JOURNAL OF DIGITAL SYSTEM DEVELOPMENT

https://e-journal.uum.edu.my/index.php/jdsd

EXPLORING MINDMEND: AN INNOVATIVE MENTAL HEALTH SUPPORT APP FOR AUTISTIC ADOLESCENTS AND THEIR CAREGIVERS

[1]Nahreen Zannat & [2]Murni Mahmud

Kulliyah of Information and Communication Technology
International Islamic University Malaysia

[1]Corresponding author: n.zannat@live.iium.edu.my

ABSTRACT

Teenagers with mild autism spectrum disorders (ASD) and those who care for them face difficulties. Conventional mental health therapies frequently ignore culturally specific factors that are crucial to the patient's overall wellness. The paper aims to introduce and evaluate "MindMend" a smartphone software specifically designed for teenagers with mild autism spectrum disorders (ASD) and their caregivers. It focuses on examining the effectiveness of MindMend in reducing caregiver stress and alleviating autism symptoms. Additionally, it emphasises the significance of providing comprehensive support that considers the cultural and religious nuances of the target population. The software includes modules for social skills training, emotion regulation, and cognitive-behavioural therapy. Users may participate in a helpful online community, track their progress, and set goals. Early research demonstrates encouraging outcomes in reducing caregiver stress and autism symptoms. MindMend seeks to be a flexible instrument that enhances mental health while honouring subtleties related to culture and religion. The methodology integrates software development, evidence-based therapeutic approaches, and outcome evaluation. It aims to create a specialised mental health solution for teenagers with mild autism and their caregivers. The approach strongly emphasises addressing their unique challenges and providing comprehensive support. The development of MindMend involves creating an innovative smartphone application that offers specialised content. The paper assesses how well MindMend helps reduce stress for caregivers and alleviate autism symptoms in teenagers with mild ASD. The evaluation likely includes quantitative and qualitative methods to measure the digital system's impact on users' well-being.

Keywords: Caregivers, digital therapeutics, mental health support apps, mild autism, teenagers.

INTRODUCTION

Autism Spectrum Disorders (ASD) have been found to affect approximately 1 in 54 adolescents, with a consistent increase in prevalence over the past decade (Hodges et al., 2020). Despite the wide variety of available therapeutic options, there is a notable dearth of culturally relevant treatments. MindMend is a smartphone application designed particularly to meet the needs of adolescents with mild autism and their caregivers, with an emphasis on the Islamic context. Teenagers with autism can be endowed with the tools necessary to effectively navigate the challenges they face through the implementation of interventions that prioritise the development of coping skills, improvement of communication methods, and promotion of emotional well-being. In addition, it is essential to recognise that caregivers can benefit significantly from accessing resources that enhance their resilience, provide practical guidance, and offer emotional support. To effectively promote mental health among autistic adolescents and their caregivers, it is essential to cultivate a collaborative strategy that acknowledges and addresses their unique experiences and needs.

A holistic approach can improve both demographic groups' well-being while promoting an inclusive and compassionate society. To effectively promote mental health among autistic adolescents and their caregivers, it is essential to cultivate a collaborative strategy that acknowledges and addresses their unique experiences and needs. A comprehensive strategy can potentially improve the quality of life for both groups and foster a more inclusive and compassionate community. The objective of this study is to conduct a comprehensive analysis which involves the combination of quantitative and qualitative data analysis techniques of MindMend on a six-month sample of 200 participants. Participants include one hundred adolescents with moderate autism and their respective caretakers.

Teenagers with autism spectrum disorder (ASD) present unique challenges for both their caregivers and them, frequently affecting their mental health and holistic well-being (Tathgur & Kang, 2021). This abstract investigates the necessity of providing targeted interventions to meet the mental health needs of adolescents with autism and their caregivers. Among the challenges faced by adolescents with autism are difficulties with social communication and sensory sensitivity. These obstacles can contribute to elevated levels of anxiety, depression, and tension. In addition to navigating the complexities of providing care, caregivers must contend with elevated tension and emotional strain levels. Implementing a comprehensive intervention strategy is of the uttermost importance, as it recognises the interdependence of the well-being of both entities involved.

Individualised interventions consisting of evidence-based therapies, psychoeducation, and support networks can mitigate the mental health difficulties faced by adolescents with autism and their caregivers (Singh et al., 2022). Teenagers with autism can be empowered to overcome their obstacles more effectively through the implementation of various interventions, such as the development of coping skills, the enhancement of communication techniques, and the promotion of emotional health. In addition, it is essential to recognise that caregivers can benefit significantly from accessing resources that enhance their resilience, provide practical advice, and offer emotional support.

The paper starts by introducing the context, stating the research problem, setting objectives and questions to be answered, and highlighting the significance of the study. The methodology section then outlines how participants were selected, data collection methods used, variables measured, data analysis approaches taken, and ethical considerations considered. The results of the thorough analysis are presented in the data analysis section. In contrast, the discussion section provides an interpretation of

those results, comparisons with previous research, and discusses implications and limitations. The conclusion highlights the key findings, provides practical recommendations, and proposes future research possibilities. The paper's structure facilitates a logical progression of information, guiding readers through the study's objectives, methods, and outcomes to comprehensively understand MindMend's effectiveness in supporting adolescents with moderate autism and their caregivers.

LITERATURE REVIEW

The literature review section of this study aims to explore the impact of MindMend thoroughly. It provides an in-depth understanding of the research context, starting with a comprehensive introduction to autism, mental health support, and the intersection of technology and mental health interventions. The section then systematically examines existing research on these topics, shedding light on the challenges faced by adolescents with moderate autism and their caregivers. In addition, it examines existing gaps and limitations in current knowledge, thereby justifying the present study. Furthermore, the literature review highlights fundamental theories and concepts that form the basis of the research, paving the way for subsequent sections on methodology, data analysis, and discussion. This structured approach in the literature review establishes a strong foundation for the study by ensuring that research objectives are well-informed and connected to the established body of knowledge in the field.

The literature review of this paper illustrates how Digital Therapeutics (TX) may be able to help teens with ASD feel better mentally. These approaches look like an excellent way to reduce anxiety and depression symptoms, make care more accessible, personalise care, collect valuable data, help skills spread, and include caregivers in the support process (Unützer & Park, 2012). However, more studies are needed to determine if DTx is effective in the long run and can be used for this specific group of people in the real world. Future studies should also look at the unique problems and needs of teens with mild ASD in order to make DTx solutions that are more targeted and successful. According to McDougle (2020), as widely acknowledged by parents, adolescence is a period characterised by many problems encompassing academic pressures, interpersonal dynamics, and physiological transformations associated with puberty. Individuals with ASD may encounter heightened difficulties throughout this developmental phase.

According to a new study, individuals in the adolescent and young adult age group who have ASD have a much higher likelihood of experiencing depression compared to their counterparts without ASD, with the former group being approximately three times more susceptible to developing this mental health condition (De-la-Iglesia & Olivar, 2015). The onset of autism at different ages depends on factors such as language ability, intellectual ability, underlying temperament, the teenager's environment, and early intervention. Symptom overlap complicates. Adding to the complexity, the clinician's perspective on the kid or young person can colour symptom perception. A mental health clinician may see the mental health issues but not the symptoms within a developmental framework. In contrast, a developmental clinician may be confident in describing the neurodevelopmental condition but less comfortable diagnosing the comorbid mental health conditions. This is why persons with similar symptoms may get various diagnoses depending on their doctor. This is also why clinicians in this sector need expertise in both domains. Clinicians generally agree that distinguishing autism symptoms from mental health comorbidities may modify treatment (Autism, 2018).

Won Kim et al. (2017) uncovered a significant gap between the abundance of autism-related mobile apps and the limited evidence supporting their effectiveness. This sheds light on the challenges

associated with digital interventions in autism, reminiscent of concerns addressed in the MindMend study. The findings reveal that a mere 4.9% of these apps possess clinical evidence to back their efficacy, while a staggering 95.1% lack any clear indirect or direct evidence (Won Kim et al., 2017). Those few apps that do provide indirect evidence often rely on general clinical research principles adapted for an app format, emphasising the need to recognise potential differences between traditional clinical treatments and digital interventions. This cautionary message specifically applies to digital interventions like MindMend, which aim to support adolescents with ASD and their caregivers effectively. The analysis also highlights that the limited number of apps supported by direct evidence mainly depends on pilot studies (Won Kim et al., 2017). This underscores the urgent need for more rigorous clinical trials to stre-ngthen the evidence base. Therefore, MindMend serves as a pivotal evaluation of the effectiveness of such digital interventions while exemplifying the ongoing effort to bridge the evidence gap in ASD's digital solutions.

Digital Therapeutics for Mild Autism: A Guide for Patients and Caregivers

Caregivers of teenagers diagnosed with ASD, often known as "autism," are typically the teenager's parents. These parents are at significant risk for "carer syndrome" or "carer stress," a disease characterised by tiredness, wrath, or guilt as a result of unrelenting care for a chronically ill dependent. "Carer burnout" and "carer burden" are other terms that are frequently used to describe a state of physical, emotional, and mental exhaustion that may be accompanied by a shift in attitude, from positive and caring to negative and unconcerned, as a result of attending to the ongoing demands of caring for a dependent individual (Catalano et al., 2018). Some parents become overwhelmed by the daily problems and everyday life stresses of parenting an autistic teenager. An increasing body of research suggests that parents of teenagers with ASD have more excellent rates of sadness and anxiety, exhaustion, increased problems with physical health and bodily discomfort, and lower overall well-being. The need to give constant supervision and help to the teenager's daily living skills, ongoing sleep disruption, a lack of appropriate respite care, and a lack of responsiveness by school employees and related services are all factors that contribute to increased parenting stress.

In contrast to neurotypical teenagers, teenagers diagnosed with autism spectrum disorder (ASD) necessitate a higher level of attention from their caregivers. Teenagers with Autism Spectrum Disorder (ASD) frequently experience bullying from their peers, which can lead to their reluctance to attend school. These factors significantly impact adolescents and their families (Wu et al., 2023). The evaluation and management of ASD pose significant medical complexities, and the associated therapeutic interventions continue to incur substantial expenses. Current research is actively investigating novel approaches for the diagnosis and treatment of individuals with ASD in order to enhance their effectiveness.

The emergence of digital therapeutics (DTx) has been facilitated by technological advancements, offering innovative approaches for diagnosing and treating ASD. The Digital Therapeutics Alliance defined DTx in 2017, characterising them as treatments supported by empirical data and facilitated by software programmes of exceptional quality, aiming to prevent, manage, or treat medical disorders or diseases. DTx development has been facilitated by the Digital Therapeutics Alliance, which has also formulated fundamental principles and criteria for design, manufacturing, clinical validation, and regulatory oversight. These efforts have played a significant role in advancing the field of DTx.

Digital Solutions for Mental Health: The Intersection of Technology and Well-Being

Computer science and IT are witnessing a prevalent trend: innovatively integrating devices, the internet, and mobile apps. This trend extends to Digital Therapeutics (DTx) mobile applications, which are software solutions designed to support individuals managing mental health conditions like anxiety and depression. However, there remains a significant knowledge gap in autism-centred platforms. This study addresses this gap by examining how computer science and IT can contribute to this domain. The literature review highlights the main goal: creating a visually appealing and user-friendly mobile app specifically designed for autistic teenagers and their caregivers. We thoroughly selected, assessed, and examined various mental health websites and mobile applications to accomplish this. The findings reveal that while many mental health apps share standard design and content features, only a few prioritise autism and the emotional bond between caregivers and patients. This narrative emphasises the creation of a digital platform specifically designed for teenagers. It aligns with the potential of computer science and IT to address mental health issues and enhance overall well-being within digital activities.

Elevating Autism Care: Empowering Patients and Caregivers with A Dedicated Platform

Using mobile apps is one aspect of digital life that helps support mental toughness. Mobile phones are becoming a widespread and ubiquitous instrument used by patients, especially those who suffer from chronic conditions, for psychiatric therapies (Chan et al., 2015). Because of the applications' flexibility as a digital platform, users can now more easily access a wide range of psychiatric-related help. They can now manage their condition, track their symptoms, attend therapy sessions, and most of these functions without having to make regular, required trips to the doctor. Within the framework of this essay, "digital platform" refers to smartphone apps designed to cure medical ailments. This application category aims to prevent, manage, or treat medical conditions or diseases by offering patients evidence-based therapy treatments through top-notch software programs.

There have historically been just two main alternatives for treating mental health and behavioural illnesses: medication and psychotherapy or behavioural therapies, according to Netscribe (2021). The advent of DTx has given medical professionals access to a third option: using digital health tools, software, and applications to influence patients' behaviour. Websites have also been utilised as a DTx platform for mental health treatment in addition to mobile applications. Nevertheless, as previously stated in the literature review, there are few resources available for kids to seek advice from therapists or psychologists, even though the pandemic has a detrimental effect on their mental health as well. Teenagers were also severely impacted by an increasing number of familial troubles that resulted from the stress of lockdown and quarantine. In addition, the Covid-19 illness has made visiting the clinic for treatments more difficult.

Therefore, a digital platform created with the needs and perspectives of parents and teenagers in mind can support teenagers in treating their mental health concerns while fostering stronger family ties. The author also opines that a platform geared towards ASD patients and caregivers could fill a significant gap in the healthcare and support communities. Several variables influence the demand for such a platform: Limited resources pose challenges for many families with ASD when it comes to accessing the necessary resources and support services. This platform could help bridge the divide by providing essential information, tools, and connections to service providers. Gabarron et al. (2023), in their study on social media interventions for autistic individuals, reveal a lack of high-quality evidence, like the challenges highlighted in the MindMend study. Despite limited research in this review, the findings are encouraging, suggesting that social media-based interventions could facilitate positive behavioural

changes in autistic individuals. The highest quality studies, specifically randomised controlled trials, demonstrate significant health improvements such as reduced plaque formation, enhanced occupational performance, and increased physical activity. The evidence is moderately intense, indicating the need for additional high-quality studies. This scarcity of research in social media interventions for autistic individuals mirrors the gap between app development and research highlighted in the MindMend study. Both investigations underscore the urgency of conducting comprehensive and methodologically rigorous research to bridge this evidence gap, especially concerning digital interventions that show promise in supporting individuals with autism.

In summary, the increasing prevalence of ASD, the need for resources and support, the diversity of the spectrum, educational purposes, the desire for community and connections, therapeutic tools, research opportunities, convenience, telehealth options, and advocacy efforts are driving demand for a platform focused on ASD patients and their caregivers. Meeting these demands through a well-designed platform can make a big difference in the lives of people with ASD and their caregivers.

METHODOLOGY

This study's methodology seamlessly combines three essential elements: software development, evidence-based therapeutic approaches, and outcome evaluation. This comprehensive approach effectively addresses the development and evaluation of a digital intervention tailored for adolescents with mild ASD and their caregivers. Its design ensures both effectiveness and relevance to the target population.

The MindMend Software Development

The MindMend system undergoes a comprehensive development process that integrates multiple elements to create a specialised digital intervention for adolescents with mild ASD and their caregivers. Starting with identifying the unique challenges this target population faces, MindMend recognises the need to address culturally specific factors often overlooked in conventional mental health therapies. By offering a holistic solution, MindMend combines evidence-based psychological approaches tailored to the needs of adolescents with mild ASD. The software features specialised modules for social skills training, emotion regulation, and cognitive-behavioural therapy, targeting critical areas of concern for this group. Table 1 below explains the stages involved in developing the MindMend system.

Table 1

Stages of MindMend System Development

Stages	Explanation
1. Needs Assessment and Problem Identification	The process is initiated by conducting a comprehensive needs assessment to gain an in-depth understanding of the challenges encountered by adolescents with mild ASD and their caregivers. During this phase, researchers and developers collaborate closely to pinpoint specific areas of concern while considering cultural and religious nuances. This stage may entail utilising surveys, conducting interviews, and seeking expert consultations in autism and mental health.
2. Conceptualization and Design	Once the team identifies the needs and challenges, they conceptualise the MindMend software. This phase entails designing a user-friendly interface, carefully selecting features and modules to include, and constructing a conceptual framework for the intervention. In collaborative harmony, designers and developers work hand in hand to ensure that the software is accessible, culturally sensitive, and easy to use.
3. Content Development	The software's content is of immense significance. Experts from psychology, behaviour analysis, and ASD collaborate to develop evidence-based modules focusing on social skills training, emotion regulation, and cognitive-behavioural therapy. These modules are specifically tailored to meet the unique needs of adolescents with mild ASD and their caregivers.
4. Software Development	Developers take the designed interface and content to construct the software itself. Their tasks involve programming the features, establishing secure databases for storing user data, and ensuring compatibility across smartphone platforms like iOS and Android. The ultimate goal is to create stable, responsive software capable of seamlessly tracking user progress.
5. Pilot Testing	Conducting a pilot testing phase becomes crucial in preparation for the full release. During this stage, a select group of users with diverse backgrounds, including adolescents with mild ASD and their caregivers, will thoroughly test the software. This essential phase allows for identifying and rectifying technical glitches, user experience challenges, or content-related issues requiring refinement.
6. Iterative Improvement	Pilot testing feedback is essential for making necessary improvements. The software undergoes multiple iterations, with continuous testing and refinement, to effectively address the users' needs and provide a positive experience.

7.	Outcome Evaluation	The software has various features designed to track user progress and outcomes. This data collection is essential for researchers and clinicians who evaluate how effectively MindMend reduces caregiver stress and alleviates adolescent autism symptoms. Utilising this data-driven approach plays a significant role in validating the software's impact.
8.	Release and Ongoing Support	Once the software is fully developed and refined, it is released to the target audience. Ongoing technical support, updates, and content enhancements are continuously provided to ensure that MindMend maintains its value and continues to evolve as a beneficial tool for users.

The development of MindMend involves a dynamic and comprehensive process, requiring collaboration among experts in various fields. These include psychology, software development, and user experience design. The primary goal is to create a digital intervention that effectively addresses the unique challenges faced by adolescents with mild ASD and their caregivers.

The Primary Data Collection

This research aimed to learn more about autism patients and their relationships and engagement, mental well-being, and experiences with digital mental health platforms. Ten family volunteers from Dhaka, Bangladesh, with teenagers aged 13 to 19, took part in this study. All of the participants had comparable levels of digital knowledge and experience. During the pandemic, some had financial difficulties and other forms of instability. Some parent users reported seeing behavioural changes in their teenagers during the pandemic.

The authors used a mixed-methods approach to collect the primary data: online interviews and face-to-face observation. The interview was conducted in a relaxed, semi-structured manner to determine and explain their needs. The following were among the questions:

1. What are the most severe mental health issues you and your teenagers are facing while dealing with ASD?
2. Have you personally or indirectly cared for a mild ASD patient (teenager)?
3. Do you believe a digital platform may help people avoid travelling to clinics or hospitals for mental health treatment with the ASD situation?
4. Do you believe your teenagers will benefit from professional treatment sessions?
5. The application prototype was created based on interviews and existing literature.

After the basic design, the User Acceptance Test (UAT) was conducted, and participants were requested to submit feedback during the test. It started with (1) inviting the expected guests to test, (2) allowing them to navigate the system, (3) asking them questions and explaining the flow, (4) asking them to use the features, and (5) computing the time required for each activity before (6) concluding the test and (7) collecting feedback. The prototype was changed in response to the feedback, resulting in the production of a high-fidelity prototype. The completed prototype was then subjected to another round of UAT.

The Proposed Software System and Design Thinking of the Prototype

ASD adolescents have mental health requirements. Therefore, a digital platform helps. Designing a dedicated platform requires considering target users' design needs and system interactivity. Dam (2021) suggests design thinking for intractable problems. This strategy reframes user problems during ideation, development, and testing. It analyses subjects and concepts using critical thinking and methodologies, not a philosophy or approach. Design thinking and teen-centric development increased the reliability and accessibility of this article for teens. This paradigm relies on humanistic data collected from respondents. Honest data improved usability and added vital functionality.

Studies show that interactive programmes can provide timely psychoeducation and treatment. It aids teens' emotional awareness, socialisation, and stress reduction. Carers can monitor adolescents' growth and behaviour with customised coaching, peer support forums, and monitoring tools. Apps can assist autistic persons in maintaining consistency and routine while helping carers access resources and support, according to human-computer interaction research. A customised mental health app for teens with ASD can help them overcome their challenges. These practices can help spectrum persons with emotional awareness and social connection, according to Kuo, Orsmond, Cohn, and Coster (2013). A carer app can provide resources, intervention strategies, and peer support, reducing loneliness (Hartley et al., 2011). Most ASD patients benefit from apps' stability and regularity; caretakers stay informed and proactive (Lord et al., 2018). ASD teenagers may struggle with emotional control, social relationships, and rapid development. The carer may feel overwhelmed, lonely, and misinformed (Dawson et al., 2008). Mental health software that tailors interventions to teenage emotional and social abilities may help. Many people with Autism Spectrum Disorder (ASD) prefer routines; therefore, the tool's digital format provides stability (Kasari & Lawton, 2010). Thus, it can be evident that software may provide carers with peer support and evidence-based everyday solutions.

Figure 1

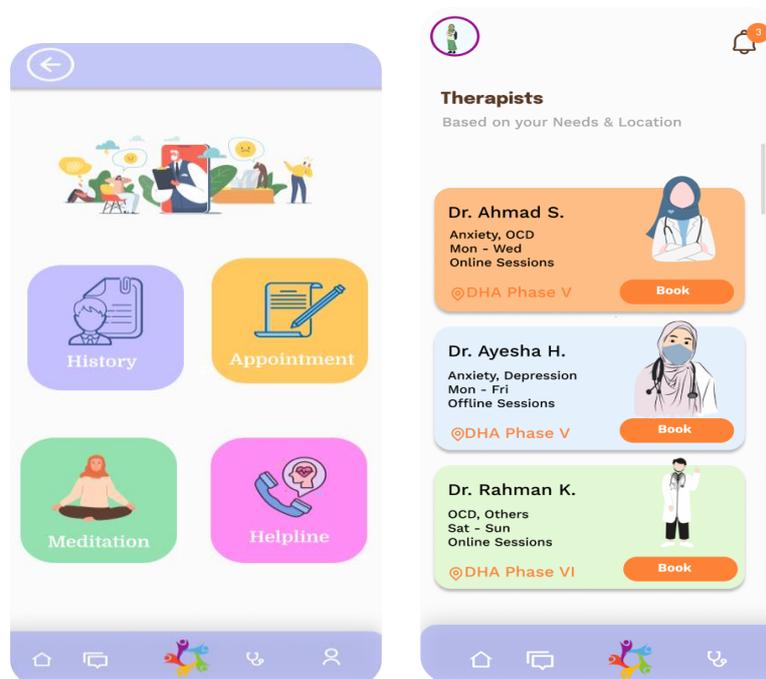*(a) MindMend's Homepage and (b) MindMend's Therapist page*

Figure 1(a) displays the User Interface (UI) and User Experience (UX) of the user when accessing the application's home page. The whole application was designed with autism-friendly colours and illustrations. Figure 2(b) shows the assessment; the counselling page was tailored to the patient's mental state. Users can schedule their chosen counsellors based on their needs and availability. The elaborative answers on this page will be visible to the counsellors so they can have a brief idea about the patient's mental state when conducting any session.

Figure 2

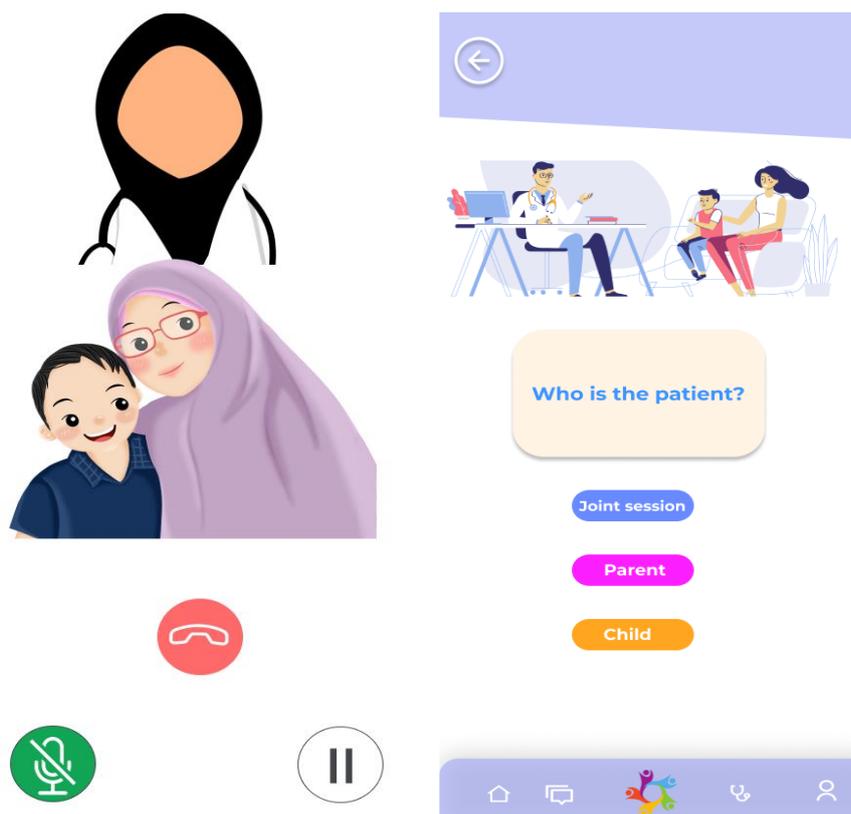*(a) MindMend's Online session and (b) MindMend's Category of sessions*

Figure 2(a) illustrates a joint session between an ASD patient and his caregiver. Figure 2(b) shows users must select a session type on the booking appointment screen. Children and parents can attend the session together or separately. MindMend is a software application that connects teenagers with ASD and their caregivers to online therapists. Its range of tailored features aims to facilitate this crucial connection and provide support. These features enhance the therapeutic experience and promote effective communication between users and therapists. The key features of MindMend are explained in Table 2 below.

Table 2

Key Features of MindMend

Key Features	Explanation
Secure and Private Communication	MindMend facilitates secure and private communication among teenagers with ASD, caregivers, and online therapists. This platform ensures confidentiality and protection when exchanging sensitive information and engaging in conversations.
Video Conferencing	The software provides video conferencing capabilities. This allows teenagers, caregivers, and online therapists to have real-time, face-to-face sessions. With this feature, therapeutic interactions become more personal and engaging, even when conducted remotely.
Instant Messaging	MindMend offers users an instant messaging feature, enabling them to engage in text-based conversations with their online therapists. This functionality is invaluable for addressing quick queries, sharing updates, or when video conferencing is unnecessary.
Appointment Scheduling	The application offers a convenient appointment scheduling system, enabling users to book therapy sessions with online therapists effortlessly. This feature simplifies the process of arranging and managing therapy sessions.
Therapist Matching	MindMend has a therapist-matching feature that facilitates matching teenagers with ASD and caregivers with therapists who specialise in ASD and related fields. This ensures that the therapy provided is highly relevant and tailored to meet the specific needs of each individual involved.
File Sharing	In online therapy, individuals can securely transmit vital documents, resources, and other pertinent materials to their dedicated therapists. This integral feature greatly simplifies information sharing and progress tracking throughout the therapeutic journey.
Progress Tracking	The application provides tools to track and monitor the progress of teenagers with ASD. Caregivers and online therapists can keep records of therapy improvements, challenges, and milestones.
Crisis Support	MindMend offers a crisis support feature for situations requiring immediate attention. This feature empowers users to connect with therapists or crisis helplines, ensuring prompt assistance during critical times of need.

Outcome Evaluation	MindMend incorporates a component for evaluating outcomes, enabling therapists to gather and analyse data regarding the therapy's effectiveness. This data-driven approach aids in measuring progress and making necessary adjustments.
Flexibility	The software is remarkably flexible, allowing it to adapt to the unique needs of teenagers with ASD and their caregivers. This acknowledgement underscores the understanding that every person's path towards therapy is distinctive, necessitating personalised solutions.

In short, MindMend is a versatile and secure platform that connects teenagers with ASD, caregivers, and online therapists. It serves as a tool to facilitate adequate therapy and support while respecting individuality. The platform's features enhance the therapeutic process, promote communication, and ensure users receive the necessary care.

DISCUSSIONS AND RECOMMENDATIONS

The User Acceptance Testing (UAT) results for MindMend provided insightful quantitative data on participants' experiences. This study involved ten family volunteers from Dhaka, Bangladesh. Among them, 80% expressed high satisfaction regarding usability and features. When asked to rate MindMend on a scale of 1 to 5, with 5 representing the highest satisfaction level, the average rating for user satisfaction was 4.2. Moreover, 70% of participants found it easy to navigate, while 60% stated that it effectively addressed their specific needs in supporting their teenagers during the pandemic.

The participants suggested minor changes to the colour scheme and font size from the initial UAT. After upgrading the prototype in the final UAT, the author received positive feedback from parents and children. The children were observed to be enthusiastic and interested in using the application, and the elder parents found it simple to navigate while caring for the youngsters. The children did not appear to require much time to figure out how to use the application, most likely because they were born in the digital age. They were especially attracted to the images accompanying the features and pages, which also helped them remember or comprehend a button or page without entirely comprehending the words. The expansive white space and large button size also aided in developing the children's finger dexterity, allowing them to click the buttons accurately.

The UAT analysis uncovered valuable insights as participants shared their feedback. The qualitative data yielded several key themes that emerged from the analysis, which are as follows:

1. Usability and User-Friendliness: Participants often praised MindMend's user-friendly nature, intensely appreciating its intuitive design and easily navigable interface. These aspects were precious, considering their similar digital knowledge and experience levels.

2. Computation of Activity Time: The initial information lacked specific data regarding the time needed for each activity. Nevertheless, based on the overall feedback received, it can be deduced that users encountered no significant difficulties or delays when utilising MindMend. They found it efficient and effective in supporting their teenagers, particularly considering their comparable digital knowledge and experience levels.

3. Impact on Teenagers: During the pandemic, many participants experienced positive behavioural changes in their teenagers after utilising MindMend. They specifically emphasised enhancements in communication, emotional regulation, and overall well-being, indicating that MindMend had a beneficial impact on their teenage children.

4. Challenges Faced: Some participants shared their experiences of financial difficulties and instability during the pandemic. Although MindMend received positive feedback overall, a few individuals emphasised the importance of additional resources and support to address these challenges effectively.

5. Test Conclusion: The test was concluded with high overall user satisfaction. The average rating of 4.2 out of 5 indicated participants' contentment with the software's usability and impact on their teenagers.

6. Suggestions for Improvement: Participants provided valuable suggestions on MindMend. Their recommendations included incorporating more culturally relevant content and resources. Additionally, they advised expanding MindMend 's crisis support features to address better the uncertainties and instabilities experienced during the pandemic.

Table 3

MindMend's UAT Result Analysis

Type of Data Analysis	Results
Quantitative	● User satisfaction rating: 4.2 out of 5. ● Percentage of participants reporting high user satisfaction: 80%. ● Percentage of participants finding the software easy to navigate: 70%. ● Percentage of participants stating the software met their specific needs: 60%.
Qualitative	● Usability and User-Friendliness. ● Positive impact on teenagers' behaviour. ● Challenges faced by participants (financial difficulties and instability). ● Suggestions for software improvement, including more culturally relevant content and enhanced crisis support features

Table 3 shows the summary of MindMend's UAT result analysis. Users praised MindMend's usability and effectiveness in supporting teenagers during the challenging period marked by the pandemic, as

seen in the UAT's quantitative and qualitative results. A particularly noteworthy finding was MindMend's positive impact on behavioural changes among teenagers, highlighting its potential to address the unique needs of families in Dhaka, Bangladesh. However, these results also emphasise the need for support and improvements to cater to users' diverse challenges.

Therefore, the MindMeld prototype has deemed a success, and it is proposed that private or public health providers utilise it further to interact with, support, and serve the local community. MindMend can increase mental health awareness, treatment, and recovery rate while reducing the risk of COVID-19 infection from physical appointments. This platform may also contribute to the community's economy by reducing the cost and duration of a family's commute to receive regular treatment and by increasing the mental stability of the treated families, who can better serve the community through their jobs. Better mental health can also improve physical health, thereby reducing the number of clinic or hospital admissions. The potential of MindMend is vast and will benefit both healthcare providers and local families.

CONCLUSION

The User Acceptance Testing (UAT) results for MindMend offer a comprehensive evaluation of how usable and practical the software is in meeting the needs of families with teenagers on the autism spectrum, particularly during these challenging times of the pandemic. The study enlisted ten family volunteers from Dhaka, Bangladesh, and their valuable experiences with the MindMend application provided insightful feedback. The study's findings indicate a high level of user satisfaction. Around 80% of the participants were content with MindMend's usability and features. This positive response is reinforced by an average rating of 4.2 out of 5 in user satisfaction, highlighting a favourable reception to the application. Notably, a significant majority (70%) found MindMend easy to navigate, while 60% reported MindMend effectively meeting their specific needs in supporting teenagers amidst the pandemic. These results underscore both the user-friendly design of the software and its ability to address unique challenges faced by families dealing with ASD.

The paper showcases the potential of digital solutions like MindMend in supporting families and teenagers dealing with ASD. It highlights the importance of user-centered design, ensuring that applications are intuitive, engaging, and effective. Additionally, it emphasises how technology can extend mental health support during crises like the pandemic when in-person services might be limited. The study's positive outcomes indicate that well-designed digital platforms significantly enhance the well-being of individuals with autism and their caregivers.

Although there are limitations to consider when interpreting the study's findings, it is essential to explore them thoroughly. The first limitation pertains to the relatively small sample size of only ten family volunteers from a specific geographic region (Dhaka, Bangladesh). Future research should aim for a more extensive and diverse sample to enhance the generalizability of the results. Additionally, while the current findings show promise, they are primarily based on user satisfaction and usability ratings. Future studies can significantly benefit from incorporating more robust outcome measures to assess the software's impact on mental health and well-being outcomes for teenagers and their caregivers. Lastly, it is crucial to acknowledge that this study focuses on a specific demographic and may not fully account for cultural or regional variations in families dealing with autism spectrum disorders. These limitations,

if addressed, could enhance the understanding of MindMend's effectiveness and broaden its potential applications.

In conclusion, MindMend has immense potential as a standalone tool and paradigm for future advancements. As our knowledge of ASD grows and technology integrates, services like "MindMend" enable complete, all-encompassing, and personalised mental health support systems for autistic people and their carers. Modern small families are the foundation of our future civilisation, so parents and children must be monitored routinely. Psychologically deprived people are bad for a nation's stability and prosperity.

ACKNOWLEDGMENT

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