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## Redesigning Teaching and Learning towards Sustainable Education

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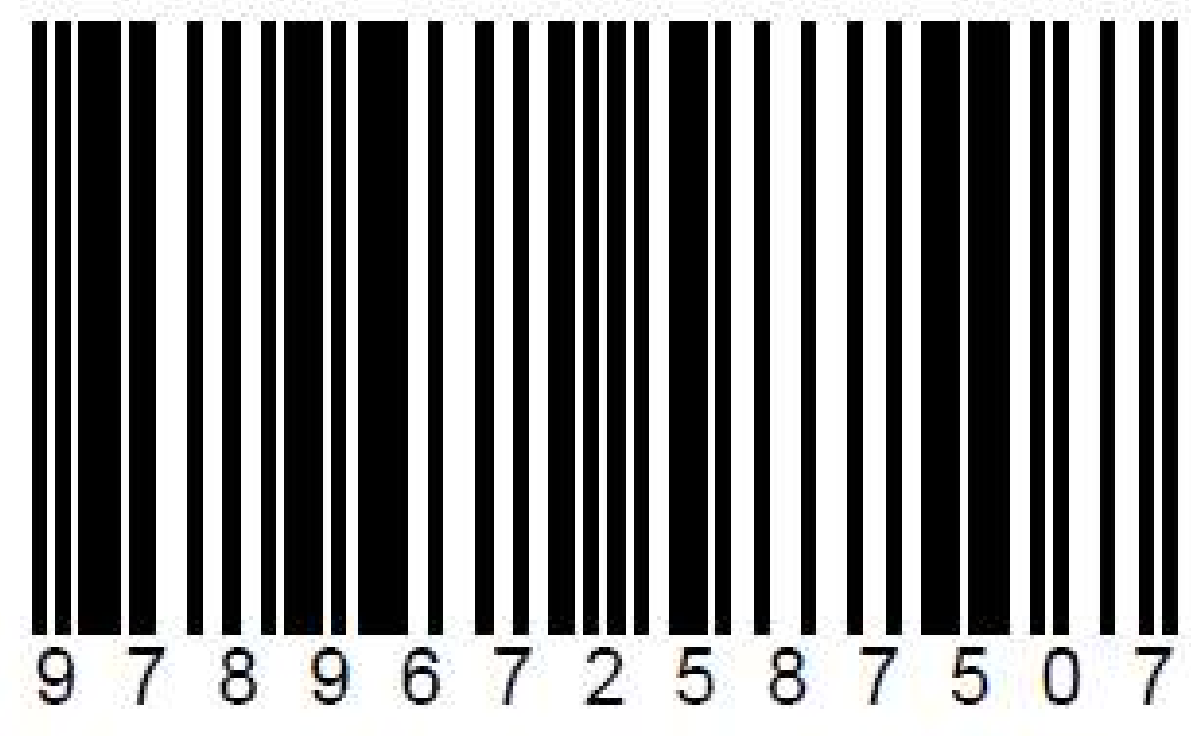
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# Artificial Intelligent Applications for Mental Health Support: A Review paper

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**Abstract**— Mental health is every human's right. Physical health cannot be achieved without a healthy mind. Good mental health helps dealing with the stress of life, affects physical health, and allows building and maintaining strong human relationships. Individuals with a healthy mind can be a valuable part of society and contribute to their community while feeling fulfilled and satisfied. While its importance is obvious, almost everyone at some points in their lives faces some life-altering experiences that could challenge their mental health, such as trauma, abuse and family problems, genetics, and lifestyles. At the moment, the treatment options are majorly limited to attending psychotherapy, medical therapy, and self-help.

Unfortunately at the moment, the option of attending a psychotherapy session is not available or affordable for everyone around the world. Also, accessibility to professional therapists is limited. Besides that even though therapists are trained to be unbiased and fair, it is always harder for humans to overcome their personal preferences and biases. Sometimes that is way easier to control and manipulate with machines. This paper will review the latest advancements in technology, from mobile applications to robots, that are designed to help with mental health matters.

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**Keywords:** *Artificial Intelligence, Machine Learning, Mental Health, Therapeutic Chatbot, Deep Learning Approaches.*

## 5. INTRODUCTION

The World Health Organization (WHO) reported in January 2020 that more than 264 million are suffering from depression. It also mentioned depression as the leading cause of disability, and it may lead to suicide [1]. After the COVID-19 pandemic, WHO reported in October 2020, that based on their recent survey, less than 1% of international budgets for health is dedicated to mental health. While during the pandemic mental health services were disrupted in 93% of countries around the world [2].

The National Institute of Mental Health reported that more than a quarter of American adults face some sort of depression or anxiety every year [3]. Based on the study done in 2017 on 273,203 individuals in Malaysia, more than 6.7% of them were suffering from some level of depression [4]. The National Health and Morbidity Survey (NHMS 2019) reported, almost half a million Malaysians are experiencing some signs of depression. Also, 424,000 children are facing mental health issues [5]. Based on a Kaiser Family Foundation poll, about half of American adults are concerned about the effects of the COVID-19 pandemic on their mental health [6]. It can only conclude, the increase of depression and mental health in Malaysia as well.

More than 165,000 healthcare apps are available in smartphones app stores at the moment, of which only 6% are related to mental health matters [7]. As mentioned in the UNHCR's Sustainable Development Goals (SDG), Fig 1, SDG1: no poverty, SDG2: no hunger, SDG3: good health and well-being and SDG16: peace and justice are every human being's right. UNHCR published an article in May 2018, "Mental health is a human right". The complication of participating in daily activities such as attending school or work, personal and communal responsibilities with an ill mind is mentioned. Mr. Dainius Pūras states while it is evident "there cannot be health without mental health", there still is not merely as much attention and budget allocated to it compared to physical health anywhere in the world [8].



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Fig 1. UNHCR’s Sustainable Development Goals [9]

Cognitive Behavioral Therapy (CBT) is a known empirically-supported treatment that implements several cognitive and behavioral interactions [10]. The ideology of CBT relies on the importance of inaccurate beliefs and mindsets, dysfunctional information processing, and behavior in the etiology of depression [11]. So during a therapy session, cognitive-behavioral techniques are introduced and practiced, with homework assignments to internalize the new mindsets [12]. Hence these sessions are mainly conversational, making the CBT technique perfect for this project. The chatbot will have conversations with the user to readjust their beliefs and mindset while keeping their assignments and progress.

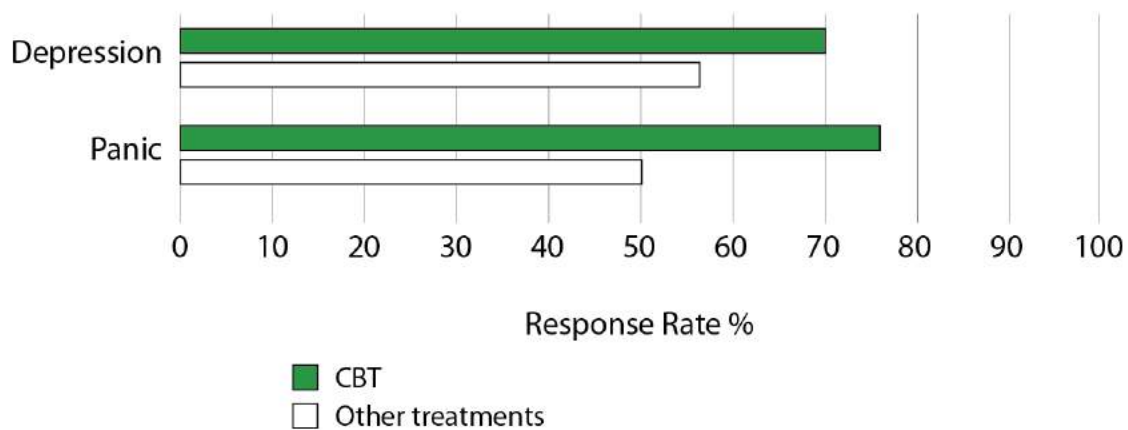


Fig 2. The effectiveness of CBT compared to other treatments [13]

In the following section, this paper is going to analyze the conventional available methods of mental health diagnoses and treatment in Malaysia. After that, an array of popular applications are compared and discussed. In section 3 different methods analyzed earlier are going to be discussed and compare. Finally, the paper is concluded and some future works are suggested.

## 6. RELATED WORK

There are different methods available to help improve one's mental health. In this section, first, the costs of available therapy and consultation sessions, online and in-person are compared. Then some of the available chatbots apps and robots in the market are discussed.

### 6.1 Conventional Methods

Based on an article published in a personal website in October 2018 [14], while the cost of seeking treatment in a Malaysian government hospital can be as low as RM15 per session, patients are required to have a referral letter from a general practitioner and they will not receive consultation from a psychotherapist but a medical doctor. This is not a long term solution for a serious problem. Attending a private therapist can cost between RM200 and RM500 per session. While this is an effective solution, unfortunately not affordable for everyone.

### 6.2 Online Consultations

More affordable and accessible psychotherapy sessions are available through online applications. During the sessions, patients would have a conversation with a certified therapist via text or voice call. Betterhelp, figure 3, and Talkspace are examples of these applications. Betterhelp charges between \$60 to \$80 per week [15] and Talkspace between \$35-\$80 [16]. While fairly more affordable, still expensive for some and reliable on the therapists' accessibility.

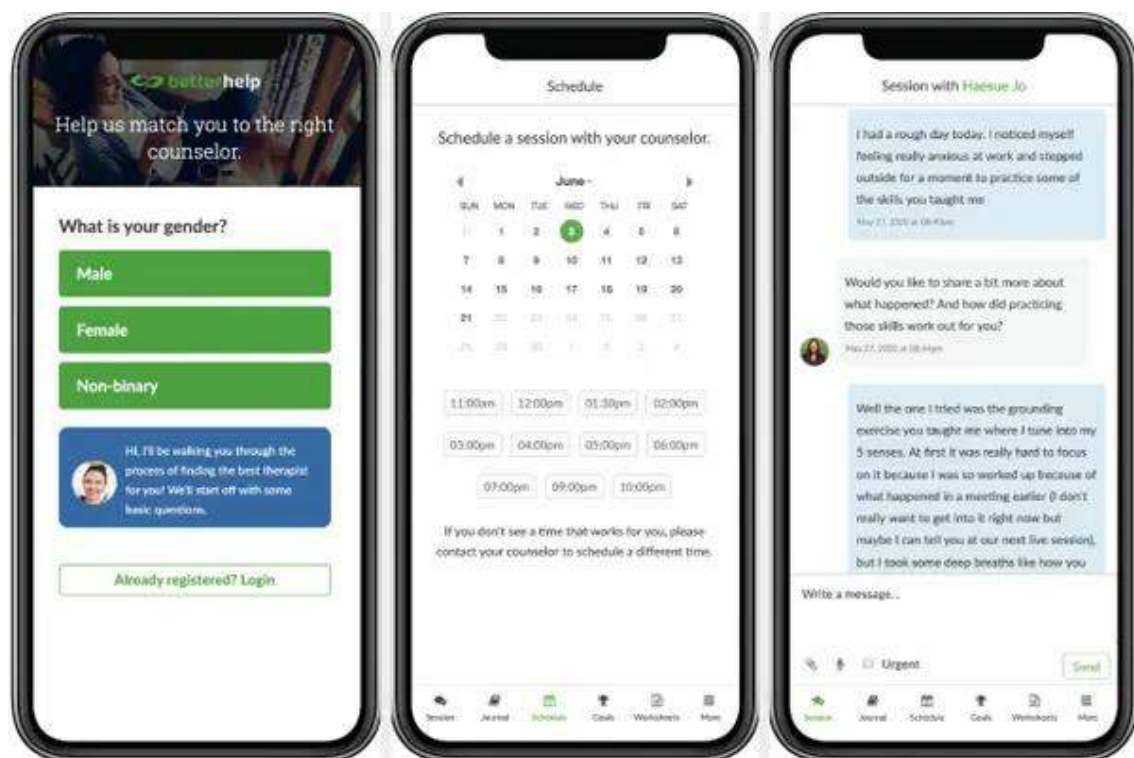


Fig 3. Betterhelp application [33]

### 6.3 AI Robots and Applications

In the following, some of the applications that are mainly free and don't require an active therapist to function will be discussed. Table 1 compares their methods, findings, and gaps.

- Catch It [17]: This is an android app collaboration project between the Universities of Liverpool



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and Manchester, using the Deployment of Kohonen's SOM (Self Organizing Maps) algorithm for CBT to treat personality disorders. Even though this application is one of its kind in the field of using Cognitive Neuropsychology and Artificial Neural Networks, users find it limiting since it mostly just records your moods and suggests you find the triggers yourself. Also, the features of the application mostly look like a form that the user should fill up as mentioned by the developers as close-ended questions, Fig 4. As of December 2020, the application's rated 3.8/5 by 141 users in Google Play Store.

A screenshot of the 'Record Mood' app interface. At the top is a teal header with a back arrow, the text 'Record Mood', and a home icon. Below the header are three buttons: 'Catch It' (highlighted in teal), 'Check It', and 'Change It'. The main content area is titled 'Record mood' and includes the text 'The things that happen to us can affect our moods.' Below this are four sections of questions, each with a dropdown menu: 'What Mood have you experienced?' (Anxiety), 'How strong was this Mood?' (1 (weak)), 'When did you experience this Mood' (25 Mar 2015, 14:19, and a red 'Just Now' button), and 'Where were you?' (Home). At the bottom is a large red 'Next' button.

Fig. 4. Catch It app [17]



- Ryan the Companion Bot [18]: Ryan is a Socially Assistive Robot, developed using Program-R, a dialogue management system, using CBT to treat depression designed by a team of engineers in the University of Denver. It also analyzes the user's spoken responses and facial expressions. Based on the results of treatments attained by Ryan, it is not yet a viable alternative to therapists. Also since it is a physical robot, it still would not be accessible to a wide range of users.
- Youper [19]: This application uses CBT, Commitment Therapy, and mediation to help with anxiety and stress. Though the application receives good reviews in app stores, 4.9/5 in Apple App Store as of December 2021, there are no studies or research published by the team to prove its efficacy. This application is a chatbot that mostly allows you to respond using limited options. So technically the user is taking a multiple question quiz rather than converting with the chatbot using their own words. Technically Youper is an example of an expert system designed with the help of therapists, figure 5.
- Appsiety [20]: This is not a published app, so it is not available for testing. Based on the paper published, it is mainly a platform that would be used by patients while already visiting a therapist. This way they can provide more regular updates and be easier in touch with therapists. Though it is a useful app in the sense of more regular documentation and communication between the patients and therapists, it is not a useful tool for situations that no therapist is available.

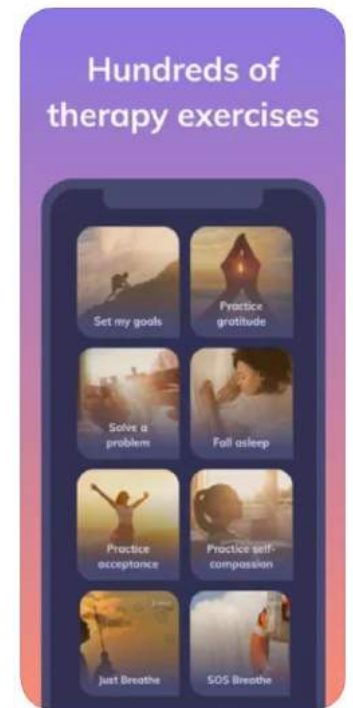


Fig 5. Youper

- T-Bot [21]: It is a therapy chatbot that helps to detect depression severity and suggest remedies for self-improvement. Though it provides a lot of techniques and helps users to find their depression level, it is not able to proceed with a conversation as much as providing techniques instead. It is basically up to the user to learn and implement the techniques they like.
- Replika [22]: This is a popular generative bot that can have a meaningful conversation with users while remembering and recalling the conversions afterward. It clones the user's conversion and messaging behaviors and slowly learns to talk similarly. While technically it is showing great results as a spoken system, hence it doesn't hold any expertise in mental health matters, it is not recommended to be used instead of seeking professionals. In some senses relying on its responses might be dangerous because it would learn what the user likes to hear which means it can even possibly encourage the user to pursue a wrong decision just because the user would enjoy this encouragement. In short, it would tell you what you like to hear but not what you need to hear.

Table 1. Table of comparison

No	Research work	Methods	Findings	Gaps
1	Catch It, 2014 [17]	<ul style="list-style-type: none"> <li>• Deployment of Kohonen's SOM algorithm for CBT to treat personality disorders</li> </ul>	<ul style="list-style-type: none"> <li>- Records moods and keep diary</li> <li>- Help users to find triggers</li> <li>- 3.8/5 rating in Google Play app store by 141 users</li> </ul>	<ul style="list-style-type: none"> <li>- UI is just filling a form without flexibility</li> <li>- The bot's responses are vague and useless based on users comments</li> </ul>



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		<ul style="list-style-type: none"> <li>• Cognitive Neuropsychology and Artificial Neural Networks</li> </ul>		
2	Ryan the Companion Bot, 2017 [18]	<ul style="list-style-type: none"> <li>• Uses Program-R, dialogue management system, using CBT to treat depression</li> <li>• Analyzes spoken responses and facial expressions</li> </ul>	<ul style="list-style-type: none"> <li>- Improved depression and dementia in elderly users</li> <li>- Can engage with users</li> </ul>	<ul style="list-style-type: none"> <li>- Since it is physical, not widely accessible</li> <li>- Considers as a companion, not a therapist</li> <li>- Mainly for entertainment at this stage</li> </ul>
3	Youper, 2016 [19]	<ul style="list-style-type: none"> <li>• Uses CBT, Commitment Therapy, and mediation</li> <li>• Example of an expert system designed with the help of therapists</li> </ul>	<ul style="list-style-type: none"> <li>- Users self-reported improvement in their anxiety and stress</li> <li>- 4.9/5 rating by 14.2K users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- No studies were released to prove its efficacy</li> <li>- Quiz-like</li> <li>- Mainly uses documentation and self helps on different issues</li> </ul>
4	Appsity, 2019 [20]	<ul style="list-style-type: none"> <li>• Uses build on sensors to collect users activities that can help therapists</li> <li>• The System Usability Scale (SUS) used to assess users</li> </ul>	<ul style="list-style-type: none"> <li>- Helps keeping track of patient already attending therapist</li> </ul>	<ul style="list-style-type: none"> <li>- Not published, so can't be tested</li> <li>- Don't benefit those who don't have access to therapists</li> </ul>
5	T-Bot, 2018 [21]	<ul style="list-style-type: none"> <li>• PHP module using the A.L.I.C.E. technology</li> <li>• Based on Program E</li> </ul>	<ul style="list-style-type: none"> <li>- Provides treatments methods</li> <li>- A more interactive way of self-help/ tutoring</li> </ul>	<ul style="list-style-type: none"> <li>- Does not include a spoken system</li> <li>- Users can't have a meaningful conversation with the bot</li> <li>- Not available to the public</li> </ul>
6	Replika - 2017 [22]	<ul style="list-style-type: none"> <li>• Neural Networks</li> <li>• Generative chatbot using natural language interfaces</li> </ul>	<ul style="list-style-type: none"> <li>- Great in making meaningful conversations</li> <li>- Remembers the conversations and clone the behavior of the user</li> <li>- 4.7/5 by 1.9k users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- No expertise in mental health or any specific ethical values</li> <li>- No published evidence of improvement in mental health</li> </ul>
7	Woebot: your self-care expert, 2017 [23]	<ul style="list-style-type: none"> <li>• By Stanford psychologists and AI experts</li> <li>• Web-based CBT</li> <li>• Conversation Management System</li> <li>• NLP</li> </ul>	<ul style="list-style-type: none"> <li>- Based on a study on university students, a significant reduction in depression, PHQ-9 (<math>F=6.47</math>; <math>P=.01</math>) and anxiety GAD-7 (<math>F1,54= 9.24</math>; <math>P=.004</math>)</li> <li>- 4.9/5 rating by 28 users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- Based on users feedback, responses are mainly generic, script-like</li> <li>- Not generative</li> </ul>
8	COVID Coach, 2020 [24], [25]	<ul style="list-style-type: none"> <li>• By US Department of Veterans Affairs (VA)</li> <li>• Secure privacy protections</li> </ul>	<ul style="list-style-type: none"> <li>- Educating on the pandemic</li> <li>- Great tool for self-help</li> <li>- Mood and goal tracking</li> <li>- 4.8/5 rating by 524 users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- Does not include chatbot</li> <li>- Just a self-management tool</li> <li>- No studies on its effectiveness</li> </ul>



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<b>9</b>	<i>Wysa: Mental Health Support, 2015 [26]</i>	<ul style="list-style-type: none"> <li>• <i>Conversational AI Agent</i></li> <li>• <i>CBT</i></li> <li>• <i>NLP an emotional balance</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Have an online session with a professional coach</i></li> <li>- <i>As reported by developers, 93% find it helpful</i></li> <li>- <i>Best stress app of 2019 by Apple</i></li> <li>- <i>4.9/5 rating by 131 users in Apple app store</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Possible availability and bias issues from the coaches for the professional sessions</i></li> <li>- <i>Only about 20% cheaper than face to face therapy</i></li> <li>- <i>Vocal conversations with chatbot not included</i></li> </ul>
<b>10</b>	<i>Naluri , 2017 [27]</i>	<ul style="list-style-type: none"> <li>• <i>Malaysia base</i></li> <li>• <i>A platform for healthcare providers to communicate with patients/ messenger</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Easy accessibility</i></li> <li>- <i>Variety of coaches, including psychotherapists and dietitians</i></li> <li>- <i>4/5 by 16 users in Apple app store</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>The application still immature with bugs based on comments</i></li> <li>- <i>Possible availability and bias issues from the coaches</i></li> </ul>

## 7. DISCUSSION

The concept of employing software technologies to help mental health is not new and the AI chatbot technology goes back to the 1960s. While through this time their complexity and involvement in mental health have improved, still the majority of the available solutions concerns psychoeducation [28]. Psychoeducation concentrates on educating the patients and their families with the relevant knowledge [29]. While based on studies it helps destigmatizing mental health disorders and usually has a positive impact on patients, the effectiveness and quality of this method is not well documented and the knowledge might not be appropriate for all individuals.

While using mobile applications might increase the chance of regular checking from the patients due to notifications, it might as well lead to information overload and less interest in using the application[30]. Information Seeking Anxiety (ISA) happens when there is a gap between what a person understands and what a person thinks they should understand [31]. Overwhelmed by the amount of information receiving from the application, the user may experience ISA and stop learning about mental health.

When it comes to chatbots and other AI applications the biggest concern is the lack of clinical standards and regulations [32]. There is an immediate need for transparency and accountability regarding AI applications. Analyzing the available applications can help create an informed path on how to protect patients and their personal information.

In terms of efficacy, a mental health application, like other treatment techniques, must undergo extensive testing before being recognized as a clinically effective tool. Unfortunately, only a limited number of chatbots have been clinically tested under specific circumstances. Based on those studies AI applications proved to have positive impacts on patients with depression and anxiety. The efficiency of therapeutic treatments included in chatbots is also a factor to investigate. CBT is one well-known example of an anxiety and depression treatment that has been demonstrated to be helpful both in-person and online. Although app designers have espoused the potential usefulness of mental health apps, specialists are hesitant to suggest them without more information about their efficacy. Because there is currently no empirical research on mental health apps, evidence-based suggestions and suggestions for many tools, including chatbots, cannot be provided.

## CONCLUSION

The primary intent of mental health apps and AI chatbots is to aid individuals, and there is a demonstrable demand for support in the mental health field. As previously stated, mental health physicians are in limited supply, with certain locations lacking any certified mental health doctors. People may be unable to see a mental health clinician in the degree or frequency that they require. People with lower earnings, such as teenagers, the seniors, ethnic and racial minorities, and other vulnerable groups, are particularly affected by these inequities. Stigmatization adds to the situation by discouraging people from obtaining medical assistance.

Mental health AI chatbots have the capacity to assist relieve the shortage of mental healthcare, but their lack of



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user-centered architecture, efficacy, protection, and privacy make them a risky option.

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# Artificial Intelligent Applications for Mental Health Support: A Review paper

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**Abstract**— Mental health is every human's right. Physical health cannot be achieved without a healthy mind. Good mental health helps dealing with the stress of life, affects physical health, and allows building and maintaining strong human relationships. Individuals with a healthy mind can be a valuable part of society and contribute to their community while feeling fulfilled and satisfied. While its importance is obvious, almost everyone at some points in their lives faces some life-altering experiences that could challenge their mental health, such as trauma, abuse and family problems, genetics, and lifestyles. At the moment, the treatment options are majorly limited to attending psychotherapy, medical therapy, and self-help.

Unfortunately at the moment, the option of attending a psychotherapy session is not available or affordable for everyone around the world. Also, accessibility to professional therapists is limited. Besides that even though therapists are trained to be unbiased and fair, it is always harder for humans to overcome their personal preferences and biases. Sometimes that is way easier to control and manipulate with machines. This paper will review the latest advancements in technology, from mobile applications to robots, that are designed to help with mental health matters.

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**Keywords:** *Artificial Intelligence, Machine Learning, Mental Health, Therapeutic Chatbot, Deep Learning Approaches.*

## 5. INTRODUCTION

The World Health Organization (WHO) reported in January 2020 that more than 264 million are suffering from depression. It also mentioned depression as the leading cause of disability, and it may lead to suicide [1]. After the COVID-19 pandemic, WHO reported in October 2020, that based on their recent survey, less than 1% of international budgets for health is dedicated to mental health. While during the pandemic mental health services were disrupted in 93% of countries around the world [2].

The National Institute of Mental Health reported that more than a quarter of American adults face some sort of depression or anxiety every year [3]. Based on the study done in 2017 on 273,203 individuals in Malaysia, more than 6.7% of them were suffering from some level of depression [4]. The National Health and Morbidity Survey (NHMS 2019) reported, almost half a million Malaysians are experiencing some signs of depression. Also, 424,000 children are facing mental health issues [5]. Based on a Kaiser Family Foundation poll, about half of American adults are concerned about the effects of the COVID-19 pandemic on their mental health [6]. It can only conclude, the increase of depression and mental health in Malaysia as well.

More than 165,000 healthcare apps are available in smartphones app stores at the moment, of which only 6% are related to mental health matters [7]. As mentioned in the UNHCR's Sustainable Development Goals (SDG), Fig 1, SDG1: no poverty, SDG2: no hunger, SDG3: good health and well-being and SDG16: peace and justice are every human being's right. UNHCR published an article in May 2018, "Mental health is a human right". The complication of participating in daily activities such as attending school or work, personal and communal responsibilities with an ill mind is mentioned. Mr. Dainius Pūras states while it is evident "there cannot be health without mental health", there still is not merely as much attention and budget allocated to it compared to physical health anywhere in the world [8].



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Fig 1. UNHCR’s Sustainable Development Goals [9]

Cognitive Behavioral Therapy (CBT) is a known empirically-supported treatment that implements several cognitive and behavioral interactions [10]. The ideology of CBT relies on the importance of inaccurate beliefs and mindsets, dysfunctional information processing, and behavior in the etiology of depression [11]. So during a therapy session, cognitive-behavioral techniques are introduced and practiced, with homework assignments to internalize the new mindsets [12]. Hence these sessions are mainly conversational, making the CBT technique perfect for this project. The chatbot will have conversations with the user to readjust their beliefs and mindset while keeping their assignments and progress.

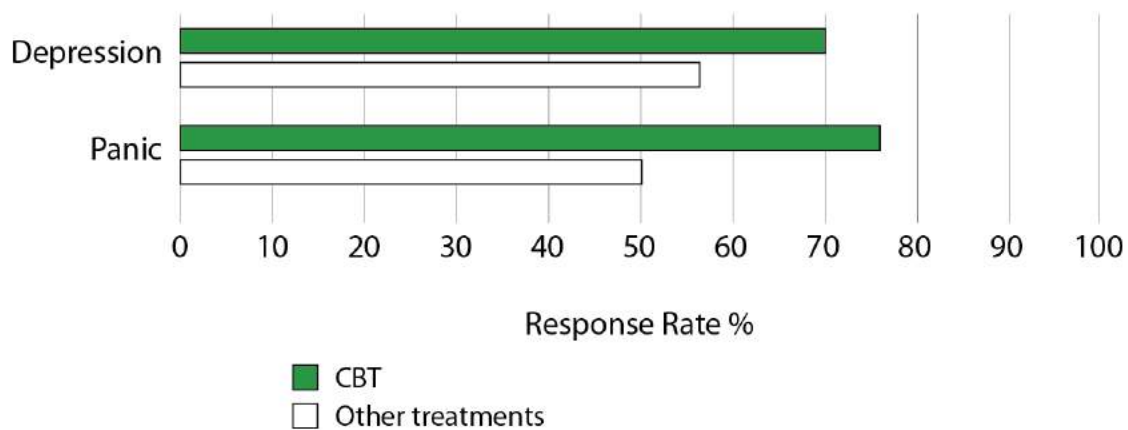


Fig 2. The effectiveness of CBT compared to other treatments [13]

In the following section, this paper is going to analyze the conventional available methods of mental health diagnoses and treatment in Malaysia. After that, an array of popular applications are compared and discussed. In section 3 different methods analyzed earlier are going to be discussed and compare. Finally, the paper is concluded and some future works are suggested.

## 6. RELATED WORK

There are different methods available to help improve one's mental health. In this section, first, the costs of available therapy and consultation sessions, online and in-person are compared. Then some of the available chatbots apps and robots in the market are discussed.

### 6.1 Conventional Methods

Based on an article published in a personal website in October 2018 [14], while the cost of seeking treatment in a Malaysian government hospital can be as low as RM15 per session, patients are required to have a referral letter from a general practitioner and they will not receive consultation from a psychotherapist but a medical doctor. This is not a long term solution for a serious problem. Attending a private therapist can cost between RM200 and RM500 per session. While this is an effective solution, unfortunately not affordable for everyone.

### 6.2 Online Consultations

More affordable and accessible psychotherapy sessions are available through online applications. During the sessions, patients would have a conversation with a certified therapist via text or voice call. Betterhelp, figure 3, and Talkspace are examples of these applications. Betterhelp charges between \$60 to \$80 per week [15] and Talkspace between \$35-\$80 [16]. While fairly more affordable, still expensive for some and reliable on the therapists' accessibility.

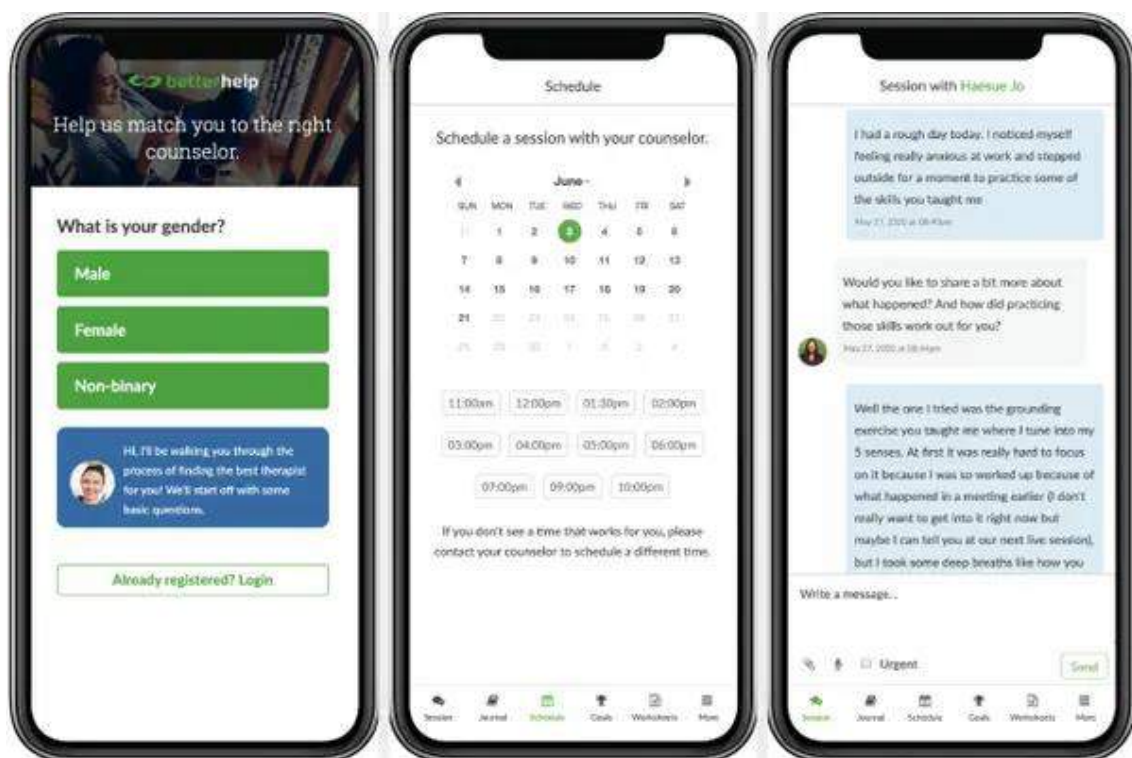


Fig 3. Betterhelp application [33]

### 6.3 AI Robots and Applications

In the following, some of the applications that are mainly free and don't require an active therapist to function will be discussed. Table 1 compares their methods, findings, and gaps.

- Catch It [17]: This is an android app collaboration project between the Universities of Liverpool





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and Manchester, using the Deployment of Kohonen's SOM (Self Organizing Maps) algorithm for CBT to treat personality disorders. Even though this application is one of its kind in the field of using Cognitive Neuropsychology and Artificial Neural Networks, users find it limiting since it mostly just records your moods and suggests you find the triggers yourself. Also, the features of the application mostly look like a form that the user should fill up as mentioned by the developers as close-ended questions, Fig 4. As of December 2020, the application's rated 3.8/5 by 141 users in Google Play Store.

A screenshot of the 'Record Mood' app interface. At the top is a teal header with a back arrow, the text 'Record Mood', and a home icon. Below the header are three buttons: 'Catch It' (highlighted in teal), 'Check It', and 'Change It'. The main content area is titled 'Record mood' and includes the text 'The things that happen to us can affect our moods.' Below this are four sections of questions, each with a dropdown menu: 'What Mood have you experienced?' (Anxiety), 'How strong was this Mood?' (1 (weak)), 'When did you experience this Mood' (25 Mar 2015, 14:19, and a red 'Just Now' button), and 'Where were you?' (Home). At the bottom is a large red 'Next' button.

Fig. 4. Catch It app [17]

- Ryan the Companion Bot [18]: Ryan is a Socially Assistive Robot, developed using Program-R, a dialogue management system, using CBT to treat depression designed by a team of engineers in the University of Denver. It also analyzes the user's spoken responses and facial expressions. Based on the results of treatments attained by Ryan, it is not yet a viable alternative to therapists. Also since it is a physical robot, it still would not be accessible to a wide range of users.
- Youper [19]: This application uses CBT, Commitment Therapy, and mediation to help with anxiety and stress. Though the application receives good reviews in app stores, 4.9/5 in Apple App Store as of December 2021, there are no studies or research published by the team to prove its efficacy. This application is a chatbot that mostly allows you to respond using limited options. So technically the user is taking a multiple question quiz rather than conversing with the chatbot using their own words. Technically Youper is an example of an expert system designed with the help of therapists, figure 5.
- Appsiety [20]: This is not a published app, so it is not available for testing. Based on the paper published, it is mainly a platform that would be used by patients while already visiting a therapist. This way they can provide more regular updates and be easier in touch with therapists. Though it is a useful app in the sense of more regular documentation and communication between the patients and therapists, it is not a useful tool for situations that no therapist is available.

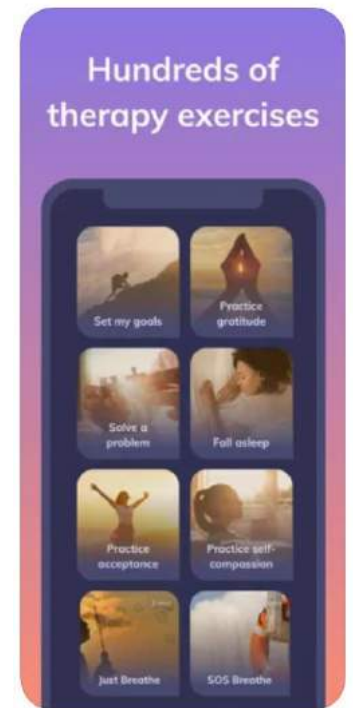


Fig 5. Youper

- T-Bot [21]: It is a therapy chatbot that helps to detect depression severity and suggest remedies for self-improvement. Though it provides a lot of techniques and helps users to find their depression level, it is not able to proceed with a conversation as much as providing techniques instead. It is basically up to the user to learn and implement the techniques they like.
- Replika [22]: This is a popular generative bot that can have a meaningful conversation with users while remembering and recalling the conversations afterward. It clones the user's conversation and messaging behaviors and slowly learns to talk similarly. While technically it is showing great results as a spoken system, hence it doesn't hold any expertise in mental health matters, it is not recommended to be used instead of seeking professionals. In some senses relying on its responses might be dangerous because it would learn what the user likes to hear which means it can even possibly encourage the user to pursue a wrong decision just because the user would enjoy this encouragement. In short, it would tell you what you like to hear but not what you need to hear.

Table 1. Table of comparison

No	Research work	Methods	Findings	Gaps
1	Catch It, 2014 [17]	<ul style="list-style-type: none"> <li>• Deployment of Kohonen's SOM algorithm for CBT to treat personality disorders</li> </ul>	<ul style="list-style-type: none"> <li>- Records moods and keep diary</li> <li>- Help users to find triggers</li> <li>- 3.8/5 rating in Google Play app store by 141 users</li> </ul>	<ul style="list-style-type: none"> <li>- UI is just filling a form without flexibility</li> <li>- The bot's responses are vague and useless based on users comments</li> </ul>



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		<ul style="list-style-type: none"> <li>• Cognitive Neuropsychology and Artificial Neural Networks</li> </ul>		
2	Ryan the Companion Bot, 2017 [18]	<ul style="list-style-type: none"> <li>• Uses Program-R, dialogue management system, using CBT to treat depression</li> <li>• Analyzes spoken responses and facial expressions</li> </ul>	<ul style="list-style-type: none"> <li>- Improved depression and dementia in elderly users</li> <li>- Can engage with users</li> </ul>	<ul style="list-style-type: none"> <li>- Since it is physical, not widely accessible</li> <li>- Considers as a companion, not a therapist</li> <li>- Mainly for entertainment at this stage</li> </ul>
3	Youper, 2016 [19]	<ul style="list-style-type: none"> <li>• Uses CBT, Commitment Therapy, and mediation</li> <li>• Example of an expert system designed with the help of therapists</li> </ul>	<ul style="list-style-type: none"> <li>- Users self-reported improvement in their anxiety and stress</li> <li>- 4.9/5 rating by 14.2K users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- No studies were released to prove its efficacy</li> <li>- Quiz-like</li> <li>- Mainly uses documentation and self helps on different issues</li> </ul>
4	Appsity, 2019 [20]	<ul style="list-style-type: none"> <li>• Uses build on sensors to collect users activities that can help therapists</li> <li>• The System Usability Scale (SUS) used to assess users</li> </ul>	<ul style="list-style-type: none"> <li>- Helps keeping track of patient already attending therapist</li> </ul>	<ul style="list-style-type: none"> <li>- Not published, so can't be tested</li> <li>- Don't benefit those who don't have access to therapists</li> </ul>
5	T-Bot, 2018 [21]	<ul style="list-style-type: none"> <li>• PHP module using the A.L.I.C.E. technology</li> <li>• Based on Program E</li> </ul>	<ul style="list-style-type: none"> <li>- Provides treatments methods</li> <li>- A more interactive way of self-help/ tutoring</li> </ul>	<ul style="list-style-type: none"> <li>- Does not include a spoken system</li> <li>- Users can't have a meaningful conversation with the bot</li> <li>- Not available to the public</li> </ul>
6	Replika - 2017 [22]	<ul style="list-style-type: none"> <li>• Neural Networks</li> <li>• Generative chatbot using natural language interfaces</li> </ul>	<ul style="list-style-type: none"> <li>- Great in making meaningful conversations</li> <li>- Remembers the conversations and clone the behavior of the user</li> <li>- 4.7/5 by 1.9k users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- No expertise in mental health or any specific ethical values</li> <li>- No published evidence of improvement in mental health</li> </ul>
7	Woebot: your self-care expert, 2017 [23]	<ul style="list-style-type: none"> <li>• By Stanford psychologists and AI experts</li> <li>• Web-based CBT</li> <li>• Conversation Management System</li> <li>• NLP</li> </ul>	<ul style="list-style-type: none"> <li>- Based on a study on university students, a significant reduction in depression, PHQ-9 (<math>F=6.47</math>; <math>P=.01</math>) and anxiety GAD-7 (<math>F1,54= 9.24</math>; <math>P=.004</math>)</li> <li>- 4.9/5 rating by 28 users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- Based on users feedback, responses are mainly generic, script-like</li> <li>- Not generative</li> </ul>
8	COVID Coach, 2020 [24], [25]	<ul style="list-style-type: none"> <li>• By US Department of Veterans Affairs (VA)</li> <li>• Secure privacy protections</li> </ul>	<ul style="list-style-type: none"> <li>- Educating on the pandemic</li> <li>- Great tool for self-help</li> <li>- Mood and goal tracking</li> <li>- 4.8/5 rating by 524 users in Apple app store</li> </ul>	<ul style="list-style-type: none"> <li>- Does not include chatbot</li> <li>- Just a self-management tool</li> <li>- No studies on its effectiveness</li> </ul>



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<b>9</b>	<i>Wysa: Mental Health Support, 2015 [26]</i>	<ul style="list-style-type: none"> <li>• <i>Conversational AI Agent</i></li> <li>• <i>CBT</i></li> <li>• <i>NLP an emotional balance</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Have an online session with a professional coach</i></li> <li>- <i>As reported by developers, 93% find it helpful</i></li> <li>- <i>Best stress app of 2019 by Apple</i></li> <li>- <i>4.9/5 rating by 131 users in Apple app store</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Possible availability and bias issues from the coaches for the professional sessions</i></li> <li>- <i>Only about 20% cheaper than face to face therapy</i></li> <li>- <i>Vocal conversations with chatbot not included</i></li> </ul>
<b>10</b>	<i>Naluri, 2017 [27]</i>	<ul style="list-style-type: none"> <li>• <i>Malaysia base</i></li> <li>• <i>A platform for healthcare providers to communicate with patients/ messenger</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Easy accessibility</i></li> <li>- <i>Variety of coaches, including psychotherapists and dietitians</i></li> <li>- <i>4/5 by 16 users in Apple app store</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>The application still immature with bugs based on comments</i></li> <li>- <i>Possible availability and bias issues from the coaches</i></li> </ul>

## 7. DISCUSSION

The concept of employing software technologies to help mental health is not new and the AI chatbot technology goes back to the 1960s. While through this time their complexity and involvement in mental health have improved, still the majority of the available solutions concerns psychoeducation [28]. Psychoeducation concentrates on educating the patients and their families with the relevant knowledge [29]. While based on studies it helps destigmatizing mental health disorders and usually has a positive impact on patients, the effectiveness and quality of this method is not well documented and the knowledge might not be appropriate for all individuals.

While using mobile applications might increase the chance of regular checking from the patients due to notifications, it might as well lead to information overload and less interest in using the application[30]. Information Seeking Anxiety (ISA) happens when there is a gap between what a person understands and what a person thinks they should understand [31]. Overwhelmed by the amount of information receiving from the application, the user may experience ISA and stop learning about mental health.

When it comes to chatbots and other AI applications the biggest concern is the lack of clinical standards and regulations [32]. There is an immediate need for transparency and accountability regarding AI applications. Analyzing the available applications can help create an informed path on how to protect patients and their personal information.

In terms of efficacy, a mental health application, like other treatment techniques, must undergo extensive testing before being recognized as a clinically effective tool. Unfortunately, only a limited number of chatbots have been clinically tested under specific circumstances. Based on those studies AI applications proved to have positive impacts on patients with depression and anxiety. The efficiency of therapeutic treatments included in chatbots is also a factor to investigate. CBT is one well-known example of an anxiety and depression treatment that has been demonstrated to be helpful both in-person and online. Although app designers have espoused the potential usefulness of mental health apps, specialists are hesitant to suggest them without more information about their efficacy. Because there is currently no empirical research on mental health apps, evidence-based suggestions and suggestions for many tools, including chatbots, cannot be provided.

## CONCLUSION

The primary intent of mental health apps and AI chatbots is to aid individuals, and there is a demonstrable demand for support in the mental health field. As previously stated, mental health physicians are in limited supply, with certain locations lacking any certified mental health doctors. People may be unable to see a mental health clinician in the degree or frequency that they require. People with lower earnings, such as teenagers, the seniors, ethnic and racial minorities, and other vulnerable groups, are particularly affected by these inequities. Stigmatization adds to the situation by discouraging people from obtaining medical assistance.

Mental health AI chatbots have the capacity to assist relieve the shortage of mental healthcare, but their lack of





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user-centered architecture, efficacy, protection, and privacy make them a risky option.

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