P"

Test	Pre-intervention	Post-intervention
DASS 21	Depression: extremely severe Anxiety: extremely severe Stress: severe	Depression: extremely severe Anxiety: extremely severe Stress: severe
Hamilton	Very severe depression	Very severe depression
Cognitive distortion	Arbitrary inference: I don't know math because my teacher spoiled me when I was little. Personalization: everyone laughs at me for not knowing math. Labeling: I'm ugly and not good enough.	Arbitrary inference: I did not learn mathematics because of my condition (dyscalculia). Personalization: not everyone laughs at me Labeling: I am pretty and useful
Beck's cognitive triad (negative view)	Of oneself: I am not good enough. Of the world: I don't like people.	Of oneself: I am pretty, I am useful, and my family loves me. Of the world: some people love me.

Of the future: everything will stay the same.	Of the future: I will not die alone; I will be happy.

4. Discussion

Horne, Horne, Messer, and Messer (2014) mention that current technology provides therapists with new opportunities to intervene with people. During this research, digital tools such as artificial intelligence and the use of serious video games were integrated into the intervention design. In the case of "J" the disappearance of depressive symptomatology was shown at a quantitative and qualitative level, however, in "P" it only showed a decrease at a qualitative level. It might seem that the intervention with digital tools is not entirely effective, however, there is currently no model of care that shows 100% effectiveness for the treatment of depression because it is a disorder with a multifactorial etiology (Organización Panamerica de la Salud, 2023).

Additionally, during the sessions it was identified that "P" presented dyscalculia, which is a learning disorder characterized by difficulty in understanding, learning, and performing mathematical operations based on numbers (Jacobson, 2022). She also expressed symptoms such as hearing voices, so at the end of the intervention sessions she was referred to the child psychiatry area for care. The Institute for Health and Care Excellence (NICE) (Fleming, Lucassen, Stasiak, Sutcliffe and Merry, 2021) who consider that these tools are useful for the treatment of depression in the first line, i.e. cases that are not yet extremely severe as in the case of "P". During the serious video game's application, it was observed that both "J" and "P" showed skills for videogames. Both expressed having played video games previously, which reflects what was expressed by the Instituto Federal de Comunicaciones in 2022 where it is reported that among video game players 50.3% are women and 49% are men.

Another point to explore during the intervention is the level of depressive symptomatology presented by adolescents, since it seems that mild and moderate levels the use of digital tools may present greater effectiveness compared to adolescents who present extremely severe levels. Among the limitations found within the study, internet access represented a challenge due to speed limitations during the application of the animated videos in the virtual room. This was solved by downloading both the animated videos and the videogame on the laptop to avoid complications during the intervention. Also, typing on the computer proved to be a challenge for the adolescents since both expressed that they do not use the digital keyboard much in their day-to-day life, since they use the cell phone or a tablet for the completion of their tasks.

Based on the results of this research, we suggest the development of digital tools on mobile devices that facilitate interaction and the capture of information with the adolescent. Likewise, the development of serious videogames in cooperative mode allows the immersion of the therapist and the patient in digital environments to avoid disconnection with the therapist during the session and modeling of behaviors. At the same time, it is expected that in the future new intervention models using digital tools can be developed to go beyond the adaptation of existing models.

5. Conclusion

The use of artificial intelligence in psychotherapy processes allows the expansion and application of new psychoeducational and intervention tools and strategies that can generate greater access and scalability to treatments. It also provides greater opportunities for instrument customization, continuous monitoring, and constant updating. Artificial intelligence can help in the identification and diagnosis of depressive symptomatology by generating questions or analyzing the topics that

a person is reviewing. Likewise, in the future, artificial intelligence will be able to generate intervention plans that will allow standardization and efficiency of research and design times for mental health professionals.

Animated videos generated with artificial intelligence allow the production of multimedia content at low cost, which allow the dissemination of information related to childhood depression through campaigns that can be attractive and in which children can identify themselves. While the use of videogames represents an area of opportunity for the creation of new types of interventions that could become standardized and provide quick and direct feedback to the user, as in the case of Endeavorx (2024) which is currently a video game recognized by the FDA as a drug that can be prescribed by a doctor for the treatment of attention deficit hyperactivity disorder. It could even work on the development of video games that integrate artificial intelligence for the analysis of data provided by the user, such as words, images, or videos. Making that the interaction with artificial intelligence or a video game could become therapeutic.

Digital tools such as Adobe Express, ChatGPT 3.5, GDevelop, Narakeet and Spatial allow the ap-plication of Beck's depression model, which includes the techniques of the model and the explanation of Beck's cognitive triad of depression for the reduction of depressive symptomatology. Additionally, it is considered that digital tools can increase the interest of adolescents in therapeutic work since they are users of technology daily, which allows them to feel comfortable with the use of these tools. Computer-based therapies, apps and websites have enormous potential for mental health and wellness, can be as effective as traditional therapies and other mental health interventions, and are powerful and scalable (Digital Mental Health Lab, 2021).

Finally, there is substantial evidence supporting the use of digital tools to treat mental health problems, so much so that the Institute for Health and Care Excellence (NICE) recommends such tools as first-line treatment (Fleming, Lucassen, Stasiak, Sutcliffe, & Merry, 2021). This is not intended to replace therapeutic work, but rather to provide greater options to professionals and the general population for the diagnosis, treatment and evaluation of mental disorders that may affect the population. However, it is still necessary to continue research on the effectiveness of the use and development of digital tools in the treatment of depression in children and adolescents. It is expected that in the future new intervention models will incorporate new technologies or in its case, be born from technology for the treatment of different disorders.

Acknowledgements

References

Adobe Express: Animar a Partir de Audio, 2024. URL: https://new.express.adobe.com/

American Psychiatric Association: ¿Qué es la depresión?, 2020. URL: https://www.psychiatry.org/patients-families/la-salud-mental/depresion/que-es-la-depresion

A. Beck, P. Wynnendod, Thinking and depression, volume 10 of Arch. Gen. Psychiatry, 1964

Digital Mental Health Lab: Digital Tools for Mental Health and Wellbeing. Te Herenga Waka. Victoria University of Wel-lington, 2021. URL: https://www.hpa.org.nz/sites/default/files/Digital%20Tools%20for%20Mental%20Health%20and%20Wellbeing_Report.pdf

Endeavorx: Endeavorx, 2024. URL: https://www.endeavorrx.com/

Facultad de Psicología: Universidad Autónoma de Yucatán. Servicio Externo de Apoyo Psicológico (SEAP), 2023. URL: https://www.psicologia.uady.mx/seap.php

T. Fleming, M. Lucassen, K. Stasiak, K. Sutcliffe y S. Merry, Technology Matters: SPARX – computerized cognitive be-havioral therapy for adolescent depression in a game format. Volume 26 of Child and Adolescent Mental Health, 2021. doi: https://doi.org/10.1111/camh.12444

GDevelop: GDevelop 5, 2024. URL: https://gdevelop-app.com/

Instituto Federal de Telecomunicaciones, Reporte Especial Estado del Gaming en México, 2022. URL: https://www.ift.org.mx/sites/all/themes/bootstrap/templates/ift-umca/files/pdfs/eramca/INFORME%20Videojuegos2022%20VF.pdf

R. Jacobson, Cómo detectar dyscalculia, Child Mind Institute, 2022. URL: https://childmind.org/es/articulo/como-detectar-la-discalculia/#:~:text=La%20discalculia%20es%20un%20trastorno,clases%20que%20utilizan%20las%20matem%C3%A1ticas.

Narakeet: Easily Create Voiceovers Using Realistic Text to Speech, 2024, URL: https://www.narakeet.com/

National institute of Mental Health: Depresión, 2023. URL: https://www.nimh.nih.gov/health/publications/espanol/depresion-sp

OpenAI: ChatGPT Version 3.5, 2024. URL: https://chat.openai.com/auth/login

Organización Panamericana de la Salud, Depresión, 2023. URL: https://www.paho.org/es/temas/depresion

Secretaría de Salud México, Guía Clínica Depresión en Niños y Adolescentes. Secretaría de Salud México, 2018. URL: https://www.gob.mx/cms/uploads/attachment/file/304292/Depresion_en_ninos_y_adolescentes_2018.pdf

H. Simons, El Estudio De Caso: Teoría Y Práctica, Ediciones Morata, 2011.

Society of Clinical Psychology: Depression, 2022, URL: https://div12.org/psychological-treatments/disorders/depression/

Spatial: Spatial, 2024. URL: https://www.spatial.io/

Universidad Internacional de Valencia, Aplicación de nuevas tecnologías en la terapia conductual. Universidad Internacional de Valencia, Campus Virtual, 2017, URL: https://www.universidadviu.com/es/actualidad/nuestros-expertos/aplicacion-de-nuevas-tecnologias-en-la-terapia-conductual