Research Article

A Chatbot System for Mental Healthcare Based on SAT Counseling Method

Takeshi Kamita [ID],[1] **Tatsuya Ito,**[1] **Atsuko Matsumoto,**[2] **Tsunetsugu Munakata,**[3] **and Tomoo Inoue** [ID][4]

[1]*Graduate School of Library, Information and Media Studies, University of Tsukuba, Tsukuba, Japan*
[2]*Graduate School of Comprehensive Human Science, University of Tsukuba, Tsukuba, Japan*
[3]*SDS Corporation, Icikawa, Japan*
[4]*Faculty of Library, Information and Media Science, University of Tsukuba, Tsukuba, Japan*

Correspondence should be addressed to Takeshi Kamita; s1730527@s.tsukuba.ac.jp and Tomoo Inoue; inoue@slis.tsukuba.ac.jp

In recent years, mental health management of employees in companies has become increasingly important. As the number of psychotherapists is not enough, it is necessary for employees to be able to keep their mental wellness on their own. A self-guided mental healthcare course using VR devices has been developed, and its stress reduction effect has been validated previously. This study proposes a new version of the course using smartphones and chatbots to enhance its convenience for use and to maintain user motivation for daily and repeated use. The effects of stress reduction and motivation maintenance were acknowledged.

1. Introduction

Research of online courses on mental healthcare has become active, as the importance of keeping good mental health has been widely recognized. Keeping employees' good mental health in companies has even been legislated recently in Japan. This resulted in sudden increase of the number of potential clients for mental counseling most of whom are not in sick, whereas the number of psychological experts or counselors who usually carry out counseling does not increase. To cope with this issue, it is in high demand to provide the means to take care of their mental health by themselves and to utilize the data of employees' mental health for more effective collaborative support by experts.

In order to realize such means, firstly, Kamita et al. [1–3] started to have converted the SAT (structured association technique) counseling method [4] into a digital content and developed a self-guided mental healthcare system with wearing a VR (Virtual Reality) head-mounted display (HMD) and eventually obtained good stress relief evaluation.

However, when using VR in a company, it is assumed that a dedicated HMD will be installed in a shared location, such as a healthcare room or relaxation room. Due to the limited location available, it was impossible for employees to use anytime when they wanted to reduce their daily stress or solve problems, and there were problems in their practicability. In the SAT method of therapy, visual stimulation with images encourages intuitive associations and inspiration, and the effect is established by frequent stimulation with repeated viewing of the images [5, 6]. Continuous use of the self-guided mental healthcare course is important, but motivation to promote the use of course for employees who do not necessarily actively engage in self-care is a challenge.

Therefore, we propose a self-mental healthcare course using chatbot (Chatbot course) on LINE, a SNS platform that is commonly used as a communication tool using a widely used smartphone terminal from the viewpoint of practicality and motivation. In this study, we conducted a comparative intervention experiment with the Chatbot course and non-chatbot course built as web contents (Web course) to investigate the efficacy of chatbot in a self-guided mental

healthcare course from the two perspectives of whether the Chatbot course performed on a smartphone without the use of VR would also have a stress reduction effect and whether chatbot induction would enhance user motivation.

2. Related Works

2.1. Use of a Smart Phone for Mental Healthcare. In recent years, research studies have been conducted to apply psychotherapy to digital contents and use them with mobile devices as a complementary tool for treatment and counseling, or a training tool. Research studies on one of the major psychotherapy, cognitive behavioral therapy (CBT), have especially progressed [7–9], and there are many commercially available mobile applications [10]. In the CBT session, the counselor modifies the negative cognitive distortion of the client through dialogue with the client to encourage positive thinking and behavioral change. After the session, clients are given a home work called the diary or column method in which they write their daily thoughts and the counselor analyzes them in the next session for use in therapy. The CBT application is mainly digital content of this homework part and does not cover the entire CBT process. Therefore, it is hard for users to realize effect of stress reduction or stress problem solving in one-time use. While it may be an effective auxiliary tool for professional support, in case of using as a self-guided tool, users are required to be fully aware of the program and to maintain a high level of motivation to continue using it.

The cognitive bias modification (CBM) approach has attracted attention as a counseling technique, mainly in Europe and the United States, and is being used extensively in research and psychology [11]. Cognitive bias refers to the assumption that people with high levels of anxiety or depression are more likely to negatively interpret vague information that can be interpreted positively or negatively. CBM-supported smartphone applications include Mood Mint, a training tool to reduce anxiety and depression [12]. In the Mood Mint, a screen displays a smile and three negative faces, all four of which are scored by immediately tapping the smile. Repeated implementation may increase the speed of response to positive images and reduce the focus on events with negative cognition. However, one-time use of Mood Mint is not intended to reduce stress or solve problems, so the user will continue to train repeatedly without knowing the stress-reducing effect. As with CBT applications, users themselves are required to maintain motivation. Mood Mint uses a system to provide point incentives for the token economy [13] as a method to encourage its use.

Mindfulness stress reduction using meditation (MBSR) and mindfulness cognitive therapy (MBCT) are also increasingly used in research and psychological clinics in Europe and the United States [14, 15] and are widespread in Japan [16]. In the United States, changes in brain function were measured after 8 weeks of meditation, confirming the effectiveness of meditation [17]. MBSR refers to the "state of focus here," which is conducted in groups and individuals in combination with sedative meditation, walking meditation,

and breathing techniques. Research and development on digital content of meditation has been advanced [18], and "Headspace" [19] is available in the smartphone application. In this application, courses are provided for each purpose, such as anxiety and depression, and the user performs 10 to 30 10-minute sessions per course in accordance with voice guidance. However, because some of the functions of therapy are implemented, and the main objective is to guide meditation, a single practice is not implemented with a sense of the effectiveness of stress reduction or problem solving. Thus, as with CBT and CBM applications, users themselves need to maintain high motivation. Some studies have found that meditation poses a risk of increasing discomfort and pain [20], and some aspects of the study aim require careful handling as a self-care tool.

2.2. Mental Healthcare Using a Chatbot. Chatbot, a program that automatically talks through texts and voices, has been developed since ELIZA [21] was developed in 1966.

In 2016, the development environment was opened as a messaging function of two social networking service platforms, Facebook ("Facebook" is a registered trademark of Facebook, Inc.) [22] and LINE [23], which enabled us to offer chatbots through SNS.

Chatbots in the field of mental health care have been developed to support interpersonal skills as a training component of a depression treatment program rather than therapy [24]. In addition, chatbots specialized to cope with stress problems have been also studied. Based on the Perceptual Control Theory, a self-help program MYLO in the form of a chatbot has been developed. In comparison with ELIZA on MLYO effectiveness, MYLO and ELIZA led to relief of pain, depression, anxiety, and stress and MYLO was thought to be more useful for problem solving [25].

Besides that, an automatic conversational chatbot "Woebot" using Facebook messenger has been developed based on CBT [26]. As a result of an evaluation experiment using "Woebot" for college students, it was found that the participants' depressive symptoms were significantly reduced. They commented that using "Woebot" was more receptive than traditional therapies. However, same as the CBT application mentioned above, Woebot does not cover the whole process of CBT but mainly provides programs of psychoeducation for stress coping. Users are required to maintain their motivation for a certain period of time before the achievement can be realized.

This study aims to realize a self-guided mental healthcare tool that assumes the use of a large number of employees with varying degrees of motivation to self-care. This program is to provide self-care measure when experiencing stress, to realize the effectiveness of stress reduction even in one-time use, and to realize a tool that can be used continuously to solve stress problems on a daily basis.

3. SAT Method

3.1. Overview of SAT Method. The SAT method is an interview-style counseling and therapy techniques developed

by Munakata [4]. Unlike conventional counseling technique, which uses language stimuli obtained through dialogue with a counselor to act on thoughts, the SAT uses visual stimuli obtained by viewing image images to quickly identify unrecognized real feelings and desires by functioning associations, inspiration, and intuition. The SAT method consists of several techniques. Techniques to clarify the problem and characteristics of the client and to motivate the client to solve the problem include temperament coaching method, health coaching method, and emotional clarification method to clarify intrinsic emotional needs. Techniques for reducing stress and solving problems include SAT imagery method, which consists of emotional stabilization therapy, behavioral modification therapy, problem solving therapy and so on. The counselor reviews the client's main complaint, stress conditions, psychologic characteristics, and progress and effectiveness of counseling, selecting and administering appropriate techniques. We developed a digital-content technique using the emotional stabilization therapy.

3.2. Emotional Stabilization Therapy. The emotional stabilization therapy is a technique that can be used to reduce or solve daily stress problems, such as current problems, problems in the past, and alleviate physical symptoms, and can be administered for oneself if trained during counseling or by a training seminar. The counselor throws structured questions (Table 1) to the client, who then replies or enhances his or her image in his or her mind, and proceeds with the treatment. First, the person should be reminded of a stress situation, and aversive feelings associated with discomfort may trigger the sensation of discomfort by the body, such as a stomach stick or chest stuffiness. This is followed by focusing attention on body discomfort and providing an image of mild warm lights printed on paper media (Figure 1), which allows the client to select a comfortable image and to recall an image of the light that is surrounded and healed by the body discomfort (the light imaging method) [5]. In addition, a list of smile face images that symbolize joy is presented, allowing the client to select the images that the client likes, and to recall the sense of security and safety that the client enjoys and protects. Hence, self-affirmation and stress reduction can be achieved by encouraging the client to recognize his or her own persistence and captivity, changing his or her sense of perception to change the meaning and interpretation of the problem, and allowing the client to anticipate a constructive outlook for solving the problem (the surrogate representation imaging method) [5].

4. Digital-SAT Method

In the emotional stabilization therapy, the counselor checks the treatment effect from conversation with the client, color of face, gestures, etc., asks the client condition, induces eye closure, and returns to the previous procedure if the effect is judged to be insufficient. The digital-SAT method enables the self-guided mental healthcare based on the SAT method without the guidance of the counselor using the system. In the digital-SAT method, original questions for the emotional stabilization therapy were subdivided to provide one question at a time, and

the questionnaire was simplified (Table 1). The Chatbot course based on this digital-SAT method was developed.

4.1. Structure of Digital-SAT Method. Based on the structure of the SAT method, the composition and procedures of the digital-SAT method are classified into three categories: (1) to clarify the problem and characteristics of the client and to motivate the client to solve the problem (assessment part), (2) to reduce stress and solve problems (solution part), and (3) to learn psychological knowledge for maintaining mental wellness and increasing resilience against mental disorder (learning part). In this study, we deal with assessment part and solution part.

4.1.1. Assessment Part. In the assessment part, a mental characteristic check test (Table 2) is conducted, using the SAT six psychological scale to measure the mental condition and characteristics and record the changes before and after the use of the course.

4.1.2. Solution Part. The solution part follows the digital-SAT method questions in Table 1. First, the stress currently held (Q.1-1, 2, and 3) is recalled, and the aversion to the stress is illustrated by color and shape (Q.2-1, 2), which stimulates perception of body discomfort and is clearly visualized by concrete numerical images of the degree of stress (Q.3-1, 2, and 3). Next, the physical discomfort is relieved by using light images (Q.4-1 and 2), and a smile face image is used to foster a sense of security and safety (Q.5-1 and 2), and stress levels are reduced (Q.6-1). Subsequently, conditions with reduced stress responses can provide positive personality images and encourage the perception that different ways to catch stress problems are encountered (Q.7-1, 2, and 3). In addition, by choosing one of the most worrisome smile face images and imagining messages that the person with the smile face gives to user's self, the user can remember the words the user needs in the context of stress (Q.8-1 and 2) and finally, confirm and terminate the extent to which the initial stress problem was encountered (Q.9-1, 2, and 3).

5. Implementation of the Chatbot Course

In the conventional self-mental care method, withdrawal of users is the biggest problem [35, 36]. Even in the SAT method, frequent stimulation of smile face images can improve the mental health improvement effect and the practice of course repeating is important. To solve this problem, we devised the Chatbot course using a chatbot with conversational guidance. In this research, we adopted LINE which is widely used as a chat tool in Japan and developed a self-mental care system for practicing the Chatbot course.

5.1. System Configuration. Figure 2 shows the configuration of this system. The numbers in the figure show the flow of data processing. As a chat tool, we provide a chatbot service on the LINE application of the most popular SNS service in Japan. A chatbot application server is built on a commercial HEROKU ("Heroku" is a registered trademark of Heroku, Inc.) server

TABLE 1: Question items comparison defined in SAT and Digital-SAT.

Q.	SAT	Q.	Digital-SAT
1	Do you have any problems that you would like to solve with your current stress problem? (If unanticipated, chose one item from the stress source checklist) Which of the following is to be taken up this time?	1-1	Remember that you feel stressed now
		1-2	What is it (select from the stress source checklist)?
		1-3	What are the stresses? (5-point scale)
2	Please close your eyes and think the stress problem. If you represent an aversive image or feeling of the stress in color and shape, which color do you image? Red, brown, or black etc.? Which is its shape, such as square, sharp, etc..?	2-1	Please close your eyes and think the stress problem. If you represent an aversive image or feeling of the stress in color, which color do you select? (Select from options)
		2-1	If you represent an aversive image or feeling of the stress in shape, which shape do you select? (Select from options)
3	Please image something with the selected color and shape and tell me at which your body part you feel the body discomfort, "head, face, throat, etc.", and how you feel around the body part, "heavy, painful, choked, etc.". And tell me the level of stress caused by the body discomfort. Please answer by percentage between 0% and 100%	3-1	When you image something with the selected color and shape, which your body part you feel the body discomfort? (Chose from options)
		3-2	How do you feel around the body part? (Chose from options)
		3-3	How much is your stress level by percentage? (Select from options from 0% to 100%)
4	(Show a list of light images) which light image may make your body discomfort relaxed and decrease your stress level to 0%? Please answer with inspiration. You can select images as many as you want	4-1	Which color may make your body discomfort relaxed? (Select from options)
		4-2	When you are covered by the color, how many percentages will be? (Chose from options)
5	(Show a list of smile face images) when you look at the smile face images list, while looking at the selected light image, which face are coming into your eyes or do you think you like? Once you're looking at all smile faces (if the client cannot select it, change your word, for example, "which face does you make warm or bright?")	5-1	Select smile face images which are coming into your eyes or you think you like. (Chose from options)
		5-2	How do you feel surrounded by the selected people? Are you healed or relaxed? If your feeling does not change, please change the images
6	If you look at the selected smile face images, how many percentages will the level of your stress be reduced? If the percentage become 0%, you adopt the images. (If the percentage does not reach 0%, ask the client to repeat Q4-Q5 on the remaining percentage to achieve 0%.)	6-1	How many percentages will the level of you stress be reduced? (Select from options from 0% to 100%)
7	If you look at all the smile face images you found here, what type of personality can you imagine yourself? Big-hearted? Bright? Positive? If you have such personalities, what kind of behavior do you do in the stress situation? What would you expect results of the coping? (Free answer)	7-1	When you look at these smile face images, what type of personality can you imagine yourself? (Select from options)
		7-2	If you have such personalities, what kind of behavior do you do in the stress situation?
		7-3	If you do such a behavior, is it likely work?
8	Which is the best one of you selected face images? If you look at the one, what messages is the person likely to give you? (Free answers)?	8-1	Which is the best one of you selected face images?
		8-2	What messages is the person likely to give you?
9	If you look at all the smile face images that you found here, how does your feeling to the stress problem first thought become? If the client can select "unworried," "comfortable," "happy," etc., the therapy is completed	9-1	When you look at all the smile face images that you found here, how does your feeling to the stress problem first thought change? (Select from options)
		9-2	When you were covered by the light image, your stress percentage is xx %. How about now? (Select from options from 0% to 100%)
		9-3	How much does your stress level become? (5-point scale)

[37], and LINE server is provided by LINE. And, the Messaging API [38] program provided by LINE is used for servers' linkage. The Messaging API is an application programming interface that allows data to be exchanged between the chatbot application server and the sending and receiving server of LINE.

5.2. Start Screen. The user adds the LINE @ account of the chatbot. Select the added chatbot from the list on LINE's "Friends" screen and press the "Talk" button on the next screen to display the start screen (Figure 3). The function menu at the bottom of the screen has three buttons, "Start," "Questionnaire," and "Help". Click "Start" to start the course. When "Questionnaire" is pushed, it transits to the web page screen (Figure 4) of the mental characteristic check test of the assessment part.

5.3. Assessment Part. The limitations of the features that can be implemented on the chat screen preclude, for example, the ability to select from a list of multiple options and images. The mental characteristics check test used by the Assessment part consists of 80 questions and is created on

FIGURE 1: The list of images in printed form used in the SAT method.

TABLE 2: Mental characteristic check test.

Scale	Contents	Score range (SAT criteria)
Self-esteem (Rosenberg 1965, Japanese version-Munakata et al., 1997) [27, 28]	The degree to which a person has a good or positive image for self. Higher self-esteem is more likely to be able to cope with stress and less likely to cause anxiety or depression	0–10 (0–6 lower/7, 8 mid/9, 10 higher)
State-trait anxiety inventory (STAI) (Spilberger 1970, Japanese version-Mizuguchi et al, 1982) [29]	The tendency to become anxious, not state anxiety that varies over time, but a vague degree of anxiety that reflects an individual's past experience	20–80 (20–31 lower/32–34 mid/35–41 higher/42–80 much higher)
Self-rating depression (SDS) (Zung 1965, Japanese version–Fukuda et al 1973) [30, 31]	The depressive symptoms in mood, appetite, and sleep	20–80 (20–35 non/36–48 lower/49–68 higher, 69–80 painful)
Health counseling needs (Munakata, 1999) [32]	Whether or not the response to stress manifested in the mind, body, or behavior, and to the extent.	0–20 (0–6 lower/7–10 mid/11–20 higher)
Self-repression behavioral trait (Munakata, 1996) [33]	The behavioral characteristics that suppress one's own feelings and thoughts	0–20 (0–6 lower/7–10 average/11–14 slightly higher/15–20 higher)
Difficulty in recognizing emotions (Munakata, 2001) [34]	The tendency to avoid feeling of one's own feelings, either subjectively or involuntarily Higher scores tend to accumulate stress and become chronic with physical symptoms even if they are not aware of them	0–20 (0–5 lower/6–8 higher/9–20 much higher)

the web page (Figure 4). When the user pressed the button with the URL link on the chat screen, the user moved to the test page and when the test was completed, the end button at the top of the screen was pressed to return to the chat screen.

5.4. Solution Part. The Solution part, along with the question procedure in Table 1, will provide the user with a series of questionnaires by a chatbot, and the user will be free-written or answered by choice (Figure 5). Following the user's response, the next question will be automatically presented, and a chatbot will induce progression. Images such as light image (Table 1, Q.4-2) and smile face image (Q.5-2) were viewed, and the selected image was displayed as large as

possible on the screen in a scene where good image was obtained (Figure 6). Since the list of options that can be displayed on the chat screen is restricted to characters (Figure 5), the image selection scenes of Q.2-1 (aversive image selection), Q.2-2 (aversive image selection), Q.4-1 (light image selection), and Q.5-1 (smile face image selection) that need to be selected from the image list were moved from the chat screen (Figure 7) to the Web page (Figure 8).

6. Experiment

A comparative experiment was conducted to assess the stress reduction effect by using the Chatbot course with
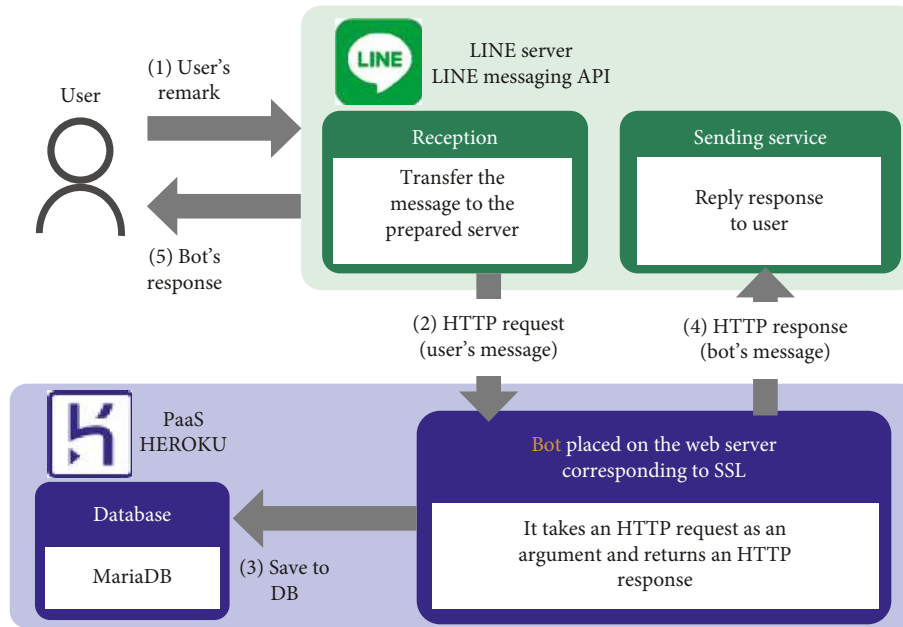
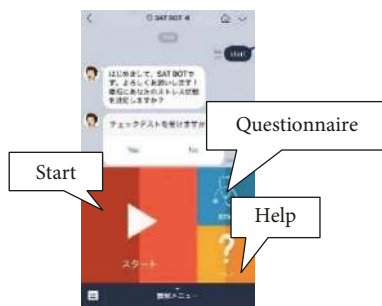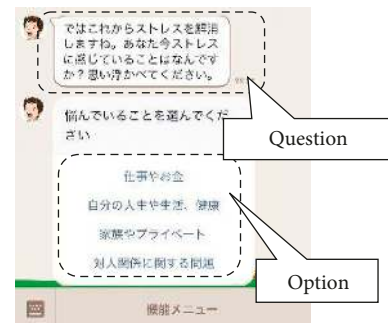Figure 2: System architecture.

Figure 3: Start screen.

Figure 5: Scene of question and selection.

Figure 4: Page of check test.

Figure 6: Scene of selected images viewing.

smartphones and the motivation to the courses and investigate the effectiveness of chatbot in the self-guided mental healthcare course. A control group will use another self-guided mental healthcare course built by web pages without a chatbot (Web course). The Web course was also conducted using smartphones to control experimental conditions.

This experiment was carried out with the approval of the ethics review committee in Faculty of Library Information

and Media Science, University of Tsukuba (Notification No. 29-137).

6.1. Web Course.
According to the digital-SAT method procedure (Table 1), the Web course was implemented on web pages to be the same as page configuration of the Chatbot course consisting of the scene of question and selection and the scene of selected images viewing. In implementing a Web course, the start page is displayed when the user starts the Web browser and logs in on the login page

Figure 7: Scene of image selection.

Figure 8: Page of image list.

Figure 9: Scene of question and selection for Web course.

Figure 10: Scene of image viewing for Web course.

using the ID and password. Click Menu on this page to move to the Assessment or Solution part page. The Assessment part used the same check test page as the Chatbot Course (Figure 4). According to the digital-SAT procedure, the Solutions part implements and displays the situations of questions/choices (Figure 9, corresponding to Figure 5) and image viewing (Figure 10, corresponding to Figure 6) on each page.

The difference between the two courses is that when a user reads a question sentence presented by the blow out of the chat, responds and selects, the order is automatically displayed with the next blow and the development of the scene proceeds, while the Web course is developed by the user reading the question text at the top of the screen, depressing the option button (Figure 9), and then pressing the "Next" button at the bottom of the screen and sending the page (Figure 10).

6.2. Procedure. Twenty-seven college students were selected as participants and randomly assigned to two groups, the Chatbot course and the Web course (Chatbot course: $N = 15$, male 6, female 9, name, average age 24.80 years, SD = 1.57, Web course: $N = 12$, male 6, female 6, average age 25.33 years, SD = 3.37). The experiment was conducted in accordance with following procedure:

(1) Explanation of this study (10 min)

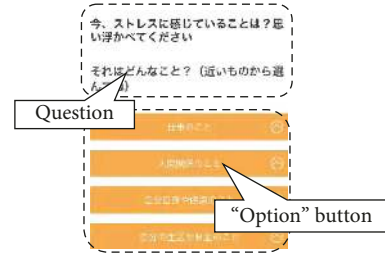(2) Survey of stress condition by the mental characteristics test on web page (15 min)

(3) Explanation of the SAT methodology and the way of using the course (30 min)

(4) Implementation of the course (10 min)

(5) Survey of stress condition by the mental characteristics test and motivation to use the course by a questionnaire of TAM model (see Section 6.3) (20 min)

6.3. Measurement. The stress reduction effect was evaluated using the stress characteristic check test consisting of SAT psychological scales (Table 2), and the user's motivation to use the course (the effect of improving the motivation to use) was evaluated using a questionnaire created based on the technology acceptance model (TAM) which is a human behavior model that predicts and explains the usage behavior of the information system (7 levels of the Likert scale) [39]. In this model, perceived usefulness (PU), perceived ease of use (PEOU), attitude toward using (AU), and behavioral intention to use (BI) as factor leading to user's system use are measured for user's motivation.

Regarding to the obtained data, the difference in the score of the mental characteristics check test before the course between the two groups was tested by the Mann–Whitney's U test at 5% significance level. The difference in the score of the mental characteristics check test between before and after the course in each group was tested by Wilcoxon's signed-rank test at 5% significance level. And then, the difference in the score of the Likert scale of the question included in each factor of questionnaire created based on TAM was tested by Mann–Whitney's U test at 5%

significance level. Python's SciPy package was used for analysis. All tests used two-tailed measurements. Nonparametric tests were used to perform all tests with a small number of samples.

7. Result

First, we performed Mann–Whitney's U test to determine whether there were differences in stress condition before the course between the two groups (Table 3). No significant difference was found in any of the scale scores. It was found that there was a significant difference in the score changes of self-esteem, STAI, and SDS in the Chatbot course (self-esteem: $p = 0.024$, STAI: $p = 0.038$, SDS: $p = 0.043$).

Regarding the score of the questionnaire based on the TAM model, the average scores for all scores in the Chatbot course were higher than the Web course (Table 4). The result of the Mann–Whitney's U test on the scores showed that there was a significant difference in the score of PEOU ($p = 0.030$) and BI ($p = 0.027$) and a significant trend in the score of PU.

8. Discussion

First, it was confirmed that there was no significant difference between the Chatbot course group and the Web course group in the six scale scores before the course was implemented and that the group was not a group with different stress characteristics. The two groups are then compared.

According to the evaluation criteria of the SAT method (Table 2), the self-esteem score in the Chatbot course group before the course is in the "lower" level and STAI score is in the "much higher" level. In the interpretation of the SAT method, the low self-esteem and the inability to positively evaluate oneself predispose people to anxiety, even if problems arise in front of the eyes, because they are unable to tackle positively and are unable to make prospects. Continued high anxiety is associated with increased depression and higher SDS scores, but the SDS score of the group is in the "middle" level and does not lead to severe depression. In addition, the score for health counseling necessity, which indicates whether a stress response is manifested by physical illness or addictive behaviors, is also in the "middle" level and is not an increasingly serious condition. However, the self-repression behavioral trait of the index of stress personality tendency, which causes stress, is close to the "slightly higher" level and the difficulty in recognizing emotions is also in the "middle" level. Therefore, if the anxiety continues, it is a group in which the physical and mental distress caused by stress may become manifest. The Chatbot course significantly improved self-esteem, STAI, and SDS scores and improved self-esteem and STAI rating levels and confirmed the stress reduction effect. Improvements in these indicators are justified by the interpretation of the SAT method because of improved self-esteem, reduced anxiety, and decreased depression.

Self-esteem, STAI, and SDS scores are indicators of the state of stress and are relatively variable depending on the contemporary state. On the other hand, self-repression behavioral trait and difficulty in recognizing emotions are less variable than the above-mentioned three scales as representations of stress-producing personality traits. In the clinical setting of the SAT method, improvement of these indicators is one of the objectives of modifying the perception of stress, resolving problems, and increasing stress tolerance. Although the mean scores for self-repression behavioral trait and difficulty in recognizing emotions in the Chatbot course group decreased, no significant difference was found and no improvement was seen as the criteria changed. A latest survey using our VR course confirmed improvements to the deeper characteristics of stress traits such as self-repression behavioral trait and difficulty in recognizing emotions other than self-esteem, STAI, and SDS. In the Chatbot course, no significant difference in the effect on the stress personality trait could be confirmed, so it can be said that all improvements have been made. Alternatively, this could be a limitation of the Chatbot course performed on a small smartphone 2D screen.

Regarding the evaluation of the motivation to use the system by TAM, PEOU and BI were higher in the Chatbot course than in the Web course. In PEOU's "It's easy to learn to use this system," "I think it is easy to master this system," "I think it is easy to use this system" 3 total points and BI's "I will use this system in the near future," "I believe that the interest in this system will increase in the future," "Recommend to use this system for others" 3 total points, a significant difference was observed at the total points of the two question items. In addition, a significant trend was seen at the total point of the five question items of PU. These results suggest that Chatbot course may be more motivated than the Web course. In the Web course, although the same self-SAT procedure was implemented, no significant differences were found for any scale. Taken together, Chatbot's support suggests that motivation to use could be focused on the care process itself and exerted a stress-reducing effect. Given the importance of focusing on the care process itself, it may be substantiated that the intrusive view of the VR course produced higher levels of concentration and had a higher stress reduction effect.

Compared with VR, a smartphone-based Chatbot coarse offers considerable convenience and has the advantage of inducing Chatbot that allows users to guide self-care without being aware of it. This is a useful training tool. Some users who are familiar with this method may prefer to be able to perform it at their own pace, do not need Chatbot guidance, and may find it easier to use the Web course. In our other recent survey, a significant reduction in the STAI scale has been confirmed with the 2-week implementation of the Web course. It is possible to use VR to deepen the sense and understanding of its effectiveness, and then to repeat training in the Chatbot course and the Web course.

Future research firstly aims to develop tools that will be more effective by deepening research on how to use and combine tools. Further, the system, gathering data through

TABLE 3: Stress characteristic check scores before and after using the courses (Chatbot course: $N = 15$; Web course: $N = 12$).

Scale	Chatbot course average ± SD	Web course average ± SD	p value[1]
Self-esteem			
Before	6.93 ± 2.76	6.00 ± 3.07	0.208
After	8.00 ± 2.17	6.42 ± 3.50	
p value[2]	0.024*	0.314	
State-trait anxiety inventory (STAI)			
Before	45.33 ± 8.14	45.83 ± 12.68	0.480
After	40.80 ± 8.28	40.33 ± 12.81	
p value[2]	0.038*	0.245	
Self-rating depression scale (SDS)			
Before	41.07 ± 9.54	47.42 ± 13.27	0.106
After	37.73 ± 8.14	45.33 ± 16.76	
p value[2]	0.043*	0.193	
Health counseling necessity			
Before	7.00 ± 3.74	7.92 ± 4.36	0.304
After	5.80 ± 3.43	7.58 ± 4.32	
p value[2]	0.192	0.856	
Self-repression behavioral trait			
Before	10.40 ± 2.32	9.92 ± 3.87	0.199
After	10.27 ± 2.55	8.92 ± 3.87	
p value[2]	0.875	0.465	
Difficulty in recognizing emotions			
Before	8.60 ± 3.87	8.17 ± 4.26	0.432
After	7.40 ± 3.44	8.50 ± 3.99	
p value[2]	0.102	0.758	

[1]Mann–Whitney's U test for difference in score between groups ($*p < 0.05$). [2]Wilcoxon's signed-rank test for score change in each group ($*p < 0.05$).

TABLE 4: The score of the questionnaire based on the TAM model (Chatbot course: $N = 15$; Web course: $N = 12$).

Scale	Average ± SD	p
PU (perceived usefulness)		
Chatbot course	24.73 ± 6.09	0.078[†]
Web course	21.92 ± 4.89	
PEOU (perceived ease of use)		
Chatbot course	18.53 ± 2.92	0.030*
Web course	17.33 ± 1.44	
AU (attitude toward using)		
Chatbot course	21.27 ± 5.06	0.140
Web course	19.50 ± 3.75	
BI (behavioral intention to use)		
Chatbot course	16.00 ± 3.09	0.027*
Web course	13.25 ± 3.44	

Mann–Whitney's U test: $^{†}p < 0.1$; $*p < 0.05$.

using these tools and providing actual mental health condition of users to specialists, such as industrial doctors or counselors, for collaborative support, could be developed in the next stage. In addition, it should be mentioned that people who can use these courses are limited to users who can use SNS and smartphones.

As a limitation of the study, the number of participants in this study was small and further research with a bigger sample is needed on the effectiveness of the course in reducing stress. And, above all, the assessment was conducted once to determine motivation to use and continuity and not to verify whether or not the course was actually used continuously. Future studies should include an increase in the number of participants and a survey on the continued use of the course over a period of time.

9. Conclusion

In this study, the SAT method was converted to digital contents; a self-guided mental healthcare course and a system using a chatbot were developed, and a comparative evaluation experiment was conducted with a Web course without a chatbot as a control group. The results of the experiment show the possibility that the use of the chatbot enhances user's motivation and supports to reduce stress and is effective in the self-guided mental healthcare course. However, the sample of users in this study is small, and the user's motivation and stress reduction effect were evaluated based on one-time use of the course. Future studies should include an increase in the number of participants and a survey on the continued use of the course over a period of time.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Disclosure

This manuscript is an extended version of the paper presented at the 2018 International Workshop on Collaborative Technologies and Data Science in Smart City Applications.
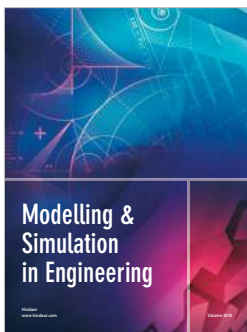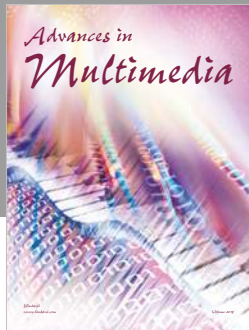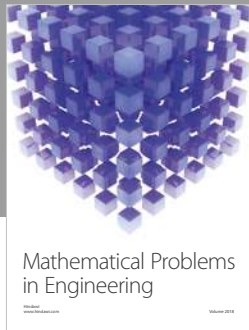
Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] T. Kamita, A. Matsumoto, T. Munakata, and T. Inoue, "Realization of self-guided mental healthcare through the digital content based on the counseling technique SAT method," *IPSJ Transactions on Digital Content*, vol. 6, no. 2, pp. 32–41, 2018.

[2] T. Ito, T. Kamita, A. Matsumoto, T. Munakata, and T. Inoue, "Virtual reality course based on the SAT counseling method for self-guided mental healthcare," in *Proceedings of 2018 IEEE International Conference on healthcare Informatics (ICHI)*, pp. 299–306, New York City, NY, USA, June 2018.

[3] T. Ito et al., "A self-guided mental healthcare digital content for smartphone VR based on the counseling technique SAT method," *IPSJ SIG Technical Report*, vol. 2018, no. 37, pp. 1–8, 2018.

[4] T. Munakata, *SAT Therapy*, Kanekoshobo, Tokyo, Japan, 2006.

[5] T. Munakata, "The applicability of the simple edition of SAT method in promoting universal health," *Journal of Health Counseling*, vol. 17, pp. 1–12, 2011.

[6] T. Munakata, "Does SAT Re-scripting expression imagery enable us to overcome unendurable hardships toward true life career?," *Journal of Health Counseling*, vol. 15, pp. 1–12, 2009.

[7] P. J. Batterham, A. L. Calear, L. Farrer, S. M. McCallum, and V. W. S. Cheng, "FitMindKit: randomised controlled trial of an automatically tailored online program for mood, anxiety, substance use and suicidality," *Internet Interventions*, vol. 12, pp. 91–99, 2018.

[8] K. H. Ly, E. Janni, R. Wrede et al., "Experiences of a guided smartphone-based behavioral activation therapy for depression: a qualitative study," *Internet Interventions*, vol. 2, no. 1, pp. 60–68, 2015.

[9] D. Bakker and N. Rickard, "Engagement in mobile phone app for self-monitoring of emotional wellbeing predicts changes in mental health: MoodPrism," *Journal of Affective Disorders*, vol. 227, pp. 432–442, 2018.

[10] J. Torous, D. K. Levin, M. L. Ahern, and M. L. Oser, "Cognitive behavioral mobile applications: clinical studies, marketplace overview, and research agenda," *Cognitive and Behavioral Practice*, vol. 24, no. 2, pp. 215–225, 2017.

[11] Y. Hakamada and H. Tagaya, "Cognitive biases in anxiety and depression: emergence of cognitive bias modification approach," *Japanese journal of biological psychiatry*, vol. 22, no. 4, pp. 277–295, 2011.

[12] "Mood Mint," December 2018, http://www.biasmodification.com/.

[13] F. B. Dickerson, W. N. Tenhula, and L. D. Green-Paden, "The token economy for schizophrenia: review of the literature and recommendations for future research," *Schizophrenia Research*, vol. 75, no. 2-3, pp. 405–416, 2005.

[14] -Z. Jon Kabat, "An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: theoretical considerations and preliminary results," *General Hospital Psychiatry*, vol. 4, no. 1, pp. 33–47, 1982.

[15] R. A. Gotink, P. Chu, J. J. V. Busschbach et al., "Standardised mindfulness-based interventions in healthcare: an overview of systematic reviews and meta-analyses of RCTs," *PLoS One*, vol. 10, no. 4, 2015.

[16] Y. Kimura, "Literature review of mindfulness training," *Doshisha Women's College of Liberal Arts Annual Reports of Studies*, vol. 67, pp. 79–82, 2016.

[17] R. A. Gotink, R. Meijboom, M. W. Vernooij, M. Smits, and M. G. M. Hunink, "8-week Mindfulness Based Stress Reduction induces brain changes similar to traditional long-term meditation practice-a systematic review," *Brain and Cognition*, vol. 108, pp. 32–41, 2016.

[18] I. H. Bennike, A. Wieghorst, and U. Kirk, "Online-based mindfulness training reduces behavioral markers of mind wandering," *Journal of Cognitive Enhancement*, vol. 1, no. 2, pp. 172–181, 2017.

[19] "Headspace," December 2018, https://www.headspace.com/.

[20] J. R. Lindahl, N. E. Fisher, D. J. Cooper, R. K. Rosen, and W. B. Britton, "The varieties of contemplative experience: a mixed-methods study of meditation-related challenges in Western Buddhists," *PLoS One*, vol. 12, no. 5, Article ID e0176239, 2017.

[21] J. Weizenbaum, "ELIZA: a computer program for the study of natural language communication between man and machine," *Communications of the ACM*, vol. 9, no. 1, pp. 36–45, 1966.

[22] "Facebook," December 2018, https://www.facebook.com/.

[23] "LINE," December 2018, https://line.me/ja/.

[24] D. Elmasri and A. Maeder, "A conversational agent for an online mental health intervention," in *Proceedings of International Conference on Brain Informatics*, pp. 243–251, Omaha, NE, USA, October 2016.

[25] H. Gaffney, W. Mansell, R. Edwards, and J. Wright, "Manage your life online (MYLO): a pilot trial of a conversational computer-based intervention for problem solving in a student sample," *Behavioural and Cognitive Psychotherapy*, vol. 42, no. 6, pp. 731–746, 2014.

[26] K. K. Fitzpatrick, A. Darcy, and M. Vierhile, "Delivering cognitive behavior therapy to Young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial," *JMIR Mental Health*, vol. 4, no. 2, p. e19, 2017.

[27] M. Rosenberg, *Society and the Adolescent Self-Image*, Princeton University Press, Princeton, NJ, USA, 1965.

[28] T. M. Munakata, T. Takeshi, K. Yojiro et al., *A Comparative Study on the Family Environment and Mental Health of Japanese and American Youth, Scientific Research Report in Ministry of Health*, Labour and Welfare, Tokyo, Japan, 1987.

[29] C. D. Spielberger, *STAI Manual*, Consulting Psychologist Press, Palo Alto, CA, USA, 1970.

[30] W. W. K. Zung, "A self-rating depression scale," *Archives of general psychiatry*, vol. 12, no. 1, pp. 63–70, 1965.

[31] K. Fukuda and S. Kobayashi, *SDS Manual*, Sankyobo, Kyoto, Japan, 1973.

[32] T. Munakata, *Health Counseling Encyclopedia*, Nissoken Syuppan, Tokyo, Japan, 1999.

[33] T. Munakata, *Health and Disease From the View Point of Behavioral Science*, Medical Friend Co. Ltd., Tokyo, Japan, 1996.

[34] T. Munakata, "The science of mind recollection, communication, and conversation," *Health Counseling*, vol. 3, no. 6, pp. 94–102, 2001.

[35] K. M. Melville, L. Casey, and D. J. Kavanagh, "Dropout from internet-based treatment for psychological disorders," *British Journal of Clinical Psychology*, vol. 49, no. 4, pp. 455–471, 2010.

[36] J. Nicholas, J. Proudfoot, G. Parker et al., "The ins and outs of an online bipolar education program: a study of program attrition," *Journal of Medical Internet Research*, vol. 12, no. 5, p. e57, 2010.

[37] N. Middleton and R. Schneeman, *Heroku: Up and Running: Effortless Application Deployment and Scaling*, O'Reilly Media, Inc., Newton, MA, USA, 2013.

[38] "LINE messenger API," December 2018, https://developers.line.me/ja/services/messaging-api/.

[39] D. D. Fred, R. Bagozzi, and P. R. Warshaw, "User acceptance of computer technology: a comparison of two theoretical models," *Management science*, vol. 35, no. 8, pp. 982–1003, 1989.