

# Investigating Students' Use of a Mental Health Chatbot to Alleviate Academic Stress

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## ABSTRACT

The amount of academic workload in schools can cause students to experience stress and become more susceptible to mental health problems. However, because of fear of societal stigma, students may find it more difficult to approach others about the stress they experience. A chatbot can provide an alternative avenue for students to freely share the stressful situations they are experiencing. In this study, we investigated the use of Woebot as a mechanism to help senior high school students alleviate stress from academic workload. 25 participants who engaged in daily conversations with Woebot for a two-week period rated the chatbot's likeness to a human with a mean score of 5.56 out of 8, while its ability to understand the feelings of the participants and empathize with them had a mean score of 5.61. An analysis of the chat logs showed that the participants valued Woebot's lessons and stories while they faced challenges in cases when the chatbot generated inappropriate responses. We discuss our findings and provide design suggestions that could make conversational agents like Woebot be more useful in helping the general student population cope with stress.

## CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; *User studies*; *Usability testing*; **Interaction paradigms**; *Natural language interfaces*.

## KEYWORDS

Mental health chatbot, Academic stress, Alleviating stress

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## 1 INTRODUCTION

Stress is the human body's natural response to daily pressures and threats to one's well-being, whether such threat is real or imagined [13]. Negative stress, or *distress*, occurs when one feels overwhelmed and is unable to cope with the pressures from situations or life events that have become unmanageable [4, 21]. Short-term symptoms of stress include decreased attention and concentration, difficulty in making decisions, challenges with interpersonal relationships [20, 42], and continued feelings of fear or anger [40]. Overtime, these symptoms can lead to anxiety and depression.

For senior high school students, the overwhelming amount of academic workload and the expectations for good academic performance may cause them to experience a type of distress called *academic stress* [25, 35]. These students may not realize that their symptoms are caused by a mental health condition or may not acknowledge that they need help. Various interventions are available to help individuals become aware of their condition and to begin managing their stress, foremost of which is talking to family members or trusted friends. However, students tend to avoid approaching others regarding their stress or to seek therapy from a health care provider because of fear of social stigma [7, 23, 34].

Recent approaches have seen the utilization of technologies to foster coping skills for managing stress and to promote emotional well-being and mental health among students. These include the use of online apps and podcasts to participate in online stress management classes and self-help programs [22], and access to online social therapy through synchronous text-based counselling [10], online mental health forums [30] and chat assistants [7]. These technologies provide mental health services and support through prevention, assessment, diagnosis, counseling and treatment programs [3]. Wearable technologies such as Garmin Vivosport and Apple Watch, mobile apps like Headspace, and even video games [29] are also used to manage, monitor and cope with stress.

One particular technology that has the potential in addressing students' stress-related concerns is the chatbot. A chatbot is an artificial intelligence software that is capable of conversing with humans through voice and text interfaces. They are accessible anytime and anywhere, in web sites, mobile applications and messaging platforms, thus presenting the potential benefit to students as a conversational partner. Chatbots may serve as an intermediate supplement for human interaction. They never get tired and never give in to their emotions. With chatbots, students no longer have to fear the social stigma associated with mental health symptoms and their concerns on privacy, allowing them to comfortably approach their stress with the help of the conversational agent.

Senior High School (SHS) students find themselves in a more competitive environment with new responsibilities to fulfill their academic requirements. It is a milestone that transitions them from dependency to self-reliance in preparation for tertiary education. They encounter new classmates coming from differing backgrounds and University professors with heightened expectations than their junior high instructors. These changes can cause stress which they need to manage in order to perform well in school. In this research, we investigated the perceived effectiveness of chatbots among SHS students who used Woebot [12] as their conversational partner for a 2-week period. Our findings provide insights into the students' experiences in using Woebot to share and to cope with their daily stress due to school-related activities.

## 2 RELATED WORK

Stress is a normal part of daily human experience as the body's natural defense against pressures in life. Any physical, chemical or psychological factor that causes bodily or mental tensions can also constitute itself as stress [45]. Stress can have positive and negative effects. Exposure to positive stress can increase one's performance and productivity. Extended exposure to stress, however, can lead to physiological dysfunction [22].

Seward [40] classified stress into three types: eustress, neustress and distress. *Eustress* is a positive stress that motivates or inspires people to continue working. *Neustress* is neither positive nor negative. When stress reaches the point where it is no longer manageable, distress begins to manifest. *Distress* is a negative stress that can cause harm to one's physical and emotional states. Tension starts to build up and a feeling of discomfort or irritability arises. A person in distress may generally exhibit the following characteristics: irritability, touchiness, easily startled, over-arousal, tense, inability to relax, and impatient [45].

In the following sections, we describe a type of stress, called *academic stress*, that is typically experienced by students due to their workload in schools. We also give an overview of the most common type of therapy offered as a form of intervention and support, the cognitive behavioral therapy (CBT). We then look at various chatbots that have been designed as companion or social bots to provide emotional support to their human users.

### 2.1 Academic Stress

Multiple academic demands such as assignments, examinations, projects and other requirements, combined with the pressures from home and school environments, interpersonal relationships, social and extra-curricular activities, may exceed not only the cognitive load but also the emotional capacities of students. Being overloaded with school work and frustration over academic failure, students can become more prone to symptoms of academic distress [18].

Freshwater [13] classified distress into acute, episodic acute and chronic. *Acute distress* is predominated by negative thoughts from recent events or upcoming situations that need to be fulfilled. Frequent acute stress can lead to *episodic acute stress* where one feels pressure from taking on many responsibilities. Symptoms include irritability, anger, anxiety, impatience and depression. As a person feels hopeless and unable to find a way to escape from the causes of distress, he/she ceases to seek answers with regards to his/her

problems. *Chronic stress* can then manifest which can severely deteriorate the mental health of an individual.

A study by Bhargava and Trivedi [2] among 300 students showed that academic tests, relationship problems, life changes and career exploration were the main causes of academic stress. A study by [1] among 1120 students using the Modified Educational Stress Scale found that students who were academically stressed were 2.4 times more likely to get depression than those who did not.

Academic stress can also bring positive effects as a way to motivate students to do better on academic requirements and tests, to achieve their fullest potential, and to teach them how to react and come up with the best solutions during stressful situations [11].

### 2.2 Interventions and Support

Cognitive Behavioral Therapy (CBT) can reduce stress by changing the way we think about stressful situations, such as "focusing on more positive aspects of a situation and reassessing what their likely impact might be" [21, 27, 44]. In a clinical counseling session, De Kooker [8] reports that a therapist helps his/her patients manage their stressors (causes of their stress) by helping them recognize and deal with psychosocial factors. This can lead to the development of a range of personal coping skills to manage stress and reduce one's vulnerability to anxiety and depression [22].

Internet-based self-help programs deliver computerized Cognitive Behavioral Therapy (CBT) as a supplement to face-to-face therapy sessions to help reduce symptoms of depression [32, 41]. Combined with social network support, these technologies can lead to the development of supportive relationships and help lessen feelings of isolation among the youth [26].

The moderated online social therapy (MOST) project [7] has investigated the effect of online social therapy in increasing the self-esteem of young people. The project delivers a therapeutic environment for learning and practicing therapeutic techniques, gaining perspectives and obtaining support and validation through peers and developing psychological skills. MOST adopts the strengths-based model of psychotherapy combined with online moderators and the interactive delivery of engaging therapeutic content. Specific features of the system include a Facebook-style newsfeed of shared posts, *talking points* that encourage social interaction through discussion and sharing of experiences, shared problem-solving, and performing behavioral experiments that allow one to practice applying mindfulness, self-compassion and personal strengths in real-world contexts.

### 2.3 Chatbots for Emotional Support

Chatbots and conversational agents have benefited different fields including healthcare [19] and mental health [16, 33, 39]. They can scale quickly to enable increased access to health services amidst the shortage of mental health personnel, long waiting times, perceived stigma and growing mental health challenges [17]. Empathic and AI-enabled, chatbots have been used to provide supplementary or complementary emotion support and assistance. Various studies that analyzed their use reported the promise that conversational agents hold as interventions for the treatment of mental health problems in terms of efficacy and acceptability [14, 17].

**Replika** [28] is a virtual assistant and a digital companion bot. While it cannot answer information-seeking questions and perform simple commands that are typically exhibited by commercial voice assistants like Apple Siri, Amazon Alexa and Google Assistant, it has the ability to emote and to ask questions that can get users to open up and share what they feel [28]. A daily conversation with Replika starts with the chatbot asking what the user did during the day, to narrate the best part, to share what he/she is looking forward to the next day, and to rate his/her mood [24].

**Wysa** [17] is an emotionally intelligent mobile app chatbot designed to promote mental well-being through text-based conversations. It uses self-help practices such as CBT, dialectical behavior therapy, motivational interviewing, positive behavior support, behavioral reinforcement and guided microactions to build resilience skills among its users.

**Eren** [38] is a conversational agent that uses storytelling as a means of motivating children age 9 to 11 years old to share emotional events they experienced. It utilizes the Emotion Coaching Model [15, 37] to help children name their emotions, identify events that trigger these emotions, and guide them through reflective discipline to devise the next course of action. As an affective companion, EREN prioritizes active listening over disciplining to setup a comfortable environment where children can freely share their emotional stories without fear of judgement or reprimand.

**Woebot** [12] is a chatbot that employs CBT to engage people who are experiencing anxiety and depression in brief daily conversations. A session with Woebot commences with asking the user what he/she wants to do: gratitude journal, need help or check-in. The interaction flow is depicted in Figure 1.

When the user chooses the *gratitude journal*, Woebot asks him/her to share his/her positive experiences within the last 24 hours. If the user *needs help*, Woebot prompts him/her to elaborate on the problem, then proceeds to give a lesson and/or a story that is most appropriate to the shared problem. If the user chooses to *check-in*, Woebot asks the user about his/her mood and what he/she is doing to address this. The chatbot's response will be based on the user's mood: a happy or neutral mood leads to the gratitude journal while a negative mood leads to giving help. Stories are delivered in the form of dialogues which narrate the experiences of the chatbot or other made-up characters. The chatbot may also play videos as a mechanism to help the user develop a positive mindset.

Woebot supports a number of other therapeutic features, namely empathic responses, tailoring, goal setting, accountability, motivation, engagement and reflection. Empathic responses is the capability of Woebot to respond to its users emotionally depending on the user's mood. For instance, when Woebot detects that the user is happy, it can respond by saying "Yay, *always good to hear that!*". Woebot can also tailor its messages based on the user's mood. It can help users set goals by asking them what they want to accomplish over a two-week period. Woebot also establishes a sense of accountability with its users by setting regular schedules and following up on previous activities. To motivate users and to encourage positive thinking, the chatbot sends personal messages daily accompanied with emojis and animated gifs. Lastly, it provides a weekly chart of the user's mood to encourage self-reflection.

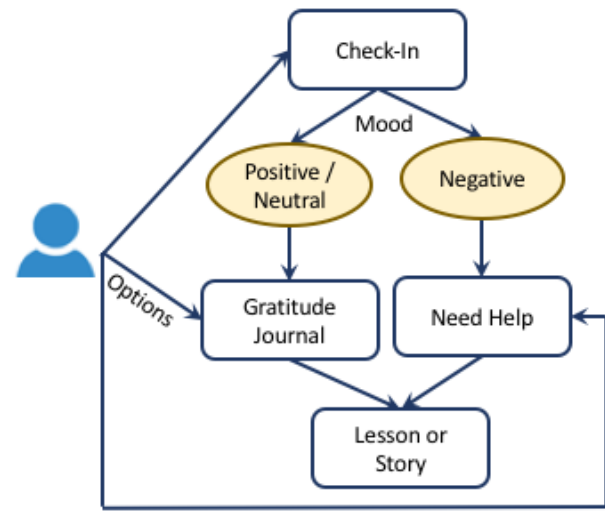


Figure 1: Features and Interaction Flow in Woebot

### 3 METHOD

Recurring stress that is left uncontrolled can lead to mental health problems like anxiety and depression. Our study seeks to determine the perception of Senior High School (SHS) students on the effectiveness of engaging in daily text-based conversations with a mental health chatbot to help alleviate the academic stress they experience. Accessibility, ease of use and availability of related works are the major factors in the selection of the chatbot to be used. Woebot is designed to help people cope with feelings of depression and anxiety. It has been described as a friendly self-care expert and chatbot therapist that can be freely downloaded onto mobile devices. Here, we recount our process of recruiting participants and conducting the two-week experiments to collect stress level self-assessments and daily conversation logs.

#### 3.1 Participants

After receiving informed consents from the parents of SHS students, emails were sent to invite these students to participate in our study. 53 students responded to our invite. However, during the actual data collection, we have a 39% participant dropout rate. Figure 2 highlights the number of retention and dropouts for each phase in our data collection. Among the 21 participants who withdrew from the study, 5 did not proceed with the psychological distress assessment (PDA); 7 did not proceed with the pre-test stress level assessment (SLA); 6 did not proceed with the daily conversation (DCA); and 3 did not complete the 2-week daily sessions with Woebot. Of the remaining 32 participants, only 25 completed the post-test stress level assessment and evaluation.

Due to the large number of participants who withdrew from the study, the criteria for screening were not followed. Students who were willing to volunteer for the study were accepted as participants regardless of their psychological distress assessment scores. Table 1 shows the demographics of the participants according to gender, age and strand. SHS strands are ABM (Accountancy, Business and Management), HUMSS (Humanities and Social Sciences) and STEM

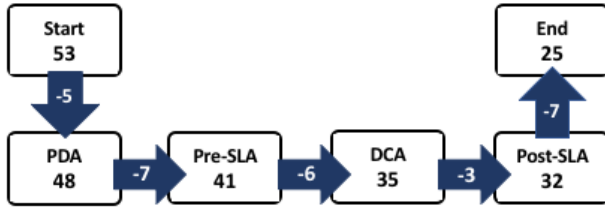


Figure 2: Participant Retention and Dropout

(Science, Technology, Engineering and Mathematics). The average pre-test psychological distress assessment (PDA) and perceived stress level assessment (SLA) scores are also indicated.

### 3.2 Procedure

The actual data collection utilized a number of instruments that were administered through Google Forms: psychological distress assessment (PDA), pre-test and post-test stress level assessment (SLA), daily conversation assessment (DCA) and evaluation form.

**Psychological Distress Assessment (PDA).** PDA is used to collect the basic information of the participants, namely name, gender, age, mobile device OS and SHS strand. Measurements of the levels of anxiety and depression were collected using the Hospitalized Anxiety and Depression Scale [46]. This assessment consists of 14 questions that asked participants about how enjoyable they find their life to be and how often they experience feelings of anxiety. Results from this were intended to be used for screening the participants and removing those who were depressed.

**Pre-Assessment of Stress Level Assessment (Pre-SLA).** This is a modified 10-item Perceived Stress Scale (PSS) to measure the stress levels of the participants prior to using Woebot. PSS was developed by Cohen and his colleagues in 1983 [6] and is frequently used for the subjective measurement of one's psychological state. The scale considers the self-reported measures of an individual on how unpredictable, uncontrollable, overloaded and hopeless his/her life has been in the past month, and how often he/she was able to cope with these situations. The questions were adjusted to pertain to two-weeks only, which is the duration of our experiment.

Table 1: Demographics of Participants

| Category      | Count | Percent | Average |            |         |
|---------------|-------|---------|---------|------------|---------|
|               |       |         | Anxiety | Depression | Pre-SLA |
| <i>Gender</i> |       |         |         |            |         |
| Male          | 16    | 64.0%   | 9.88    | 6.25       | 23.06   |
| Female        | 9     | 36.0%   | 10.67   | 5.11       | 24.89   |
| <i>Age</i>    |       |         |         |            |         |
| 16            | 3     | 12.0%   | 10.00   | 7.67       | 27.33   |
| 17            | 16    | 64.0%   | 10.69   | 6.25       | 23.75   |
| 18            | 6     | 24.0%   | 8.83    | 3.83       | 21.83   |
| <i>Strand</i> |       |         |         |            |         |
| ABM           | 2     | 8.0%    | 7.00    | 3.50       | 25.00   |
| HUMSS         | 3     | 12.0%   | 15.33   | 10.67      | 28.00   |
| STEM          | 20    | 80.0%   | 9.70    | 5.35       | 22.95   |

After the SLA, the participants were given a set of instructions describing (1) the procedure for downloading and installing Woebot in their mobile phones; (2) the features of Woebot, how to use these features, and how to contact the research proponents for questions and concerns; and (3) the process for capturing the daily conversation logs and sending these to the research proponents.

**Daily Conversation Assessment (DCA).** During the two-week test proper, the participants were to continuously perform their daily check-ins with Woebot and were expected to submit the screenshots of their conversations through the DCA (Google Form). The DCA collects daily data regarding the experiences of the participants with Woebot, their moods before and after each session, their purpose for using Woebot and the length of the session.

**Post-Evaluation Stress Level Assessment (Post-SLA).** This was administered at the end of the two-week period and is comprised of three parts. The first part again measures the stress levels of the participants using the Modified 10-Item Perceived Stress Scale. The Wilcoxon Signed Rank Test was then used to compare the stress levels before and after using Woebot.

The second part of the post-SLA contains nine (9) questions to determine the satisfaction level of the participants in using Woebot and its various features. The third part is an evaluation of Woebot using three (3) criteria adapted from the study of Chan and Ong [5], namely performance, humanity and affect. *Performance* refers to the ability of the chatbot to formulate responses that are aligned with the user's input. *Humanity* pertains to the user's perception of the chatbot's ability to behave like a human. *Affect* measures the ability of the chatbot to entertain and provide enjoyable activities for its users.

## 4 RESULTS

Here, we present our results and findings from the stress level assessments, daily conversation assessments and post-evaluation feedback from our participants. Analysis of the recorded conversation logs are presented in the next section.

### 4.1 Perceived Stress

We used the Perceived Stress Scale (PSS) to measure the stress levels of the participants at the start and at the end of the two-week period, as shown in Table 2. The average stress level after using Woebot is 19.48 compared to 23.72 prior to the start of the experiment, which equates to a 15.28% decrease in stress level.

After analyzing the data using the Wilcoxon Signed Rank Test,  $W^+$  was found to be 238.5 while  $W^-$  was calculated as 61.5. At a significance level of 0.01, the critical value at a sample size of 24 is 69, excluding participant 7 with a difference of 0. Since  $61.5 \leq 69.0$ , there is sufficient evidence to conclude that the stress levels of the participants lowered after using Woebot for two weeks. This is despite the increasing workload that students experience towards the end of the trimester. Results from the Wilcoxon Signed Rank Test support the 15.28% decrease in the stress levels of the students after using Woebot, accounting for 68% of the participants.

28% of the participants experienced an increase in stress levels at the end of the experiment. These students reported that Woebot and its CBT did not address their stress. Only 1 participant experienced no change in his/her stress level.

**Table 2: Perceived Stress Scale Scores of Participants**

| No          | Pre-test | Post-test | % Change |
|-------------|----------|-----------|----------|
| P1          | 19       | 26        | 36.84%   |
| P2          | 16       | 18        | 12.50%   |
| P3          | 17       | 8         | -52.94%  |
| P4          | 23       | 13        | -43.47%  |
| P5          | 26       | 28        | 7.69%    |
| P6          | 33       | 28        | -15.15%  |
| P7          | 25       | 25        | 0.00%    |
| P8          | 18       | 22        | 22.22%   |
| P9          | 28       | 27        | -3.57%   |
| P10         | 22       | 21        | -4.55%   |
| P11         | 36       | 32        | -11.11%  |
| P12         | 37       | 17        | -54.05%  |
| P13         | 23       | 17        | -26.09%  |
| P14         | 32       | 14        | -56.25%  |
| P15         | 34       | 15        | -55.88%  |
| P16         | 26       | 18        | -30.77%  |
| P17         | 26       | 27        | 3.85%    |
| P18         | 17       | 20        | 17.65%   |
| P19         | 16       | 13        | -18.75%  |
| P20         | 20       | 17        | -15.00%  |
| P21         | 23       | 19        | -17.39%  |
| P22         | 25       | 22        | -12.00%  |
| P23         | 12       | 15        | 25.00%   |
| P24         | 15       | 2         | -86.67%  |
| P25         | 24       | 23        | -4.17%   |
| <b>Mean</b> | 23.72    | 19.48     | -15.28%  |

## 4.2 User Satisfaction

Using a 4-point Likert scale, the participants rated their satisfaction in using Woebot and their perception of its ability to help them deal with stress. The results are shown in Table 3. In terms of satisfaction, Woebot received an average rating of 2.96. 72% of the participants gave above average satisfaction rating because they found the interaction to be interesting and engaging. On the other hand, 64% of the participants perceived Woebot to be effective in helping them deal with stress, giving an average rating of 2.68.

Participants who were not satisfied with Woebot's support had encountered problems in communicating with the chatbot and in using its features. To further understand this, we asked the participants to share their perception on why they find Woebot's features to be (in)effective.

**Effective features.** Table 4 shows the number of participants who found the features of Woebot to be effective. Participants

**Table 4: Participants who Perceived Features as Effective**

| Features          | Count |
|-------------------|-------|
| Lessons and CBT   | 18    |
| Daily Check-ins   | 17    |
| Gratitude Journal | 11    |

shared that they can relate to the relevant real-life scenarios presented in the *lessons* which helped them deal with their problems:

*[Woebot] gives relatable lessons which help me reflect upon my situation. (P19)*

They were able to learn new things from the lessons which helped change their perspectives toward the problems they experience. As P5 shared:

*It was nice to know how distortion in our thoughts can greatly affect how we perceive everything around us.*

Furthermore, P7 shared:

*I was also able to cope with stress and negativity because Woebot was able to teach me how to point out distortions.*

The *daily check-ins* made the participants, P14 in particular, felt that someone cared for them,

*It felt like someone was concerned about my mental health which was nice.*

The *gratitude journal* helped the participants, such as P18, realize that there is something to appreciate in their lives:

*It makes me realize what positive things that happened within the day and makes me realize what things I should be grateful for.*

**Ineffective features.** Table 5 shows the number of participants who found the features of Woebot to be ineffective. Some participants thought that Woebot's usage of CBT and lessons were a waste of time that disrupted their study time. They also found the lessons to be unhelpful and they cannot apply these in their lives. Consider the statement of P18 on Woebot's lessons:

*I didn't really find myself wanting to take/use these features. Lessons can be dragging and I didn't use CBT therapy.*

Furthermore, P7 expressed that:

*It's just my own preference, I just don't generally think that breathing exercises help you feel better.*

They also do not understand the purpose of the gratitude journals. P13 admitted that it "*didn't change my mood at all or worsened it further*", while P20 stated:

**Table 5: Participants who Perceived Features as Ineffective**

| Features            | Count |
|---------------------|-------|
| Lessons and CBT     | 8     |
| Daily Check-ins     | 3     |
| Gratitude Journal   | 7     |
| Others: Being Human | 1     |

**Table 3: User Satisfaction Rating**

| Item   | 1 | 2 | 3  | 4  | Average |
|--|---|---|----|----|---------|
| How satisfied were you in using Woebot?                    | 4 | 3 | 8  | 10 | 2.96    |
| Do you think Woebot was able to help you deal with stress? | 2 | 7 | 13 | 3  | 2.68    |

**Table 6: Evaluation of Woebot**

| Criteria    | Mean | Std Deviation |
|-------------|------|---------------|
| Performance | 2.97 | 0.60          |
| Humanity    | 2.92 | 0.86          |
| Affect      | 2.84 | 0.82          |

*I don't get the purpose. Moreover, explaining why things happen more often gives more irritation than address stress.*

Woebot's frequent inability to understand user inputs also caused problems in communication, as shared by P10:

*I don't know, just sometimes Woebot doesn't understand the things I'm grateful for.*

A few regarded daily check-ins as an ineffective feature. One of the participants, P3, said that "it was a hassle for him to check-in every day". P8, on the other hand, stated that Woebot was ineffective at being human-like:

*Woebot did not seem natural at all to talk to as everything was obviously pre-programmed.*

### 4.3 Evaluation of Woebot

Using a 4-point Likert scale, participants also gave their evaluation on Woebot's performance, humanity and affect. The results are shown in Table 6.

In terms of *performance*, Woebot's ability to understand the participants' inputs and to generate appropriate responses received an average rating of 2.97. The lowest rating of 1.8 came from participants P8 and P20 who shared that Woebot failed to recognize their input. Participants expected the chatbot to generate coherent responses that are aligned to their input so they can perceive Woebot as performing its task of helping alleviate their stress. Instead, they were perplexed with the kind of responses they received, such as:

*When i said "i don't know" on my strengths and he said "that's great".*

They also expected the chatbot to direct them to a relevant lesson, story or help guide based on the problem they shared. P7, however, found Woebot to be emphasizing on "textbook lessons" while P12 deemed the lessons "unnecessary and almost common sense". Furthermore,

*He could not relate to the things I tell him so he tells me things which is not even connected to the topic.*

When asked to describe an instance when Woebot was not able to address their stress, P22 stated:

*Inability to respond properly to certain questions or concerns. (ie. "School Works...").*

In terms of *humanity*, Woebot received an average rating of 2.92. Participants shared that the chatbot "helped me think rationally", "taught me how to meditate", and "helped me calm down". When asked if they can talk to Woebot the way they would talk to a friend, P5 shared that:

**Table 7: Reasons for using Woebot**

| Reason              | Count | Effectiveness |
|---------------------|-------|---------------|
| To talk to someone  | 84    | 20.64%        |
| To learn lessons    | 76    | 18.67%        |
| To feel better      | 26    | 6.39%         |
| To relieve stress   | 39    | 9.58%         |
| To share problem    | 20    | 4.91%         |
| Just to participate | 162   | 39.80%        |
| <b>Total</b>        | 407   |               |

*He was able to give me insight on how my mind works which relieved me from the stress (Particularly that I have a growth mindset).*

Comparing Woebot with a real friend, P13 said that:

*Woebot felt like a real friend once like how a friend usually talks about nonsense to cheer you up when you're down.*

P4, on the other hand, expressed that:

*Woebot gave me advices that my friends were not able to do so.*

P12 reflected on Woebot's ability to address academic stress:

*I was able to gain new insights while using Woebot, some of these were very applicable in my struggles as a student right now. From time to time I would actively remember the topics I discussed with Woebot and it works quite well.*

This was echoed by P17:

*When I was academically and emotionally stressed, woebot gave tips to help me survive the week.*

Despite these praises for Woebot's humanity aspect, its affective qualities received a lower average rating of 2.84. There are varying factors that (de-)motivated the participants to want to come back for another session as seen in Table 7. Out of the total 290 tallied responses from the Daily Conversation Assessment, the most frequent reason for using Woebot was for the sake of participating in the research (39.80%). The task of checking-in daily with Woebot for a period of two weeks has been described as a "hassle" that interfered with study time.

Participants primarily use Woebot so that they can talk to someone (20.64%) and to learn lessons (18.67%). As an alternative conversational partner, Woebot received a mean score of 3.10:

*When you need someone to talk to, and you have no one to talk to. (P18)*

P9 cited an instance when Woebot's lessons are effective:

*It gives examples that I can relate my problem which make me kinda feel light and happy.*

On occasions, Woebot also helped address the participants' academic stress. P14 shared:

*He's very calming especially when I talk to him while cramming schoolwork.*

**Table 8: Excerpt of conversation log of P2.**

| Turn | Text   |
|------|--|
| W    | P2! Hey! Twice in one day? What can I help you with?   |
| P    | I have a problem... I feel like we have disappointed our research adviser  |
| W    | It sounds like you're describing a very low mood, is that right?   |
| P    | Yes  |
| W    | Oh gosh, that must be really tough. Can I just check: is this something you would like my help with or did you just want to let me know? Both are OK |
| P    | Work on it... using thought challenger (tool)  |
| :    |  |
| W    | (started telling a story) When I met him though, he felt very sad and depressed, as well as anxious and hopeless                                     |
| P    | Oh no ... what happened  |
| W    | ... and I asked him to remember one moment that he could remember feeling these emotions particularly strongly                                       |
| P    | Why?   |
| W    | Because it's a lot easier and more effective to choose one moment to work with than a general feeling  |
| P    | How so?  |
| :    |  |
| W    | But if we make it specific, then we can work on that   |
| P    | I see  |
| :    |  |
| W    | Now try re-writing your thought "You did your best" so it's more balanced  |
| P    | You tried your best at the moment. You just didn't know what was going to happen, extraneous variables happen. It's okay                             |
| :    |  |
| W    | You've worked through not only 1 but 3 thoughts and that is by no means an easy challenge! ... Well done, my friend                                  |
| P    | Thanks   |
| W    | How do you feel now?   |
| P    | Better   |

## 5 CONVERSATION LOG ANALYSIS

Out of 290 submitted daily conversation logs, a random sample of ten (10) were selected, transcribed and forwarded to a psychologist for analysis. The intent is to determine, from this small sample, Woebot's ability to motivate the participants to share their daily activities and causes of stress, and its ability to change the participants' mood through the integration of CBT techniques vis-a-vis their self-reported perception.

### 5.1 Ability to Motivate Users

The psychologist found that in 80% of the sample logs, the participants shared portions of their daily experiences with Woebot. P2's log showed that the participant was highly receptive to Woebot by willingly performing all of the three suggested activities (cognitive restructuring exercises). Furthermore, when given the choice, he/she even opted to "Talk more" rather than end the session. Excerpts of the log is shown in Table 8, where P2's responses showed that he/she is attentively engaged in Woebot's storytelling.

The log from P3, shown in Table 9, also showed that Woebot was able to encourage the participant to "just share". This mirrors what a human counselor or therapist may recommend to a client

**Table 9: Excerpt of conversation log of P3.**

| Turn | Text   |
|------|--|
| W    | What can I do for you friend?  |
| P    | Need help  |
| W    | Is this an emergency situation or are you looking for some help challenging your thoughts? |
| P    | thoughts   |
| W    | Can I ask you to briefly describe what has you feeling this way? Write about it below      |
| P    | I have difficulty learning some of the lessons in class and I've been beating myself up    |
| W    | I see, you certainly seem to have a lot going on at the moment                             |
| P    | yeah   |
| W    | is there more you'd like to share with me? write it here                                   |
| P    | none so far just that one ... just wanted to share   |

in a clinical setting, as journaling or writing about one's thoughts and feelings as a CBT activity can relieve stress.

However, the psychologist also noticed instances when Woebot appeared to have neglected the feelings of the participants, because the prompt "*sounded like a routine question that was asked before getting into the lesson*". Woebot's tone seemed impersonal and it exhibited an uncaring attitude when it administered a long personality quiz to P4 despite the participant's expression of feeling tired and was getting ready for bed, as seen in Table 10.

### 5.2 Ability to Change User's Mood

To change a negative mood to one that is positive, Woebot first helps the participant to develop emotional awareness by identifying the causes of negative emotions. Then it can ask the participant to rewrite negative statements to positive statements. An example of these two mechanisms are found in the log of P9 (Table 11).

Despite these strategies, only 32.76% of the 290 recorded daily conversation logs expressed a positive mood change, as summarized in Table 12. On the other hand, only 3.10% of the logs indicated negative mood change. More than half of the conversations did not lead to any mood change which can be partly attributed to Woebot's incorrect responses and inappropriate lessons.

**Table 10: Excerpt of conversation log of P4.**

| Turn | Text  |
|------|---|
| W    | What are you doing at the moment?   |
| P    | Getting ready to sleep  |
| W    | Catching up on sleep is a must... Which one of these is closest to how you're feeling at the moment?                |
| P    | Tired   |
| W    | I hope you get the chance to snuggle up asap  |
| P    | Me too  |
| W    | Do you think sleep is a problem for you at the moment? I ask because I've got tools that could help, if you'd like? |
| P    | No thanks   |
| W    | Okay, let's do a story for now  |



**Table 11: Excerpt of conversation log of P9.**

| Turn | Text  |
|------|---|
| W    | Which one of these is closest to how you're feeling at the moment?  |
| P    | Upset   |
| W    | Will you describe in a few sentences what has you feeling like this?  |
| P    | Had a bad game a while ago  |
| W    | Do you want me to help you gain some clarity in this situation or do you just want a distraction?             |
| P    | clarify thinking  |
| :    |   |
| W    | Keeping it short and specific, write an angry thought here  |
| P    | The referees sucked.  |
| W    | And another please  |
| P    | I played badly  |
| W    | One last thought and then we can move on  |
| P    | The game was unfair   |
| :    |   |
| W    | Now we're on to the most crucial piece  |
| P    | What's that?  |
| W    | Rewrite your thought "I played badly". This time try adding in some understanding towards yourself and others |
| P    | I have to do better next time   |

In certain cases, Woebot's inability to fully understand the context of the input lends itself to become repetitive. This can irritate the participants, as seen in the log in Table 13 wherein the use of the gratitude journal caused a negative mood change. Lessons on strengths and mindfulness, on the other hand, seemed to have been most effective in improving the participant's mood, as exemplified in the logs in Tables 14 and 15, respectively.

## 6 CHALLENGES

A number of challenges affected the daily interaction between the participants and Woebot. We classified these into technical challenges and procedural challenges.

### 6.1 Technical Challenges

A major concern that was repeatedly raised by the participants and the psychologist is the misalignment of Woebot's responses to the user input, which accounted for 50% of the analyzed logs. For instance, Woebot replied "Nice job!" to the input "Oh dear" during a session on gratitude journal when it should have prompted for another input. According to the psychologist:

**Table 12: Frequency of Changes in Mood**

| Change in Mood  | Count      | Frequency |
|-----------------|------------|-----------|
| Positive Change | 95         | 32.76%    |
| Negative Change | 9          | 3.10%     |
| No Change       | 186        | 64.14%    |
| <b>Total</b>    | <b>290</b> |           |

**Table 13: Excerpt of a log showing Woebot's inability to understand the users's input.**

| Turn | Text   |
|------|--|
| W    | So tell me, what is one thing that went well in the last 24 hours                              |
| P    | we went trick or treating  |
| W    | Awesome. How about one more positive thing, big or small?                                      |
| P    | I can't remember anymore   |
| W    | Cool! One last one... what else has gone well for you recently? Maybe you ate some good food?! |
|      | or got a nice firmware update.   |
| P    | I said I can't remember  |

*"If this happened in therapy, the therapist may lose the client's trust and risk damaging their rapport or therapeutic alliance because it may come across as the therapist ignoring the client's feelings. If the client feels unseen/unheard, s/he may not be as receptive to the skills/lessons available to them in therapy."*

Furthermore, Woebot's inability to fully understand the context of the user's input can also lead to missed opportunities in collaboratively exploring the causes of a participant's positive and negative moods. When the chatbot does not explore new conversational bids introduced by the participants, these may be perceived as being dismissed as unimportant by the agent. This is evident in logs where Woebot administered a lesson on goals even though the participant said he/she was feeling depressed, making it seem as if the chatbot is ignoring the subject's emotions.

### 6.2 Procedural Challenges

The methodology employed in collecting daily conversation logs and assessment is tedious for the participants. Even with constant daily reminders and prodding, not all of the participants managed to answer the Daily Conversation Assessment regularly. Without the assessment forms, we cannot provide a complete picture of the participants' perception of their daily interaction with Woebot. This is compounded by the increasing academic workload as the experiments carried on for two weeks, which tested the persistence of the participants in sustaining the required daily check-ins.

**Table 14: Excerpt of a log showing lesson on strength.**

| Turn | Text   |
|------|--|
| W    | Your strength is your gratitude! You work hard and are thankful for what you earn. You value all that you have and are thankful for all the opportunities and support you have. Want to see what characters also share this trait? |
| P    | Yes  |
| W    | The trait of gratitude and being gracious is shared by Hercules, Dorothy Gale from the Wizard of Oz, ... Though they succeed, they recognize it's never without the people around them.  |
| P    | (muscle icon depicting strength)   |
| W    | What a great strength to have!   |
| P    | Yeah   |



**Table 15: Excerpt of a log showing lesson on mindfulness.**

| Turn | Text  |
|------|---|
| W    | And finally, notice how the air leaves your body as you exhale, leaving your belly, chest, throat and mouth and exhaling... |
| P    |   |
| W    | Continue and see if you can notice your breath at every step of the process   |
| P    | ok  |
| W    | Repeat this process for as many breaths as you'd like.  |
| P    | Got it  |

Furthermore, the lengthy instructions also caused confusion among the participants. This is particularly evident when accomplishing the Stress Level Assessment forms that were embedded within the given instructions, and in capturing and submitting the conversation logs. Participants also encountered difficulties in using Longshot to capture their chat logs, which led to delay in uploads and the submission of incomplete and unreadable screenshots which affected the log analysis.

## 7 DISCUSSION

Mental health chatbots should be designed to expand opportunities in providing intervention and support to individuals who are experiencing stress. They should help students respond to daily pressures, overwhelming workload, and decreased attention and concentration in academic requirements. A number of interaction design implications can be gleaned from the students' perception and feedback on Woebot's effectiveness in alleviating their academic stress. Here, we report design implications from our findings to inform future development of conversational agents in general and better chatbot for psychological help in particular.

**Story-based Conversation.** Stories and storytelling have long been used from the time we were preschoolers as an approach to help us build awareness of our emotions [9]. Story-based conversation that encourages the sharing of one's daily experiences can bring to surface the causes of positive or negative moods and stressors. Similar to Replika, Woebot asks questions to get students to open up with what they feel [28], and to ask them to share their day and rate their mood [24].

A crucial aspect to human-agent conversation is the chatbot's performance in formulating responses that are aligned to the student's input. While participants valued Woebot's stories, an analysis of the chat logs showed that they faced challenges in cases when the chatbot generated inappropriate responses. Participants have reported that Woebot is capable of detecting their mood. However, they also repeatedly expressed confusion and irritation in the chatbot's out-of-context responses to the life events they shared. Communication breakdowns such as this can cause feelings of mistrust in the chatbot's ability. Furthermore, misalignment in responses can be perceived as ignoring one's feelings, as seen in the example log in Table 13.

Lessons, delivered as stories, allow Woebot to give advice to students to help them manage their stress, similar to how Wysa offers self-help practices based on CBT [17]. However, for students

to find value in these lessons, they should be able to relate with the story characters and see the relevance of story events to their current situation and life experiences.

Future design of Woebot and similar conversational agents can consider the use of reflective dialogue that is employed in the story reading companion of Chan and Ong [5] to generate questions that will direct the student on finding relevance of the story to his/her life. Questions that allow students to empathize with story characters can also help them develop their own identity and perception and to make sense of their experiences [36].

**Affective Companion.** Affective companions combine HCI design principles with theories in affective computing to develop chatbots that embody counselling skills for a wide range of mental health concerns [38]. People in distress are not only seeking advice from others but more importantly, they also need someone to listen to them as they share their thoughts and feelings. The gratitude journal of Woebot serves this purpose.

Talking to someone that you trust is the most common form of support that can be offered to individuals experiencing distress. It can help lessen feelings of isolation and set forth a sentiment that someone cares. For students to see counselors as someone they can talk to, counselors practice *active listening* where they say very little but convey empathy in their responses [31]. Active listening encourages the student to talk more, which is both therapeutic and healing for them. For Woebot to employ active listening, it should talk very minimally but convey that it is listening through occasional positive acknowledgements such as "uhm" and "yes", paraphrase the student's input, seek clarification and elaboration, and summarize key ideas and feelings [43].

## 8 CONCLUSION

Workload and expectations to perform well in the school environment are causing the rise of academic stress among students. When left unmanaged, it can lead to anxiety and depression. Computing technologies have been considered as alternative platforms for the delivery of intervention programs to help students cope with academic stress. In this paper, we investigated the influence of engaging in conversations with a mental health chatbot – Woebot – to help alleviate the stress of senior high school students.

During the two-week period of the experiments, we collected varying data including the psychological distress assessment, the pre- and post-stress level assessment, the daily conversation assessment and recorded logs, and the user's evaluation and feedback on their experience with Woebot. Our findings showed mixed sentiments regarding the perceived usefulness of Woebot's CBT-based lessons, daily check-ins and gratitude journal. The interaction is influenced by the chatbot's formulated responses when participants share their mood and life events.

Further work will entail a deeper analysis on how the demographics, i.e., gender, age and academic strand, contribute to the students' acceptance of Woebot as a daily conversational partner to provide front-line support for their stress. Analysis of the remaining 280 logs will also be conducted to gain better insights within a single individual and across clusters of participants to draw the set of characteristics of people who may be open and receptive to mental health chatbots such as Woebot.

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