Sokoon: A Gamification-Based Cognitive Behavioral Therapy Application – An Application for Depression, Stress, and Anxiety

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ABSTRACT

The World Health Organization (WHO) estimates that depression, anxiety, and stress disorders (DASDs) are prevalent worldwide, resulting in the loss of 13 million years of life and trillions of dollars of economic loss annually. Mobile-based health (M-health) interventions can employ mental health interventions such as cognitive behavioral therapy (CBT) for adolescents worldwide. Arab youth who struggle with DASDs do not tend to engage in mental therapies, but gamification and modularization have the potential to boost their appeal. The authors have selected effective CBT interventions for DASDs, adapted them to digital interactive formats, and integrated gamification concepts. An Arabic mobile application, Sokoon, which means relaxation and relief, may encourage Arab users to practice the required CBT skills for mild-to-moderate DASDs. A pilot study was conducted to evaluate the effectiveness of Sokoon App in a small group of adults who had signs of aDASDs. Sokoon was practicable, well-received by users, and had a positive impact on participants’ feelings of anxiety and sadness.

KEYWORDS

Anxiety, C-CBT, Cognitive Behavioral Therapy, DASD, Depression, Game-Based Therapy, Gamification, Hexad Theory, M-Health, Stress

1. INTRODUCTION

University students and teenagers frequently suffer from depression and other mental health problems such as anxiety and stress, which affect their academic performance (Richardson et al., 2012; Riglin et al., 2014; Steptoe et al., 2007). A systematic analysis revealed that the weighted mean prevalence rate of depressive disorders was 30.6% among university students from several countries, including those in the Middle East, North America, East Asia, and the European Union (Ibrahim et al., 2013). Many

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studies (Sachs & Malaney, 2002; Moussavi et al., 2007; Lorant et al., 2007) have found that adverse effects that result from depression, anxiety, and stress disorders (DASDs) can result in the loss of approximately 13 million years of life annually and trillions of dollars of economic loss. However, the development of computerized cognitive behavioral therapy (C-CBT) interventions, which was driven by the necessity to address the unmet needs associated with traditional psychological therapies that are costly and difficult for many populations to access as well as rapidly increasing access to Internet-enabled devices and cheaper software development (Khazaal et al., 2018), has increased during the past decade. Although gaming has become an integral part of everyday teen life, individuals have trouble adapting to and handling its persuasive nature during puberty (Brooks et al., 2015). Recently, games have been employed in many fields such as different therapies and education (Shohieb et al., 2020; Hady & Shohieb, 2020; Kokol et al., 2020; Shohieb, 2018). Gamification refers to the use of gaming elements and mechanics in non-gaming contexts. Because mobile-based health (M-Health) interventions are simple to integrate into users’ daily lives, designing a treatment based on this platform may be advantageous because this may lead to increased involvement with C-CBT interventions. Research on game-based cognitive behavioral therapy (CBT) interventions has revealed its potential benefits for mild-to-moderate DASDs symptoms (Khazaal et al., 2015; Leutwyler et al., 2015; Tárrega et al., 2015; Merry et al., 2012). The use of gamification in community health education may appeal to the public and entice gamers to access health promotion materials during leisure time, according to a meta-analytical review (Cheng & Ebrahimi, 2023) that examined the effectiveness of gamified interventions in promoting mental health. The gamified app performs better than the non-gamified app in terms of self-reported resilience, other well-being indicators, and anxiety reduction (Litvin et al., 2020). There is proof that gamification can be successful in encouraging good health outcomes (Fitzgerald & Ratcliffe, 2019) including lowering depression and anxiety symptoms (Damaševičius et al., 2023; Sinha, 2021). This fosters the improvement of psychological issues or the development of mental wellness in people on all sides. However, the most familiar gamified apps do not include all the CBT skills required for DASDs interventions (Dias et al., 2018; Shohieb, 2019; Coyle et al., 2017; Dias et al., 2020; Miloff et al., 2015; Christie et al., 2019; Brezinka, 2012; Addepally & Purkayastha, 2017). There is only one study (Jamaludin et al., 2021) that applied hexad theory with elements of gamification for depression diagnosis, Sokoon applied them for treatment. Furthermore, the available DASDs mobile-based CBT interventions have been designed in non-Arabic languages and for other cultures. Consequently, to generalize, such applications are not suitable for most Arab users. In this study, the full design of an Arabic gamified CBT intervention, namely, Sokoon, for mild-to-moderate DASDs that accommodates teenagers and young Arab individuals are examined. The main objective of Sokoon is to provide Arab young people with mild-to-moderate DASDs symptoms with the opportunity to decrease negative mood and enhance positive mood, life satisfaction, coping skills, and health-related quality of life. It is believed this may lead to enhanced productivity and success for young Arabs, which may subsequently directly increase the national economy. Concerning the gamification user type’s classification and Hexad theory, Sokoon can be customized and personalized (Andrzej Marczewski, 2018). This is likely lead to the maximization of user motivation, engagement, and consequent usefulness.

2. C-CBT STATE OF THE ART

DASDs have similar symptoms; thus, various treatments such as CBT are utilized to treat DASDs (Rodriguez, 2015; Holland, 2018; Bruno, 2009). Computerized health interventions have increased in popularity because of many factors, including the ease with which information can be exchanged via the Internet and the fact that computers can be mobile, small, and readily accessible (Victoria Barbosa, 2015; Tavares et al., 2015). However, studies have revealed that using fully automated self-help systems is often correlated with low levels of adherence (Andrews & Williams, 2015); therefore, it is imperative that systems developed as psychotherapeutic intervention tools must take user adherence into account to strengthen remote support and bonding.
Based on the latest trends, gamification has become a strategy employed to engage and motivate users in many areas, including health, education, and business applications (Brown et al., 2016; Dias et al., 2018; Shohieb, 2019).

Patient adherence and engagement are of paramount importance to ensure treatment is effective. Therefore, gamification can be employed as a technique to promote patient adherence and engagement in DASDs therapy. Accordingly, a systematic mapping study (Dias et al., 2018) was employed to select related work. A search string, which was created from the terms depression and gamification as well as their synonyms, was inserted into eight scientific repositories, including PubMed Central, Journal of Medical Internet Research, Google Scholar, IEEE Xplore Digital Library, ACM Digital Library, Springer Library, Wiley, and Science Direct. The following question was asked: How is gamification being used to support mental health? Studies that focused on the use of C-CBT to support DASDs activities that resulted from this systematic mapping study were added to this study. These studies concerning the following eight CBT applications for DASDs are listed in Table 1:

1. gNATs (Coyle et al., 2017)
2. IAware (Dias et al., 2020)
3. The challenger app (Miloff et al., 2015)
4. Quest - Te Whitianga (Christie et al., 2019)
5. Treasure Hunt (Brezinka, 2012)
7. Sparx (Yokomitsu et al., 2020)
8. SmartCAT (Pramana et al., 2018)

Table 1. A systematic mapping study for related work

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Hint: ✓: Applied, ✗: Not applied
The eight CBT widely used applications for DASDs, market share, and the features of their products are summarized in Table 2.

3. THE PROPOSED SYSTEM (SOKOON)

3.1 Sokoon Specifications and Description

In comparison to the eight CBT applications for DASDs, the features of Sokoon have the following advantages:

- A mobile-based gamified application.
- Supports youth and adolescents with DASDs.
- The following seven CBT intervention skills are standardized for DASDs intervention:
  - Relaxation
  - Gratitude
  - Self-compassion
  - Problem-solving
  - Social skills
  - Behavior activation
  - Cognitive restructuring

In comparison to the available related work, the features of Sokoon are summarized in Table 3.

3.2 The Proposed Interventions in Sokoon for Each CBT Skill

In Sokoon, the user’s customized avatar visits a 3-D world called Sokoon which has seven planets. Each planet is designed to be the equivalent of a standard treatment session and supports a single component of a customized, developmentally appropriate CBT intervention for seven skills that should be provided in the DASDs interventions. Key concepts were illustrated through videos, conversations, embedded animations, mini-games, and interactive stories. The seven skills and design interventions in the Sokoon application are listed in Table 4.

A study of Table 4 demonstrates that some of the designed interventions in Sokoon depend mainly on music and/or voice tones in storytelling, especially in relaxation, gratitude, and self-compassion. Merging music is already employed in therapy techniques in DASDs. Many studies (Braun Janzen et al., 2019; Leubner & Hinterberger, 2017; Ray & Götell, 2018; Tang et al.,

### Table 2. Local and international CBT applications’ features and market share

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Table 3. The features of Sokoon compared to the available related work

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<th>Anxiety</th>
<th>Stress</th>
<th>Personalization</th>
<th>Gamification</th>
<th>Target Age</th>
<th>Relaxation</th>
<th>Gratitude</th>
<th>Self-compassion</th>
<th>Problem-Solving</th>
<th>Social Skills</th>
<th>Behavior Alteration</th>
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have examined the impact of music-based therapy on depression. The findings revealed that measures of depression and associated symptoms such as sleep quality and quality of life had significantly changed from baseline. Furthermore, other studies that mainly explored using voice tone variation in compassion-based therapy for patients with DASDs (Heriot-Maitland et al., 2019; Hickey et al., 2017) found the efficiency of utilizing voice tones when communicating with depressed people.

Each activity in the seven planets in which the users participate has coin rewards. Users can spend their coins on a main planet to upgrade both their personalized avatar and the planet itself as well as solve problems in their virtual community on the main planet. This affords much support for self-compassion, behavioral activations, and problem-solving skills.

At the level of data representation and algorithms, game mechanics are features that comprise a game’s abstract structure. It is rare to think of a game without picturing the accompanying aesthetics and game mechanics. Consequently, the feel of the game and users’ positive experience can be created primarily with the good utilization of suitable visual game mechanics (Laakso, 2019; Chou, 2014; Deterding et al., 2011). However, gamification dynamics can also be regarded as the fulfillment of desires. Human beings have a natural drive to be noticed, compete with one another, and attain success. Game mechanics are tools that can be employed to assist in determining how to move the action and engage the players (Deterding et al., 2011).

One of the important features of the designed system is to analyze the type of user personality. Andrzej Marczewski’s *Player and User Types Hexad* (2018) was employed to analyze such (Figure 1).

<table>
<thead>
<tr>
<th>CBT Skill</th>
<th>The proposed intervention in “Sokoon” application</th>
<th>(Depression/ Stress, or/ and Anxiety) Adequacy</th>
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<tbody>
<tr>
<td>1-Relaxation</td>
<td>• Interactive activity: <em>swimming</em> in the ocean, getting coins while listening to relaxing <em>music</em>. Similarly, there can be a set of different choices like <em>nature, space, waterfall</em>…etc. A voice-over commentary notes can give the listener more relaxation.</td>
<td>Depression Stress, Anxiety</td>
</tr>
</tbody>
</table>
| 2-Gratitude                | • A gratitude garden in which an avatar touches (tree, flower…etc.) to open a game with different gratitude phrases.  
  • In addition to gratitude voice or readable notes that can represent the objects/ terms that give the user more gratitude feelings. | Depression Anxiety                            |
| 3-Self-Compassion         | • Interactive stories that give the player some morals indirectly. In the middle of the story, the player answers questions to measure his/her reactions. | Depression Stress, Anxiety                     |
| 4-Problem-Solving          | • Interactive *stories* for different problems with the ability for choosing from different choices (positive, negative)  
  • Problem-solving, puzzle games.                                                                                     | Depression, Anxiety                            |
| 5-Social Skills            | • Interactive stories with different choices in the story to learn user communication and debate skills.              | Depression Stress, Anxiety                     |
| 6-Behavior Activation      | • Provide a collection of different activities.  
  • Challenges between player and other players (future step).                                                          | Depression, Anxiety                            |
| 7-Cognitive Restructuring  | • Provide different selections about different negative topics he feels about (failure-isolation-hopeless…) and practice some relieving actions like bubble shooting or balloon hitting.  
  • Time-based positive words game.                                                                                 | Depression Stress, Anxiety                     |

Table 4. The designed interventions in the Sokoon application for each CBT Skill
Six different types of users are defined in this model: disruptor, free spirit, achiever, player, socializer, and philanthropist. RAMP, namely, relatedness, autonomy, mastery, and purpose, reward, and change (Andrzej Marczewski, 2018), motivates them.

The users’ main characteristics are as follows:

1. **Socializers**: Networking or relatedness motivates socializers who want to make social connections and engage with others.
2. **Free Spirits**: Autonomy and self-expression inspire free spirits who desire to experiment and develop.
3. **Achievers**: Power and mastery inspire achievers. They want to not only develop their awareness and evolve as individuals but also search for obstacles to solve.
4. **Philanthropists**: They are guided by a sense of purpose and meaning. They are willing to give to others and enrich their lives without expecting anything in return.
5. **Players**: Rewarding players motivates them. They will do whatever is asked of them in order to receive incentives from the system. In essence, they are only interested in themselves.
6. **Disruptors**: They are empowered by the need to improve. They endeavor to change the system in some way by employing other users, either directly or indirectly, to force positive or negative change.

The authors employed this model in our system to add more levels of personalization and use suitable gamification techniques in accordance with user character type. This can be done by using a set of questions during the game to allow the users to express their preferences. The basic gamification mechanics or dynamics are displayed in Table 5. It includes the basic design items that correspond to each game mechanic/dynamic explanation and their visual representation in Sokoon. The adequacy of that mechanic for each user type in relation to Andrzej Marczewski’s Player and User Types Hexad (2018) for each used mechanic is also listed in Table 5.

### 4. METHODS AND MATERIALS

#### 4.1 The Starting Point

The main idea is to use computer gamification techniques to treat mild and moderate DASDs. The techniques include building a set of mini-games, interactive activities, and interactive stories to empower the patients with self-training. They can also be extended to be part of psychological therapy.
4.2 Research Design

A randomized controlled trial will be conducted to discover the effectiveness of a gamification-based CBT intervention with advanced techniques applied like Hexad theory and DDA for games for depression, anxiety, and stress treatment. Participants will complete self-report measures of depression symptoms Phq-9 and measure of anxiety symptoms GAD-7 after two weeks of using Sokoon. Assessments of depression, anxiety, and stress will be conducted at baseline and at the end of the intervention. Data will be collected and analyzed to examine the effects of the intervention on depression symptoms, motivation, engagement, and treatment satisfaction.

4.2.1 Technical Methods/Approaches

The techniques suggested were to employ gamification tools provided by a Unity (2d/3d) gaming engine (Download Unity!, 2019) to build several mini-games as well as interactive activities and stories as an Android mobile application. Unity engine is primarily a cross-platform engine, which eases the conversion process to other platforms if required such as web, desktop, and IOS.

4.2.2 Behavioral Analysis

Behavioral analysis is a useful technique that enables more user engagement during gameplay. The most suitable gamification techniques are personalized in relation to the user type classification in the user profile registration step.
One of the key concerns in our research was to avoid unbalanced levels of challenges in gamification activities. Players are likely to experience boredom if activities are too easy. On the contrary, players may feel upset and anxious if games are too difficult (Figure 2).

To accomplish this, it is necessary to measure the level of the users dynamically in accordance with their actual performance in runtime and subsequently assess players’ skills to recommend suitable gamification activities and their degree of difficulty.

4.2.3 Dynamic Difficulty Adjustment (DDA) Techniques

One of the problems in many traditional games is the static difficulty of each level. In many cases, the game designers predefine the difficulty of the level regardless of the actual performance level of each player. That can make the game levels either very difficult or too easy for some players. One way to solve this problem is a technique named Dynamic Difficulty Adjustment (DDA) (Sepulveda et al., 2019). DDA is one of the primary techniques employed in behavior analysis. DDA is a technique for automatically adjusting scenarios, parameters, and behaviors in video games in real-time, based on the player’s skill and preventing boredom (when the game is too easy) or frustration (when the game is too challenging or too difficult). It can be conducted by comparing players’ current statistics to the ideal or a reference performance (first-time performance of the current level). The time duration measure can be used to evaluate players’ results (Sepulveda et al., 2019) by employing the following equations:

\[
\text{Difficulty} = \frac{N - Z}{D} \tag{1}
\]

\[
\text{Ease} = 1 - \text{Difficulty} \tag{2}
\]

where:

Figure 2. An illustration of player experience (Sepulveda et al., 2019)
• **Difficulty** refers to the current difficulty level of the current user.
• **N** refers to the performance measure (count of times to repeat) for the current user to perform an action or activity in a game.
• **Z** refers to the baseline performance measure (count of times to repeat) for the reference player. It can be calculated either:
  ◦ For the same player but for the first (Easiest) first level. The first level shall be considered a baseline of the DDA calculations in that case.
  ◦ Or for the average results of a testing sample of users.
• **D** refers to the time duration for the current user to perform their action.
• **Ease** refers to the current level of easiness of the current player.

In the original DDA technique (Sepulveda et al., 2019), if the user performs an action for N of times in a duration D period of (time, ticks, or other measuring units), with the ideal or reference value being Z, then using a value set that abides by \(0 \leq (N - Z) \leq D\) will return a normalized value. If that condition is met, then both **Difficulty** and **Ease** will have normalized values ranging from 0 to 1.

So, the first time the player completes the first level in a game, his/her performance is stored as a Z value. After that, the next time, the player retries playing the same level (or plays the next levels), the values of N and D are calculated in runtime to dynamically adjust the level. This adjustment process can be applied in three forms:

1. **Between levels**: (After the end of one level and before the start of the next level).
2. **Periodically within a level**: It can be applied periodically during gameplay of levels to dynamically update level difficulty from time to time with waiting to finish the level. The frequency of the application of the DDA algorithm, in that case, depends on the level of average completion time.
3. **At checkpoints**: This is similar to the 2nd form, but instead of using fixed time units between DDA re-calculations. It can be applied when a player reaches some locations (checkpoints) at the level, or when he/she completes a partial sub-task on the way.

Another technique called **Reference Player’s Difficulty (RPD)** can be used also to dynamically adjust level difficulty at runtime (Sepulveda et al., 2019). In the PRD technique, the user should play the first level to measure the initial value of Difficulty with the eq. 3. If the RDP >= 0.5 then the difficulty will be decreased for the user in the next level otherwise the difficulty will be increased:

\[
RDP = \frac{S1 - S2}{S1} \tag{3}
\]

where:

• S1 refer to best score for the first level.
• S2 refer to user’s score for the first level.

**Example**: If S1=30 and S2=15 then RDP is calculated as follows:

\[
RDP =
\]

Then the difficulty will be decreased in the next level for the user to increase his/her involvement. The best situation is to reach a value of 0.5 or similar for easiness, thus indicating the proposed challenge is suitable for the current user.
A third approach is to evaluate current player performance (Cp) against expected player performance at that time (Ep[t]). The latter served as our reference point. The Expected player performance can be either fixed by the game designer according to his estimation of level difficulty, or it can be based on a statistical analysis of a random sample of test players during the game release phase. In that approach, the performance of the current player is calculated according to eq. (4):

$$\text{Performance} = \frac{CP}{EP[t]} \quad (4)$$

At first, the initial design uses the default level of difficulty that was found suitable for the testing sample of users during development. Subsequently, the DDA engine of the system automatically compares the current player’s performance with the standard (reference) player’s performance. The system modifies the current level of difficulty following these results. When the performance value is almost the value of 1, the current level of difficulty is suitable for the current user’s skills.

Also, the previous techniques can be combined also to give more details about current player performance. In our proposed project, we plan to use a combination between the first approach DDA and the third approach. The main steps involved in applying the DDA technique in Sokoon are presented in Figure 3.
4.2.4 Analysis of the User’s DASD’s Severity Improvement

The second challenge of the user’s behavioral analysis is to analyze whether the proposed CBT intervention presented through Sokoon is efficient and analysis of the improvement of the DASD’s severity after applying the proposed CBT intervention presented. The user’s desire for the next therapy session is one of the most essential measurements of success for the user’s progress (Boll & www.rt.org, 2016). As a result, if the Sokoon’s user is persistent in entering and interacting, it shows that he/she accepts the intervention. This stage is accomplished by tracking:

- The number of times the user accesses the application.
- The total time the user spends during each activity.
- The score the user achieves.

4.3 Proposed Sokoon System

Seven skills required for the psychological treatment of anxiety and stress are targeted in the proposed system. As depicted in Figure 4, Sokoon is divided into five main components.

4.3.1 The System Components Include

1. User’s Profile Component represents the user features during their experience. The user features include the user id, collected points, and levels progress.
2. Personality Hexad Checker applies the theory of the user’s Hexad to determine their personality type and subsequently selects the appropriate gamification mechanics for the current user.
3. Gamification Engine Component applies the gamification rules based on user activities. This component is also responsible for rewarding user points in accordance with progress.
4. Behavior Analysis Engine (Based on the DDA algorithm) applies the behavior analysis rules – introduced in section 4.2.1 - to analyze the user profile and feedback. It subsequently updates the user profile with the progress that has been achieved after each level. This component is divided into seven sub-components, which each focus on a specific skill. Those sub-components include:
   a. skill 1- sub-component: Relaxation
   b. skill 2- sub-component: Gratitude
   c. skill 3- sub-component: Self-compassion
   d. skill 4- sub-component: Problem-solving
   e. skill 5- sub-component: Social skills

Figure 4. Block diagram of Sokoon (Design credits: Authors)
f. **skill 6- sub-component:** Behavior activation

g. **skill 7- sub-component:** Cognitive restructuring

5. Activity Presenter includes interactive graphics and multimedia elements at each level. Those assets provide an attractive interface and scenarios so that the required therapy can be applied to the user.

Each of the above skills has a set of practices and interventions experienced by an avatar. The activity presenter component selects the suitable interventions for each skill. Those intervention(s) include one or more of the following:

1. Mini game
2. Interactive activity (similar to a tutorial with a set of interactive items)
3. Interactive stories

Some skills also comprise a combination of those techniques. The system encompasses the sequence of steps depicted in Figure 5. In this flowchart, the main algorithm of *Sokoon* is presented. At the start, the system collects basic information and thereafter makes an initial analysis of the user’s type in accordance with Hexad’s theory (Andrzej Marczewski, 2018). The system displays the skills list from which the user can select, with customized gamification mechanics according to the user type classification performed. After selecting a skill, the system monitors user behavior during

![Figure 5. General flowchart of the Sokoon (Design credits: Authors)](image-url)
gameplay and offers the required awards in accordance with the user’s achievements. If the user experiences difficult activities as challenging, those activities are marked for a dynamic change of difficulty to provide the user with additional help. When the user completes the required tasks of a skill, an analysis is conducted of their behavior and progress. Accordingly, the user profile is updated.

4.4 Design of Sokoon Framework

The first two pages of the application, namely, the login pages, are portrayed in Figures 6 and 7. Users enter important data such as name and age on the first page. They are also able to choose the avatar that suits their personality and customize it as they want, which, in turn, has an important role during
the game. The personality test depicted in Figure 7 enables one to determine the player’s personality according to Andrzej Marczewski’s Player and User Types Hexad (2018).

As depicted in Figure 8, the first page of the application after the login pages comprises the seven planets: relaxation, problem-solving, activity, gratitude, self-love, pros, and social skills. The name of each planet is derived from the name of the skill it discusses. Each planet is a CBT skill that assists users to enhance their psychological state.

1. **Relaxation planet**: The planet of relaxation helps users to relax, which is of paramount importance in DASDs. It comprises a collection of activities such as a simple game in which a player swims in the sea and collects a light with relaxing music. There is also a collection of videos with...
different types of relaxing music and images such as nature, waterfalls, space, and landscapes from which users can choose. Furthermore, there are breathing exercises to assist users to relax.

2. **Activity planet:** The activity planet focuses on behavioral activation skills. Players learn the importance of staying active on this planet and becoming involved in a variety of activities that can improve mood and well-being. The planet provides a large variety of activities for users that suit their personalities.

3. **Problem-solving planet:** Problem-solving abilities are taught through a series of interactive scenarios that are relevant to young people on this planet. The game teaches basic problem-solving skills such as identifying and defining issues, creating solutions,
evaluating options, choosing solutions, implementing the action, and assessing results (Problem-Solving, n.d.).

4. **Gratitude planet**: Each time players enter the gratitude planet; they choose something for which they are grateful. Initially, they select from among a group of choices, including their mother, friend, father, sister, and brother. Subsequently, once they have chosen what they are grateful for, this is added to their garden. The planet has a large garden full of trees and roses. Each tree the user clicks on opens a simple game that allows them to search among a tree’s leaves for things for which they are grateful such as family, friends, life, and blessings.

5. **Self-love planet**: The self-love planet is concerned with the self-compassion skills. It encompasses an interactive story in which players can help others and impart advice to love and encourage themselves. In another story, players are provided with morals indirectly. In the middle of the story, players answer questions to measure their reactions.

6. **Social skills**: On this planet, players are given interactive stories that contain a challenging dialog and/or negotiation with another character in which a variety of communication skills are taught. The players, represented by their avatars, make decisions in relation to how to act in a given situation. Poor decisions result in the relationship becoming tenser and are a source of conflict. However, positive communication is the key to winning the game and progressing through the levels.

7. **Pros planet**: This planet is concerned with cognitive restructuring skills. Every day, the planet sends a notification to users with positive words. The purpose of some of the games is to help users to get rid of their negative thoughts. The users break these thoughts, which are in the form of stones and balloons, by smashing them or piercing them with arrows.

### 4.5 Implementation and Deployment

The game was developed as an Android mobile application. Although the Unity engine is the used platform, it is primarily a cross-platform engine. This eases the conversion process to other platforms if required in the future, including web, desktop, and IOS.

### 4.6 Validation and Verification Methodology

#### 4.6.1 Aim of Study

The primary purpose of this study is to evaluate the effect of implementing C-CBT based on gamification to treat mild and moderate DASDs. This includes building a set of mini-games, interactive activities, and interactive animated stories for patients with DASDs to enable them to engage in self-training as well as possibly extend this proposed intervention to psychologists.

#### 4.6.2 Experimental Design

A quasi-experimental design will be employed:

1. **Settings**: The setting will be the Faculty of Computers and Information at Mansoura University, Egypt.
2. **Subjects**: Convenience sampling will be employed to select 120 subjects. The *Epi Info*™ (2019) program with a confidence coefficient of 90% was employed to determine the size of the sample:
   a. **Inclusion Criteria**: See below:
      i. **Population**: Adolescents, and young adults between 18-35 years of age who have been diagnosed with mild-to-moderate DASDs. The Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [50] will be employed to diagnose depression. The Hamilton Depression Rating Scale (HAMD) scores (Carneiro et al., 2015) will be used to diagnose moderate depression.
ii. **Intervention:** C-CBT via the Arabic mobile application Depression Rating Scales, Fifth Edition (DSM-5) (Tolentino & Schmidt, 2018) will be used to moderate DASDs through a series of mini-games and activities that have been customized and personalized in relation to the Hexad theory’s user type classification.

b. **Exclusion Criteria:** Adolescents who have delirium, visual, or auditory deficits, spinal disorder, cognitive impairment, expected short-term mortality, and/or have been admitted to the hospital following cardiac arrest will be excluded from the study.

3. **Data Collection:** The PHQ-9 (Kroenke et al., 2001) and GAD-7 (Sousa et al., 2015) tests, which were given at pre-test and post-test, were among the data gathering tools. The number of sessions finished, the length of each session, and any technical issues encountered were all collected in-app. The program must be used by participants for a period of two weeks, and they must be able to access it from a computer or other internet-connected device.

4. **Ethical Considerations:** Ethical approval has been obtained from the ethics committee of the Faculty of Computers and Information, Mansoura University. Informed consent will be obtained from subjects who are willing to participate in the study. The confidentiality of the data will be assured.

5. **EXPERIMENTS AND RESULTS**

5.1 The Experimental Pilot Study

From Mansoura University, given in Table 6, five volunteers (one male and four females) between the ages of 18 and 35 were chosen. According to the PHQ-9 and GAD-7 tests, all participants reported mild-to-moderate symptoms of anxiety and depression. The participants had no prior history of mental illness.

The gamification-based cognitive-behavioral treatment program was explained to the participants, and they were instructed to utilize it for two weeks determined under the guidance of a psychiatrist. Prior to utilizing the application, participants underwent a pre-test assessment of anxiety and depression. Participants completed a post-test evaluation after two weeks. Data on participant involvement, app use, and technical difficulties were also gathered.

The data gathered for the study, including means and standard deviations for the pre-test and post-test scores, were analyzed using descriptive statistics. Additionally, content analysis was performed to identify recurring topics in the participant feedback.

5.2 Results

With an average daily usage time of 15 minutes, participants reported good levels of engagement with the app. Participants were 24.6 years old on average (SD = 6.06). The participants’ anxiety symptoms decreased from the pretest (M = 10, SD = .7) to the posttest (M = 4.2, SD = 1.5), as did their depressive symptoms (M = 10, SD = 2.05), posttest (M = 6, SD = 1.7).

<table>
<thead>
<tr>
<th>Users</th>
<th>Sex</th>
<th>Age</th>
<th>Depression degree</th>
<th>Anxiety degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td>F</td>
<td>21</td>
<td>Mild</td>
<td>Moderate</td>
</tr>
<tr>
<td>User2</td>
<td>M</td>
<td>35</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>User3</td>
<td>F</td>
<td>21</td>
<td>Moderate</td>
<td>Mild</td>
</tr>
<tr>
<td>User4</td>
<td>F</td>
<td>21</td>
<td>Mild</td>
<td>Moderate</td>
</tr>
<tr>
<td>User5</td>
<td>F</td>
<td>25</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
5.3 Limitations

Preliminary results indicate that Sokoon is effective in treating mild-to-moderate anxiety and depression, which indicates that more research should be conducted to obtain the maximum benefit and best results. The generalizability of the results is constrained by the limited sample size and the lack of a control group. To corroborate the early findings of this pilot study, further research should utilize a larger sample size and randomized controlled trial approach.

6. CONCLUSION AND FUTURE WORK

Because a number of young people and adolescents have suffered from DASDs recently, the design of Sokoon, a mobile application that can be employed as an intervention for Arab youth with DASDs, is discussed in this paper. In Sokoon, evidence-based C-CBT skills based on gamification are provided. Gamification plays an important role in promoting participation, commitment to treatment, and increasing psychological reinforcement. Making use of game mechanics and dynamics such as points and badges, progress tracking can be accomplished through a series of games, activities, and animated interactive stories that are personalized for each user. Although Sokoon cannot replace psychotherapists, the main purpose of the application is to assist patients with DASDs by employing mobile phones. It is believed that CBT has the potential to significantly improve the availability of effective psychological therapies for adolescents and young adults. Andrzej Marczewski’s Player and User Types Hexad (2018) is employed to determine users’ personality types and subsequently, appropriate game mechanics for each user are adapted. The DDA technique is applied in the designed mini-games to measure the level of the user dynamically in accordance with their actual performance collected during the use of the application in comparison to reference data to assess the required skills and recommend a degree of difficulty for each skill continuously.

Other components of CBT should be considered in future studies. Other CBT skills can be added to the application, which can also include a section for children who suffer from depression, anxiety, and/or stress. Furthermore, the application may obtain the geographical location in order to assess...
certain capabilities to develop various skills. While having access to evidence-based treatment has several advantages, it may have a negative influence if the application’s usage is extreme and has an adverse effect on social life. Furthermore, it is possible to include a special section for psychotherapists so they can monitor patients’ condition and provide important advice and guidance to ensure that the treatment is completed properly, thus enhancing the application’s value and effectiveness.

CONFLICT OF INTEREST

All authors declare that they have no conflicts of interest.

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N/A
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APPENDIX

A short test similar to classifying the type of user in a gamified system (Andrzej Marczewski, 2018). Each question has seven selections with seven scoring for each selection (Strongly agree (3), Agree (2), Somewhat agree (1), Neither (0), Somewhat disagree (-1), disagree (-2), Strongly disagree (-3)).

1) It makes me happy if I am able to help others
2) I see myself as a rebel.
3) I often let my curiosity guide me.
4) I like to try new things.
5) Rewards are a great way to motivate me
6) I dislike following rules.
7) It is important to me to follow my own path.
8) It is important to me to always carry out my tasks completely
9) The wellbeing of others is important to me.
10) It is important to me to feel like I am part of a community.
11) I like overcoming obstacles.
12) It is difficult for me to let go of a problem before I have found a solution
13) Being independent is important to me.
14) I like helping others to orient themselves in new situations.
15) I enjoy group activities.
16) If the reward is enough I will put in the effort.
17) Return on investment is important to me.
18) I like to question the status quo.
19) Interacting with others is important to me.
20) I like mastering difficult tasks
21) I like competitions where a prize can be won.
22) I like to provoke
23) I like sharing my knowledge.
24) I like being part of a team
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