Developing An Engaging Computerized Cognitive Behavioural Therapy for Adolescent Depression

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Abstract **– The implementation of computerized cognitive behavioural therapy (cCBT) among adult patients has been proven effective but the effectiveness of using cCBT to treat depression among adolescents is still not clear to date. The problem lies in the failure to engage adolescents with the computerized therapy. Engagement with computerized therapy is deemed as crucial as the outcome of the therapy relies on the engagement between patients and the cCBT. In order to ensure the engagement, the cCBT has to be usable and fulfil the adolescents' needs and requirements. Hence, this study designs and develops a cCBT for adolescent depression based on an engagement model proposed. The results showed that the engagement between adolescents and the cCBT is satisfactory despites having some limitations. This shows that adolescent's engagement with cCBT can be maintained effectively if the cCBT is designed and developed to meet their needs and requirements.**

Keywords **– Adolescent, computerized, CBT, depression, engagement.**

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1. Introduction

Computerized interventions were first studied in the late 1990s and have since proven useful in treating depression and other common mental health disorders. This method has not only been found to be effective in the treatment of depression, but due to the rapid advancement of technology, the application and intervention methods of depression are expected to change and develop dramatically in the near future. Computerized cognitive behavioral therapy or mainly known as cCBT refers to technology that uses a cognitive behavioral therapy approach to treat mental health problems. The basic approach of computerized therapy is the use of interactive features to teach conceptual elements taken from cognitive behavioral therapy [18]. The development of digital interventions has overcome the barriers that prevent patients from receiving and benefiting from mental health care (e.g. Stigma, long waiting lists, physical distance to health services) [8]. Moreover, adolescents also may feel more comfortable with digital technology [11], have easy access to computers or tablets, and may find computerized therapy programs more acceptable than face-to-face interventions. Previous studies have also shown strong evidence of the effectiveness of cCBT in treating depression and anxiety among adolescents. Now, some digital therapies for adolescent depression have been recommended in treatment and prevention guidelines [21] and there is evidence to support their use.

Despite the potential effectiveness, maximizing the impact of computerized therapies is still quite a challenge. Understanding optimal design features and implementation processes for computerized therapies will be an important step in increasing their impact. The design of cCBT needs to consider every aspect of adolescent patients because the cognitive level of adolescents is different from that of adult patients.

According to Hourcade J.P. [10], in designing digital interventions, two main principles need to be considered which are usability and user experience. Adolescents have different needs, skills and motivations than adults in both of these aspects. Therefore, it is usually not appropriate to implement cCBT for adult users with teenagers [30], [22]. According to the Patient Health Engagement model (PHE) [9], by making patients engaged with their treatment, the retention in associating full meaning to therapy and in enacting effective self-management behaviors even when their life context changes can be ensured. When they are effectively engaged, patients will also develop a lasting perspective on current and future situations that can be better integrated into their behavior [7]. Some past studies have also shown a positive relationship between engagement and effective behavior change [1].

Perski *et al.* [27] have summarized that engagement can be defined as: external use (eg depth of use), subjective experience with emotional and cognitive aspects (attention, interest and affect). Kelders and Kip [16] explained that for users to be fully engaged, they need to be involved in three ways; in the aspect of behavior, cognitive and affective. However, most digital health intervention studies only focus on and measure engagement in terms of behavior only which is the usage of digital interventions [28], [31]. This is seen as problematic because system usage data only captures how often the system is used and only provides a narrow view of engagement without considering the subjective experience of the users [32]. Typically, behavior-based metrics (i.e. objective measures) such as the number of page visits and duration of use have been used as indicators of engagement [20]. However, exposure to interventions alone is not sufficient to capture the multidimensional aspects of engagement.

Engagement dimensions are not evenly distributed among individuals because each person has their unique engagement style. However, these dimensions can complement and reinforce each other, leading to increased individual engagement levels. For example, if an individual struggles with the behavioral aspect and finds it challenging to establish a routine with technology, a high level of affective engagement can compensate for it. Feeling a personal connection with the technology and experiencing positive emotions can boost overall user engagement. Kelders and colleagues concluded that eHealth technologies should be flexible to cater to different engagement styles. It is important to avoid relying solely on one form or style of engagement that may not align with users' individual preferences. To gain a comprehensive understanding of user engagement and its impact on mental health technology, it is crucial to delve deeper into the various dimensions of engagement and their influencing factors. Therefore, this paper discussed the design and evaluation of engaging cCBT for adolescents with depression.

2. Material and Methods

This study employs a user-centered approach to address the problem of low engagement with digital intervention technology [19]. The study's implementation based on User-Centered Design (UCD), which is a user interface design methodology that incorporates the active participation of end-users throughout the system development design process [15]. There is four phases in this study which are analysis, design, development, and engagement evaluation.

2.1. Analysis Phase

The analysis phase of this study involves conducting a comprehensive literature review and user requirement study. The literature review examines various aspects, including the factors influencing teenagers' engagement with computerized therapy, how these factors impact teenagers' willingness to participate in computerized therapy, and the solutions proposed by previous researchers, including the application of persuasive technology. The findings from this literature review, combined with preliminary research, play a critical role in identifying the challenges faced by adolescent users when utilizing computerized cognitive behavioral therapy and in recognizing their specific engagement needs. The outcome of the literature review results in the identification of seven key factors that influence the engagement of adolescents with computerized cognitive behavioral therapy for depression. These factors are subsequently validated by experts to further enhance the validity.

It is imperative to consider the unique characteristics of mental health symptoms and unique characteristics of adolescent users. To verify the findings from the literature study, a user requirement study with adolescent patients is conducted. User requirement study employed a semi-structured interview method in conjunction with existing computerized cognitive behavioral therapy. Qualitative methods were chosen as they are well-suited for exploring and explaining the use and design of technology for individuals with mental health concerns, as indicated by previous research [4]. The study involved five adolescent patients between the ages of 17 and 19 who were actively participating in cognitive behavioral therapy sessions at the National University of Malaysia Medical Center (PPUKM).

This study has obtained ethical approval from the National University of Malaysia Research Ethics Department with serial number JEP-2018-178. Individual interviews were conducted, with each interview guided by a set of predetermined questions. Nevertheless, the participants were encouraged to engage in open discussions, allowing for flexibility and relevance during the interviews. The use of a semi-structured guide helped ensure the reliability and comparability of the data collected across each interview session [5]. Detailed procedures and findings of this research phase have been reported in study by Marzuki *et al*. [23].

2.2. Design Phase

In the design phase a low-fidelity prototype is developed to serve as an early-stage, simplified version of the design based on the requirements obtained in the previous phase. To assess the usability and effectiveness of this low-fidelity prototype, a heuristic evaluation is conducted. This evaluation process involves the participation of seven experienced evaluators with expertise in both human-computer interaction and adolescent psychology. Their insights and feedback are invaluable in identifying potential issues and areas for improvement within the prototype.

The set of heuristics used for this assessment was derived from two sources: The Health Literacy Online Checklist (HLO) provided by the US Office of Disease Prevention and Health Promotion, and the Monkman heuristic developed by Monkman *et al*. [24]. The HLO checklist is based on an evidence-based electronic manual designed for creating web-based health content tailored to individuals with low literacy. It offers evidence-based guidelines for developing "user-friendly health websites and digital health tools." The Monkman heuristic, on the other hand, is a unique set of heuristics that summarizes the design guidelines from the HLO checklist while adapting them to be relevant for mobile devices and applications. It also integrates insights from the e-health/health literacy and usability literature. A total of seven examiners participated as evaluators who provided feedback on the usability of the low-fidelity prototype design. These examiners conducted a comprehensive review of the low-fidelity prototypes, noting any deviations from the interface that did not align with the predetermined criteria in the two sets of heuristics. The findings and analysis generated from this heuristic evaluation are then used to refine and enhance the engagement model that forms a crucial component of this study.

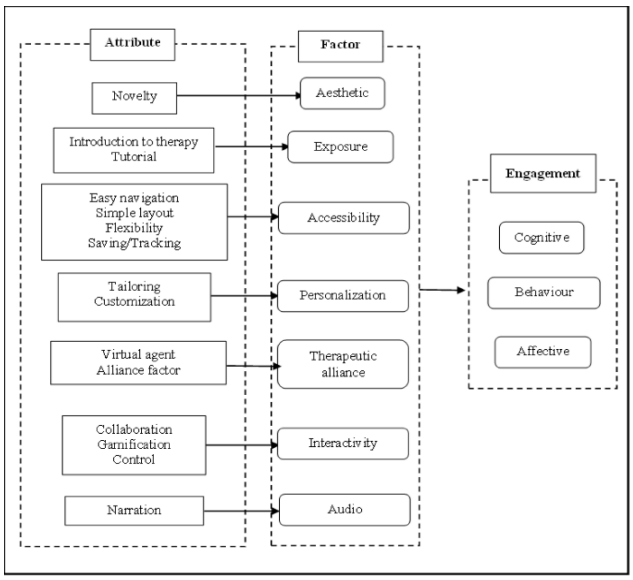

Figure 1. Proposed engagement model

It is important to acknowledge the nature of depression itself and the challenges that adolescent users may face when using computerized therapy. The engagement model proposed in this study assumes that users, particularly adolescent patients, have limited cognitive capacity and that computerized therapy should not place excessive burden on them. Recognizing that cognitive behavioural therapy can be a lengthy and challenging process for some adolescents, the model emphasizes the need for digital interventions to alleviate the burdens associated with therapy. Furthermore, digital interventions should be enjoyable and anticipated by teenage users, creating a positive attitude towards the intervention. By incorporating these considerations, the engagement model seeks to optimize the engagement of adolescent users with digital interventions, ensuring that the intervention is appealing, user-friendly, and effectively supports their mental health needs.

The proposed engagement model (Figure 1) consists of seven key factors: exposure, aesthetics, personalization, therapeutic alliance, audio, and accessibility. These factors are not independent of each other, but rather interact and influence user engagement collectively. Each factor possesses specific attributes that contribute to the overall engagement. To effectively increase and sustain a high level of user engagement throughout the intervention, strategies should encompass all three dimensions of user engagement. As highlighted by Kelders *et al*. [17], technology should aim to encompass all three sub-dimensions of user engagement to ensure that users are not solely reliant on a single dimension that may not align with their individual engagement style.

By considering and addressing these seven factors and promoting engagement across the cognitive, affective, and behavioural dimensions, interventions can be designed to optimize user engagement and improve the overall effectiveness of the digital experience.

The first key factor for adolescent engagement in computerized therapy is aesthetics, particularly achieved through novelty. Novelty, drawing users to new and unexpected elements, is crucial for initial engagement, as it forms the first impression for users. If the aesthetics are unattractive or do not align with the adolescents' values, it can impact their perception and attitude toward computerized therapy. Given adolescents' preference for immediate gratification, digital interventions must grab their attention with visually appealing, user-friendly, and interactive interfaces. In essence, incorporating novelty and appealing aesthetics enhances initial engagement, focusing users and motivating them to continue using the system. While aesthetics primarily affects affective engagement, it also indirectly influences behavioral engagement, making users more inclined to sustain their usage of the intervention.

The second factor, exposure, can be attained by introducing cognitive behavioral therapy and providing tutorials within the digital intervention. Recognizing obstacles such as a lack of guidance, unfamiliarity, and the need for instruction in previous literature, it is crucial to overcome these challenges to enhance user engagement with digital intervention. Inadequate support may hinder initial adoption, leading to disengagement. Ensuring exposure and instructional support is vital, especially for adolescents, as it provides a clear understanding of the goals and benefits of computerized therapy. This is particularly important when the digital intervention is novel to the user. Offering detailed information increases the likelihood of user engagement, even for those with limited awareness of e-mental health services. The exposure factor positively impacts both cognitive and behavioral engagement by reducing cognitive burden and facilitating the maintenance of behavioral engagement with digital intervention.

Accessibility, the third factor, is crucial for ensuring the usability of interventions and removing obstacles that might impede user engagement. Prior research highlights that interventions designed for individuals with low health literacy can also be effective for those with higher health literacy. Achieving accessibility involves prioritizing easy navigation and a simple layout in interface design, making users feel comfortable and preventing confusion. These design elements are particularly important given the structured nature of cognitive behavioral therapy, reducing the burden on users.

Flexibility is another attribute of accessibility, granting users the freedom to tailor the intervention to their needs. Features like progress tracking and session saving allow users to pause, resume, and review their therapy, providing a sense of control. While flexibility is generally positive, it can pose challenges such as making therapy easier to avoid. Balancing flexibility with maintaining user commitment is crucial. Ensuring accessibility in digital interventions enhances the likelihood of maintaining cognitive and behavioral engagement, thereby impacting the user's affective engagement positively.

Personalization, the fourth factor, plays a pivotal role in engaging users with computerized therapy through content tailoring and interface customization. Tailoring involves adapting module content, virtual agent dialogues, and feedback based on the user's conditions and progress, ensuring relevance to individual needs. Simultaneously, customization grants users the freedom to modify the interface's design to suit their preferences. By tailoring and customizing, computerized therapy aims for a personalized user experience, fostering a deeper connection. Tailoring ensures content relevance, while customization empowers users, enhancing motivation and engagement. Together, these features contribute to a user-centered experience, impacting cognitive, behavioral, and affective engagement in computerized therapy.

The fifth factor in computerized therapy is the therapeutic alliance, established through virtual agents and alliance factors. The role of virtual agents in computerized therapy is to facilitate the formation of relationships by visually representing an assistant or supporter throughout the user's engagement with the program. In compliment to that, the alliance factors outlined by Barrazone, Cavanagh, and Richards [2] can guide the implementation of virtual agents and the computerized therapy itself to enhance therapeutic alliance. These factors may include displaying empathy, providing a non-judgmental and supportive attitude, actively listening to the user, offering personalized feedback, and promoting a sense of collaboration and shared goals between the user and the virtual agent. By incorporating these alliance factors into computerized therapy, users can experience a sense of connection and trust, leading to increased engagement and a stronger therapeutic alliance. Virtual agents can play a valuable role in providing the necessary support and guidance, complementing the self-help nature of computerized therapy and enhancing the overall treatment experience. By incorporating virtual characters with friendly and caring attributes, computerized therapy programs can foster a sense of connection, trust, and support.

This enhances the user's engagement and therapeutic experience, particularly among adolescent populations who may have unique needs and preferences for interacting with therapy interventions. Therapeutic alliance factor facilitates both cognitive and affective engagement of users when interacting with digital interventions.

The sixth factor enhancing user engagement in computerized therapy is interactivity, encompassing collaboration, gamification, and control. Collaboration emphasizes two-way interaction, acknowledging users' efforts and preventing disengagement. Gamification introduces playful elements, simplifying complex therapy models and increasing motivation. Control involves giving users autonomy, enhancing engagement by providing ownership and personalization. These attributes encourage active participation, making therapy more interactive and enjoyable. Interactivity, mainly influencing affective engagement, indirectly affects cognitive and behavioral engagement by reducing cognitive burden and ensuring sustained usage of the intervention.

The seventh factor is audio, particularly focusing on narration. When designing user interfaces aimed at enhancing engagement, dynamic media like videos or voice recordings are more captivating compared to static images or text, as changing stimuli are more attention-grabbing. Verbal dialogue, in particular, is highly effective in evoking emotional responses, spanning from creating a sense of threat to fostering empathy. It is also important to offer options to turn off the music or modify the background sound to suit individual preferences. In the context of computerized therapy, narration holds significant importance. Given the lengthy and challenging nature of therapy sessions, audio narration serves as a valuable addition. It allows users to take a break from reading text-based content and can provide additional support for those who prefer auditory narration while accessing therapy materials. This factor impacts both cognitive and affective engagement by reducing the user's cognitive burden and eliciting favourable emotions when interacting with the digital intervention.

2.3. Development Phase

During this phase, high fidelity prototype is developed using predefined authoring and programming software. This prototype is an advanced and more polished version of the low fidelity prototype in the design phase. During the development of the high-fidelity prototype, feedback and input from experts who participated in the usability evaluation are considered and integrated into the design. This collaborative feedback ensures that the prototype is as effective and user centered as possible.

To develop the high-fidelity prototypes, software tools such as Proto.io, Adobe Photoshop, and Clip Studio Paint are used for graphic production and editing. Additionally, Procreate software is employed to create animations incorporated within the high-fidelity prototypes. This phase is crucial for refining and finalizing the design of the computerized therapy intervention. The prototype was developed in line with the research model, encompassing all seven engagement factors and their related attributes that impact how users interact and engage with the computerized therapy. Building a high-fidelity prototype facilitated a comprehensive assessment of each element outlined in the engagement model during the final evaluation.

This system prioritizes engaging adolescent users in computerized therapy through a thoughtfully designed interface. It includes a virtual agent guide, personalized settings, and an easy-to-navigate main page (Figure 2). Users are introduced to cognitive behavioral therapy with infographics and interactive modules (Figure 3), promoting user relevance and usability. The inclusion of an interactive plant cultivation activity (Figure 4) aims to enhance engagement, allowing users to relate therapy to real-life experiences. Users can choose from different plant options and monitor their growth based on their emotional states. Mood monitoring features (Figure 5) and a habit tracking system further enhance interactivity, enabling users to review and manage their emotional well-being. The reward page serves dual purposes: tracking progress with emoticons and claiming rewards for therapy completion.

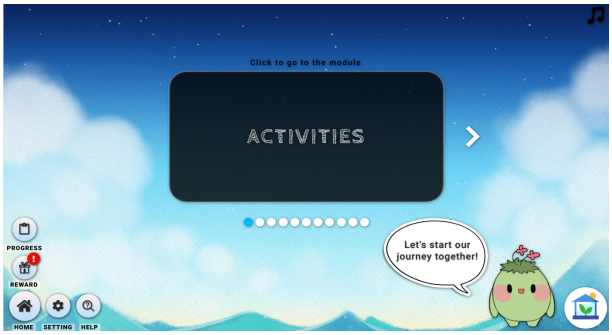

Figure 2. Screenshot of main page with virtual agent

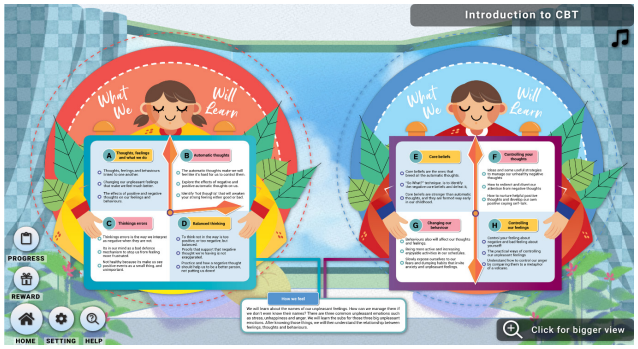

Figure 3. Screenshot of introduction to CBT

Figure 4. Screenshot of plant cultivation activity.

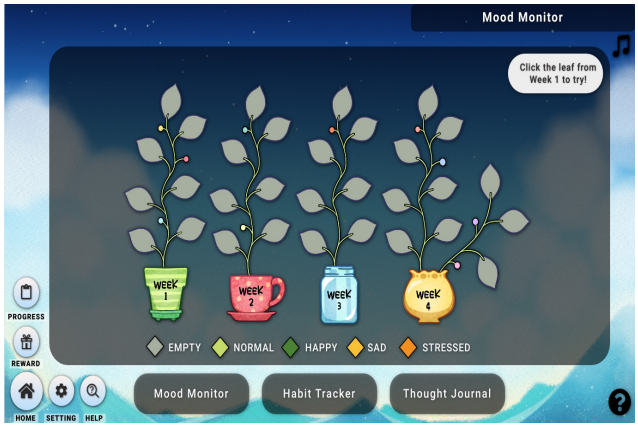

Figure 5. Screenshot of mood monitoring.

2.4. Evaluation Phase

The final phase involves evaluating the user engagement through the testing of the high-fidelity prototype with adolescent patients. User testing is conducted using TWEETS as instrument, which evaluates how engaged users are with the developed prototype. This evaluation is conducted using the triangulation method, a rigorous approach that combines multiple data sources or methods to ensure the validity and reliability of the results. In addition to assessing the users' overall experience using TWEETS, the evaluation includes the observation of user interaction patterns through screen recordings captured on participants' devices during the evaluation sessions. Participants were also interviewed in an unstructured manner throughout the testing session. Participants performed user testing followed by semi-structured interviews to obtain further feedback on user interactions. Researchers encouraged participants to talk about what they felt, saw or thought while testing the high-fidelity prototype. Verbal inquiry is also used to clarify participants' answers [12]. Each video and audio recording are transcribed and extracted.

Prior to the testing session, participants were briefed on the evaluation process and informed that the tested prototype was not a fully functional intervention. Although the tested prototype has limited functionality, it provides the essence of a fully functional intervention. Therefore, the results of the evaluation study are not affected and biased. Next, participants tested the high-fidelity prototype to begin the evaluation.

A total of 15 adolescent patients aged 14 to 18 years from the PPUKM who are currently receiving therapy treatment were selected as participants for the study. According to Nielsen [25], in user testing, five users are enough to provide the best test results. The criteria for selecting participants is based on adolescents who have been diagnosed with moderate to major depression and are also receiving face-to-face cognitive behavioral therapy treatment. Engagement in this context was assessed using the TWEETS questionnaire developed by Kelders *et al*. [17]. This questionnaire comprises nine items, each of which is rated on a 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). The total score from this questionnaire ranges from 0 (indicating a low level of engagement) to 36 (indicating a high level of engagement). Furthermore, the TWEETS questionnaire is structured into three subscales, each of which measures a different component of engagement: the affective, behavioral, and cognitive components. Each of these subscales contains three items. The questionnaire has been found to have good psychometric properties, including high internal consistency and reasonable test-retest reliability [17]. The TWEETS questionnaire has the flexibility to assess engagement at various time points, including expectations of engagement, current engagement, and past engagement. However, in this specific study, participants were requested to respond to questions related to their current engagement.

3. Result and Discussion

All calculations were performed using SPSS. First, the score on the TWEETS scale is calculated by summing all the scores on each item where a high score indicates a high engagement with the high-fidelity prototype. The mean score across participants for TWEETS was 27.47 as shown in Table 2 indicating that participants were engaged with the high-fidelity prototype developed. The scores theoretically range from 0 to 36 and most participants scored between 20 and 35 indicating a high level of engagement.

Table 1. TWEETS engagement score

Construct	Attributes	Min	Std. Dev.
Behavior	This computerized therapy can be part of my daily routine.	3.20	1.01
Behavior	This computerized therapy takes me little effort to use.	3.13	.52
Behavior	I'm able to use this computerized therapy as often as needed to reduce my symptoms.	2.93	.96
	MEAN	**9.27**	1.87
Cognition	This computerized therapy makes it easier for me to work on reducing my symptoms.	2.87	.74
Cognition	This computerized therapy motivates me to reduce symptoms.	2.87	1.06
Cognition	This computerized therapy helps me to get more insight into my conditions.	3.20	.68
	MEAN	**9.00**	2.00
Affect	I enjoy using this computerized therapy.	3.13	.83
Affect	I enjoy seeing the progress I make in this computerized therapy.	3.33	.62
Affect	This computerized therapy fits me as a person.	2.67	.72
	MEAN	**9.20**	1.90
OVERALL		**27.47**	5.30

From the result presented in Table 1, the behavioral engagement domain yielded a mean score of 9.27. This indicates that participants perceive computerized therapy as user-friendly and able to integrate it into their daily routines to address depressive symptoms. Overall, participants expressed agreement (mean score: 3.20) regarding the incorporation of computerized therapy into their daily routines. The engagement model's accessibility and interactivity factors play a key role in helping users establish routines aligned with their personal goals. Moreover, participants concurred (mean score: 3.13) that the tested computerized therapy is easy to use, emphasizing the positive influence of the accessibility factor on usability. Notably, the assessment of users' perceptions regarding how frequently they could use computerized therapy to alleviate depressive symptoms resulted in the lowest mean score of 2.93.

This suggests a neutral stance from participants on this aspect. Importantly, this neutrality does not imply a negative reaction; rather, it indicates a reasonable and neutral perspective. This aspect evaluates the effectiveness of the engagement model in terms of the accessibility factor. The lowest mean score in this aspect does not signify negative reactions, affirming that the engagement model's accessibility factors enable users to access and utilize computerized therapy according to their needs in a reasonable manner.

The second domain under evaluation is cognitive engagement, garnering the lowest mean score of 9.00, indicating a neutral response from participants. Specifically, two items within this domain received a mean score of 2.87 which are computerized therapy facilitates and motivates users on reducing their symptoms. This domain is notably influenced by the therapeutic alliance factor within the developed engagement model. Participants displayed a neutral stance on these aspects, suggesting that while computerized therapy might not intrinsically enhance user motivation, it does not detrimentally impact cognitive engagement. These results suggest the potential of the developed engagement model to effectively engage users cognitively with computerized therapy. The third item in the cognitive engagement domain assesses whether computerized therapy assists users in gaining more clarity about their condition. Participants overwhelmingly agreed with this statement, giving it a mean score of 3.20. This underscores the effectiveness of the personalization factor and its attributes within the engagement model, instilling the perception that computerized therapy is beneficial, aids in understanding one's condition, and contributes to sustained engagement.

The final domain is affective engagement, influencing the user's emotions and experience during computerized therapy obtained a mean score of 9.20. For the initial item, participants expressed enjoyment in using computerized therapy, yielding a mean score of 3.13. While aesthetics primarily influences this aspect in the engagement model, other factors also contribute to a positive user experience. This illustrates the comprehensive impact of each factor on the user's perception, influencing affective engagement. Furthermore, participants unanimously enjoyed tracking their progress in computerized therapy, scoring a mean of 3.33. This outcome supports the efficacy of the engagement model, drawing from factors like accessibility, personalization, and interactivity. It establishes that the engagement model effectively engages adolescents on an affective level.

However, the assessment of whether users feel that computerized therapy aligns with their individuality garnered the lowest mean score of 2.67, indicating a neutral response. This suggests that computerized therapy still struggles to convey a personalized impression to users. Nevertheless, it is crucial to acknowledge that study limitations influence these results, emphasizing that the developed engagement model has potential in affectively engaging adolescent users.

These findings show that the developed engagement model has the potential to engage adolescent users effectively in behavioral and cognitive aspects, as well as affectively, although there are areas where improvement is needed. However, it is important to consider the study's limitations when interpreting these results. Apart from that, some important aspects can be identified by the study conducted. Among them is that there are two types of users in the use of computerized therapy that we can theorize as module-inclined users and activity-inclined users. The results of the study found that some of the participants prefer to examine the content of the module compared to the interactive activities and some of them examined the interactive activities first. This suggests that the user's learning style influences their patterns of use and the interaction between computerized therapy and the user influences their engagement. Therefore, it is important for computerized therapy to be flexible and allow users to personalize their experience of use. Next, the provision of overviews of the activities helps the assessment of engagement even if the high-fidelity prototype has limited functionality. Furthermore, this exposure helps participants in knowing the goals and benefits of each activity they do. This also helps the user to not feel alienated by its use. Although the testing session was conducted on a one-off basis, the participants were found to be very interested and excited about the progress monitoring feature.

In addition to the scale, semi-structured interview was also prompted to capture the participants' thought processes throughout the testing session. Among the results from the interviews, participants stated that cognitive behavioral therapy is found to be boring if there is no gamification aspect and the aesthetic of the interface design does not meet the aesthetic value of the target user. They will also not feel burdened and bored if the computerized therapy contains both interactivity and aesthetic factors. Study participants also stated that the content of the therapy module was not too dense or burdensome. The use of illustrations to describe the scenario also makes the therapy content more interesting and not boring. Participants also showed interest in the high-fidelity prototype and expressed a desire to use real, fully functional computerized cognitive behavioral therapy. Furthermore, the participant also gave feedback that he found the tested prototype to be very useful for teenagers with mental health problems.

Aside from the different needs and requirements of adolescents compared to adult users, adolescents suffering from depression also have shown difficulties in interacting with computerized therapies compared to normal users. This is supported by a study conducted by Rennick-Egglestone *et al*. [29], reporting that the participants in their study who experienced mental illness (e.g. anxiety and depression) had a profound impact on their interactional capabilities. Thus, it is important to understand in the broader context of efforts to design effective health technologies, considering that users might experience anxiety or depression at some stage of their engagement. Supporting the implementation of the gamification design, participants expressed feelings of enjoyment and content while using the computerized cognitive behavioral therapy prototype. In addition, the findings of the study found that the aesthetics of the interface design and the visual presentation of the user's progress and achievements contribute to the engagement of the participants. This proves that the aesthetics of the design affects user engagement. If computerized therapy has a design that fits the aesthetic values of teenagers, the probability of them accepting the content and engaging with it positively is higher.

Therefore, by combining these findings, further evidence has been obtained supporting the use of gamification in computerized therapy by increasing intrinsic motivation and hence engaging users [13], [14]. Design choices should be made with care as they have been found to have a significant influence on the user's perception of computerized therapy content. In addition, the items related to the user's personal relevance reported a lower level of engagement compared to the other items. These findings indicate that adolescent users pay attention to the personal relevance of computerized therapy and influence their decision to engage. This explains the fact that when users are given control and can customize computerized therapy according to their own needs, higher levels of engagement, compliance, satisfaction and effectiveness are found to be higher compared to non-personalized computerized therapy [3], [6].

These findings also show TWEETS as a useful tool for analyzing and evaluating both the level of engagement and the engagement patterns of users. By examining the accurate scoring of different categories in TWEETS, improvement suggestions for different features can be made to increase the behavioral, cognitive or affective engagement of users' expectations.

With this method, it can also be used to explore how different populations and age groups differ in terms of preferred features and expected engagement scores. This study highlights the necessity for a more comprehensive exploration of gender bias and language usage in digital interventions for future research. The current studies on digital mental health interventions often lack diversity in community settings. It is recommended that upcoming studies delve into the connections between culture, race, language, and religion. An inquiry into whether these factors impact the engagement and acceptance of computerized therapy among adolescents is crucial. Additionally, considering the inherent cognitive differences in thinking patterns between male and female teenagers, there is a need to investigate potential distinctions in their engagement patterns.

4. Limitation

The first limitation pertains to the composition of adolescent participants in the study. Real users, constituting the adolescent patients, were involved in the user requirement study during the analysis phase and in the final phase for evaluating engagement. However, the study lacks gender diversity, with only one male participant in the user requirement study and no male participants in the engagement evaluation. This gender disparity may be attributed to societal norms, where females are more accepted in expressing emotions verbally, while males might face greater stigma in expressing feelings of depression [26], leading to a shortage of adolescent males, especially those dealing with depression.

The second constraint involves the number of participants in the evaluation phase. In accordance with research ethics, it is imperative for researchers to secure parental consent before involving teenage patients in studies. Ideally, engagement assessments should be conducted online, enabling adolescents to perform evaluations in an environment that aligns with their comfort, thus ensuring more accurate study findings. However, challenges arose in recruiting participants for the engagement evaluation due to the stigma prevalent in the Malaysian community. Many parents contacted by researchers declined to permit their children's participation in the study, expressing uncertainties about the transparency of the research, especially when initiated by non-healthcare entities. Consequently, the researcher opted for a direct engagement evaluation in the waiting room of the child and adolescent psychiatric clinic at PPUKM. These challenges contributed to the limited number of participants, impacting the breadth of research findings.

Additionally, the high-fidelity prototype employed in this study is limited in terms of functionality. It lacks a database, artificial intelligence, and personalization in content. While this limitation could potentially impact the engagement evaluation results, the study outcomes are deemed satisfactory. To mitigate these constraints, the researchers present insights into the ongoing use of each key component in the computerized cognitive behavioral therapy prototype. The prototype's limited functionality contributes to a third limitation of the research. This limitation pertains to the engagement evaluations being conducted as one-time assessments rather than over an extended duration. Given that the recovery from depression symptoms and user engagement with computerized therapy happen gradually over time, continuous evaluations within a specified period would be ideal. However, the high-fidelity prototype lacks a database, restricting engagement evaluations to a one-time occurrence. Nevertheless, this does not undermine the accuracy of the study results. Research suggests that evaluating computerized cognitive behavioral therapy once is valid, and if users have a positive initial impression, they are more likely to sustain engagement with the therapy [28], [17].

5. Conclusion

Our research provides valuable insights into the specific needs and preferences of adolescents regarding cCBT to enhance their engagement with the therapy. Adolescents prefer a user-friendly interface that is simple, straightforward, and aesthetically appealing to them. Interactivity is also crucial to keep them engaged throughout the therapy process. They also require support and motivation to progress through the therapy and stay committed until its completion by incorporating features that foster a therapeutic alliance between the user and the cCBT. It is crucial that the therapy is relevant to the adolescent’s specific goals and needs. This can be achieved through personalization of both the content and interface of the cCBT. Usability is another important aspect to consider, as the cCBT should be accessible and easy to navigate for adolescents. It should provide options and features that help them familiarize themselves with the program and reduce mental effort. By addressing these specific requirements and considerations, cCBT can better meet the needs of adolescents and enhance their engagement with the therapy, leading to more effective mental health treatment outcomes.

Overall, adolescents have shown positive reactions towards cCBT despite its novelty, indicating their willingness to accept this form of mental health care. However, sustaining their engagement with the program can be a challenge. It is important to address this challenge in order to ensure the effectiveness of cCBT for adolescents with depression.

Nevertheless, it is not impossible for them to achieve a positive engagement when using cCBT. The findings of this study highlight the significance of engagement as a core factor in the success of cCBT for adolescents. Involving adolescents in the intervention's design is crucial to enhance their engagement and make the program more effective. Furthermore, the study suggests the need for more detailed research on gender bias and the usage of language in digital interventions. Understanding these factors can help improve the design and effectiveness of future interventions for adolescents with depression.

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