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PAPER

A Mobile ADHD Screening App for Primary School Children: A Pilot Study in Thai Primary Care

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ABSTRACT

Attention-deficit hyperactivity disorder (ADHD) is a common condition affecting children's learning and behavior, with a high level of prevalence in Thailand. However, early detection remains challenging due to the limited number of screening tools for parents and teachers. The aim of this study was to develop the ADHD Scanning app, a mobile tool for early ADHD screening in primary schools based on the seven-color PBRI model (Traffic Light System). A mixed-methods approach was used in which the SNAP-IV scale was combined with the PBRI model and expert interviews. The completed app enables visual classification of the severity of ADHD symptoms through a seven-color system, educational modules, and pre- and post-assessments, and offers a guidebook for ADHD support. It was piloted with 30 parents and teachers of children aged six to 12 and was found to have good content validity (IOC = 0.87) according to expert review. The ADHD Scanning app identified 47% of children as high risk (dark green) for inattention, 17% for hyperactivity/impulsivity (dark green), and 10% for oppositional behavior (dark green). Most children were classified as either normal (white) or at risk (pale green), with none classified as at severe risk. User satisfaction was very high (M = 4.54, SD = 0.50), with the highest scores for content accuracy (M = 4.67, SD = 0.50), design clarity (M = 4.63, SD = 0.56), and usability (M = 4.43, SD = 0.84). The ADHD Scanning app has significant potential as an accessible tool for early ADHD detection and education in schools and homes.

KEYWORDS

attention-deficit hyperactivity disorder (ADHD), children, early detection, PBRI model, mobile application, SNAP-IV

1 INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a common neurodevelopmental disorder characterized by persistent patterns of inattention, hyperactivity, and impulsiveness, symptoms that can significantly impair a child's academic performance, emotional control, and social functioning [1]. ADHD affects around 5.4% to 8.1% of children and adolescents worldwide [2, 3]. About one in nine children in the US (11.4%)

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have been diagnosed with ADHD, with 10.5% being currently affected. Of those with current ADHD, 58.1% were found to have moderate to severe symptoms, 77.9% had a co-occurring disorder, 53.6% were receiving medication, 44.4% were receiving behavioral treatment, and 30.1% were receiving no ADHD-specific treatment [4]. In Thailand, the nationwide incidence of ADHD among pupils was recorded at 8.1% in 2012, with boys suffering at a greater rate (12%) than girls (4.2%) [5]. A recent school-based study revealed ADHD risk patterns of 10.09% for inattention and 5.50% for hyperactivity, along with a 4.59% risk for oppositional defiant disorder (ODD) [6].

Despite the high prevalence of ADHD, early detection remains limited, particularly in community and primary care settings [7, 8]. Although parents and teachers are often the first to observe behavioral problems, they often lack an adequate knowledge of ADHD and have limited access to validated screening tools that are suitable for early use outside of clinical environments [9, 10]. This lack of resources can result in delayed diagnosis and intervention, which can negatively affect children's learning, social relationships, and emotional development [11]. Access to gold-standard ADHD diagnostics remains limited due to their cost and a lack of availability, despite advances in evidence-based therapies. In this context, digital assessments, especially those using user-centered and ability-based designs, can improve scalability and accessibility [12].

Recent advancements in digital health technologies have shown promise in terms of improving mental health screening and treatment. Mobile health (mHealth) applications offer a cost-effective, scalable, and user-friendly platform for the identification and management of ADHD symptoms, and several tools have been developed to align with standardized diagnostic instruments such as SNAP-IV, WHO-ASRS, and DIVA 2.0, or criteria from the DSM and ICD [13–15]. However, recent reviews suggest that many ADHD-focused mobile applications may not fully adhere to established diagnostic frameworks and that they are often under-evaluated in terms of their reliability, validity, or usability in non-clinical populations [12, 16, 17]. Consequently, despite their potential to enhance accessibility and scalability, there remains a notable gap in the availability of rigorously validated, evidence-based tools tailored to non-specialist users, including parents and teachers. This underscores the need for a scientifically robust and practically applicable digital solution to facilitate early identification and appropriate referral of children at risk for ADHD.

The seven-color PBRI model (Traffic Light System) was originally developed by the Praboromarajchanok Institute (PBRI), Ministry of Public Health, Thailand, as an innovative tool for the prevention and early detection of non-communicable diseases (NCDs) in community and primary care settings. The model uses a color-coded scale (white, light green, green, yellow, orange, red, and black) to identify individuals at varying levels of health risk, with a particular focus on conditions such as hypertension and diabetes [18]. This model forms part of a broader program of transformative health innovations under the leadership of Professor Vichai Tienthavorn, President of the PI, whose efforts have led to the development of effective national policies for the prevention and control of thalassemia, diabetes, and hypertension, using communication tools that encourage behavior change at scale. He has also addressed the poor distribution of the health workforce in border and rural areas, thus strengthening Thailand's public health capacity and equity [18]. In 2024, the World Health Organization awarded the Sasakawa Health Prize to the PBRI in recognition of its outstanding contributions to health systems strengthening and disease prevention [19]. The PBRI model and its implementation through the PBRI-based rational intervention framework have yielded measurable success in community mobilization and people-centered care across various life stages in low-resource settings [20, 21].

Building on this proven framework, the present study introduces an innovative extension of the PBRI model to behavioral health by integrating it with the SNAP-IV

rating scale, a validated instrument for assessing ADHD symptoms. The resulting ADHD Scanning app translates clinical scores into a culturally adapted, color-coded interface that enhances understanding and decision-making for teachers, parents, and community health workers. This tool facilitates the early screening and timely referral of school-aged children at risk of ADHD in both educational and primary care settings. Our approach addresses critical gaps in evidence-based, user-centered design and leverages the scalability of cloud technology [22] to offer accessible ADHD screening in educational ecosystems.

The aim of this study was to develop and evaluate the ADHD Scanning app as a localized, technology-assisted tool to support early ADHD detection. This study represents the preliminary phase of a larger, multi-phase research project that involves developing and validating a mobile application for early ADHD screening across a diverse range of settings.

2 LITERATURE REVIEW

2.1 ADHD screening and mHealth

Recent advancements in ADHD screening applications have involved diverse technological approaches tailored to different user groups and contexts. The proposed app, which is built using modern web technologies such as Vue.js, Node.js, and MongoDB, emphasizes responsiveness, scalability, data security, and cultural relevance, and it targets teachers and parents through the use of intuitive modules for screening, progress tracking, and visual interpretation of results. This approach stands in contrast to established tools such as QbCheck, which utilize proprietary software combined with webcam-based facial and movement tracking and are primarily for clinical use, with less emphasis on cultural adaptation [23].

Similarly, the Sendero Gris app, which was developed with Kodular and Firebase for tablets, focuses on executive function screening in Spanish-speaking school environments, offering secure data access but limited device compatibility and broader accessibility [24]. Other mobile applications, such as FOCUS ADHD and AKL-X0,1 employ native or hybrid platforms and focus on symptom tracking and cognitive training, with variable localization and security practices [25]. The use of a modern web stack in our app aligns with best practices for scalable, maintainable, and secure digital health solutions, and supports broad accessibility and cultural customization, which are critical factors for effective ADHD screening outside of clinical settings [12, 26]. The integration of user-centered design with robust technology and cultural relevance appears to be essential for maximizing the adoption and impact of ADHD screening tools globally.

In addition to ADHD-specific tools, recent developments in educational technology have underscored the transformative potential of cloud computing, augmented reality (AR), and artificial intelligence (AI) in education. Papadakis et al. [22] demonstrated how cloud-based smart technologies and computer simulations could facilitate flexible, open learning environments; these approaches enable personalized, scalable interventions that could be adapted effectively for health screening applications, including ADHD detection. The subsequent work of these authors further explored the synergistic integration of cloud technologies with AR to provide immersive educational experiences, suggesting promising directions for integrating real-time monitoring and engagement features into mHealth apps [27].

Aravantinos et al. [28] systematically reviewed AI-driven educational approaches in primary school settings, with an emphasis on adaptive learning, automated assessment, and personalized feedback mechanisms. These capabilities align closely with

the needs of ADHD management tools targeting school-aged children. Their review highlighted that context-aware, pedagogically informed AI solutions could improve screening accuracy and user adherence.

In general, the integration of advanced web technologies with culturally sensitive design, cloud infrastructure, and AI-enhanced educational paradigms means that mHealth ADHD screening solutions can achieve maximal efficacy. A combination of scalable technical architectures, such as Vue.js/Node.js/MongoDB stacks, with innovations in cloud and AR environments facilitates the deployment of personalized, secure, and accessible screening tools beyond traditional clinical settings. This broadens their reach into schools and homes worldwide, thus addressing critical gaps in early ADHD diagnosis and intervention [22, 27, 28].

3 METHOD

3.1 Study design

In this study, a research and development (R&D) model was employed in which quantitative and qualitative approaches were combined to create and evaluate a mobile application for ADHD screening. The research took place at a primary school in Chiangmai, Thailand (see Figure 1).

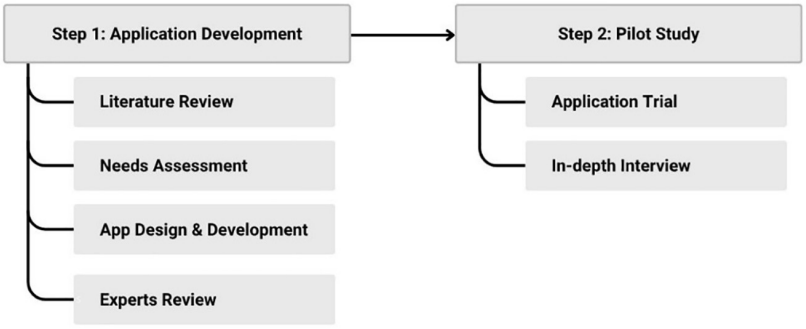

Fig. 1. Study design

3.2 Ethical considerations

The study involved human participants, including children, and was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [29]. Ethical approval was obtained from the Ethics Committee of Boromarajonani College of Nursing Chiang Mai (Reference No. BCNT09/2567). Informed consent was obtained from all participants and their legal guardians prior to participation. To enhance transparency and completeness in reporting, the study adhered to the mHealth Evidence Reporting and Assessment (mERA) checklist developed by the World Health Organization [19]. This framework guided the documentation on the design and delivery of the intervention, the technology platform (Android and iOS), user access, data security, and the implementation context.

To enhance transparency and completeness in reporting, the study adhered to the **mERA checklist** developed by the World Health Organization [30]. A mapping of the mERA items—such as infrastructure, platform, content, user access, usability testing, and data security—is provided in Appendix A to demonstrate the study's compliance with digital health reporting standards. This ensures alignment with international expectations for mHealth intervention studies.

While the **CONSORT 2010 statement** is the standard for randomized controlled trials, it is not directly applicable to this Phase 1 study, which did not involve a controlled clinical intervention or randomization. This study focuses on formative development, usability testing, and feasibility in preparation for a future Phase 2 study, where CONSORT-EHEALTH guidelines will be considered for trial reporting. The current approach is consistent with recommendations for early-stage digital health intervention design, as outlined in recent reporting frameworks [30].

3.3 Application development

A literature review, situational analysis, and a needs assessment with 15 stakeholders (teachers, parents, healthcare professionals, and community leaders) revealed strong demand for an accessible, culturally appropriate ADHD screening tool. The findings supported the development of a mobile app based on the SNAP-IV scale with the PBRI model. Expert input from child mental health professionals guided the refinement of this tool to ensure accuracy and usability.

The application was developed using modern web technologies (Vue.js, Node.js, MongoDB) to ensure responsiveness, scalability, and data security. Its design included intuitive modules for ADHD screening, progress tracking, and visual interpretation of results, with a focus on accessibility and cultural relevance (see Figure 2). The ADHD Scanning app was developed for both Android and iOS platforms, with compatibility with Android version 7.0 and above and iOS version 12.0 and above. The app was distributed via institutional download links during the pilot phase, with installation supported on users' personal devices.

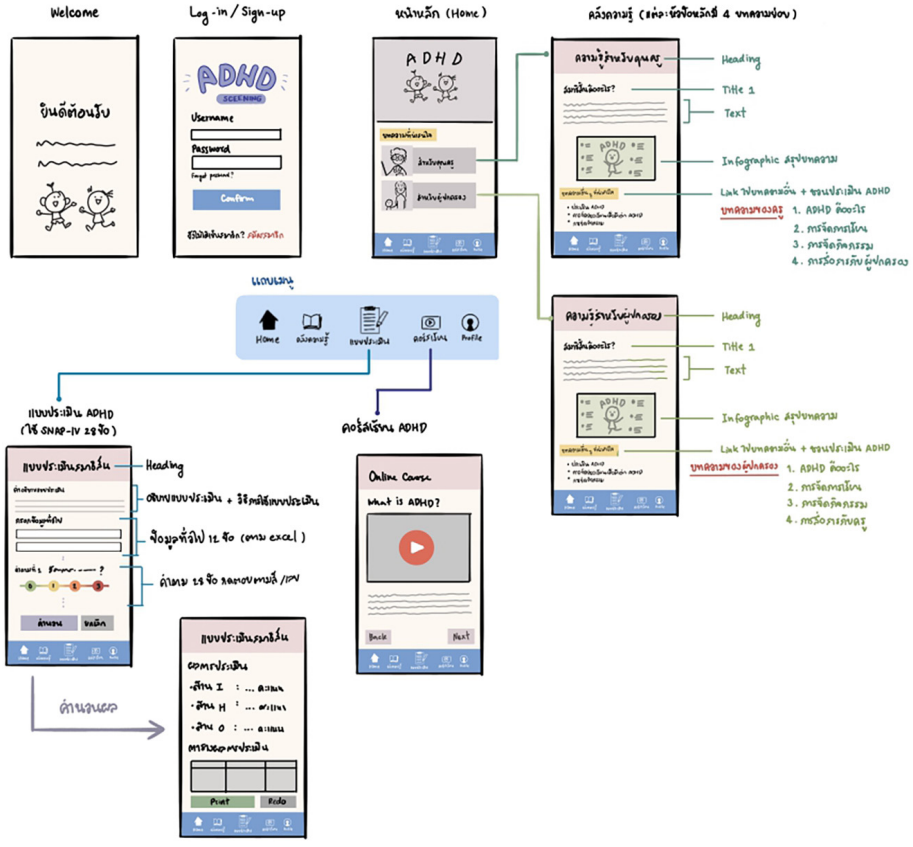

Fig. 2. Application design

3.4 Expert review

After developing the ADHD Scanning app, we invited a panel of five experts to evaluate its quality, consisting of a psychiatrist, a mental health nurse, a health professional, a special education teacher, and an IT expert. They assessed the app in terms of its content accuracy, classification and screening criteria, the appropriateness of the health advice, and the functionality and usability of the application features.

3.5 Pilot study

Participants. The sample size of 30 participants aligns with established norms for pilot and feasibility studies. According to Julious [31], a minimum of 12 participants per group is typically sufficient for pilot work aimed at assessing usability, acceptability, and feasibility prior to full-scale implementation. Hertzog [32] similarly notes that sample sizes between 10–30 are appropriate when the primary objective is to refine intervention design and assess preliminary user engagement. This sample size was thus adequate to explore user perceptions and evaluate the app's functionality in a real-world school and home setting.

A pilot study was conducted to assess the usability of the ADHD Scanning application. This study included 30 participants, consisting of 15 teachers and 15 parents of primary school children, who evaluated 30 primary school students using the app. For eligibility, at least one academic term of experience was required (for teachers) or a child aged six to 12 years (for parents), as well as the ability to use a smartphone or tablet. Exclusion criteria included prior formal ADHD training, cognitive or language barriers, or an inability to complete the evaluation.

Data collection. Data were collected after the participants had used the ADHD Scanning application. They first assessed each child's ADHD risk using the PBRI model and then accessed an educational module with a booklet and pre- and post-tests. Participants provided feedback via a satisfaction survey and a 10–15 minute interview, which was audio-recorded, transcribed, and analyzed. These sources offered both quantitative and qualitative insights into user experience, content clarity, and the utility of the app in school and primary care settings.

Data analysis. Descriptive statistics were used to summarize the characteristics of the participants and the prevalence of ADHD. The interview data were evaluated using content analysis to identify themes related to usability, content clarity, and design. The transcripts were coded in order to identify recurring patterns and insights. The Wilcoxon Signed-Rank Test was used to compare pre- and post-module assessment scores to determine the statistical significance of changes in participants' knowledge.

Dissemination and implementation planning. Following modification, the finalized app was ready for use in schools and community health settings. Implementation plans included user training and technical assistance for teachers, parents, and healthcare practitioners to ensure long-term acceptance.

4 RESULTS

4.1 Application development

Participant demographics. A pilot study was conducted with 15 participants who took part in focus group discussions. The participants included five homeroom

teachers working in primary schools, five parents of students aged between six and 12, and five healthcare professionals with expertise in child and adolescent mental health.

Findings from the focus group discussion. Content analysis was conducted on qualitative data obtained from the focus group interviews to explore the participants' perspectives on the screening tool, educational materials, and the usability of the application. Key themes were organized into two major categories: assessment and severity classification, and ADHD-related knowledge.

Assessment and severity classification. Participants found the paper-based rating scale for ADHD symptoms difficult to use. To solve this problem, the ADHD Scanning app combines the SNAP-IV scale with the PBRI model, resulting in increased clarity and use. The SNAP-IV scale contains 26 items covering inattention, hyperactivity/impulsivity, and ODD behavior. In the PBRI model, the risk levels are divided into seven colors, ranging from white (normal) to navy (severe), to help teachers and parents interpret the results more clearly (see Figure 3).

The instrument was found to have good content validity, with an IOC of 0.87, as validated by child and adolescent mental health professionals. The internal consistency reliability was calculated using Cronbach's alpha, which had a high value (α = 0.97). The small sample size (n = 30) in this study limited our ability to evaluate the psychometric properties of the ADHD screening app. Small samples in psychophonetic and digital ADHD assessments often compromise the reliability and generalizability of results, making it difficult to draw definitive conclusions about the validity and clinical utility of a tool. Consequently, larger sample sizes are essential to ensure robust validation and accurate assessment of such applications [33].

Fig. 3. PBRI model for ADHD in children rated by teachers and parents

Knowledge and awareness of ADHD. Participants reported having an inadequate baseline awareness of ADHD symptoms and basic treatment, a finding that underlines the importance of providing organized educational support through the application.

The ADHD information pamphlet was regarded as helpful, with users describing the material as clear and informative. However, some participants recommended simplifying the language to accommodate caregivers with varying levels of literacy. The interactive learning modules, including videos, pre- and post-tests, and infographics, received positive feedback. Many participants recommended the inclusion of brief summaries at the conclusion of each lesson to enhance comprehension (see Figure 4).

Fig. 4. Education modules

4.2 Application evaluation

Demographics of participants. The pilot study involved 30 participants (teachers and parents) who evaluated 30 primary school students using the ADHD Scanning application. Of the 15 students, 22 were male (73.33%) and eight were female (26.67%). The participants' ages ranged from seven to 12 years, with a mean age of 9.07 (SD = 1.91).

Prevalence of ADHD. The teachers and parents used ADHD Scanning to assess the incidence of ADHD-related symptoms, including inattention, hyperactivity/impulsivity, and oppositional defiant behavior (refer to Table 1). The results revealed that in terms of inattention, 46.67% of children were classified as high risk (dark green), 20.00% as at risk (pale green), and 33.33% as within the usual range (white). For hyperactivity/impulsivity, half of the children (50.00%) were categorized as normal (white), 33.33% as at risk (pale green), and 16.67% as high risk (dark green). In regard to ODD symptoms, 43.33% were classified as normal (white), 46.67% as at risk (pale green), and 10% as high risk (dark green). Notably, no children were classified in the most severe categories (yellow to navy) in any domain.

Table 1. ADHD risk classification by teachers and parents using the PI-based ADHD Scanning app

Risk group	Inattention		Hyperactivity/ Impulsivity		Oppositional Defiant Disorder	
	N	%	N	%	N	%
Normal (white)	10	33.33	15	50.00	13	43.33
At risk (pale green)	6	20.00	10	33.33	14	46.67
High risk (dark green)	14	46.67	5	16.67	3	10.00
Moderate (yellow)	0	0	0	0	0	0
Severe (orange)	0	0	0	0	0	0
Very severe (red)	0	0	0	0	0	0
Critical (navy)	0	0	0	0	0	0

Effectiveness of the learning module. The Wilcoxon Signed-Rank Test was used to compare participants' scores before and after completing the learning module. Post-module scores (12.30 ± 1.77) were significantly higher than pre-module scores (8.07 ± 1.20; $Z = -4.913$, $p < 0.001$).

User satisfaction. User satisfaction with the ADHD Scanning application was evaluated in regard to content, design, and usability (refer to Table 2). The highest score for satisfaction was reported for content accuracy (M = 4.67, SD = 0.54), followed by clarity of design (M = 4.63, SD = 0.60) and overall satisfaction (M = 4.54, SD = 0.50), all of which were within the 'very high' range. In terms of usability, participants rated the application as easy to use (M = 4.43, SD = 0.84), convenient (M = 4.47, SD = 0.81), and stable in performance (M = 4.40, SD = 0.84).

Table 2. User satisfaction with the ADHD scanning application

Evaluation Item	Content		
	M	SD	Interpretation
Content	**4.57**	**0.44**	**Very high**
1. Accuracy of content	4.67	0.54	Very high
2. Completeness of content	4.60	0.55	Very high
3. Relevance of content to the target group	4.57	0.56	Very high
4. Logical sequence and clarity of content presentation	4.40	0.61	High
5. Clarity and credibility of content	4.63	0.60	Very high
Design	**4.60**	**0.54**	**Very high**
6. Readability of fonts	4.63	0.60	Very high
7. Clarity and relevance of images used	4.57	0.56	Very high
Usability	**4.43**	**0.76**	**High**
8. Ease of use and simple menu navigation	4.43	0.84	High
9. Speed and convenience of use	4.47	0.81	High
10. Stability of the application	4.40	0.84	High
Overall satisfaction (all aspects)	**4.54**	**0.50**	**Very high**

Findings from In-Depth interviews. A set of in-depth interviews were conducted to gain deeper insights into users' experiences and perceptions after using the ADHD Scanning app. A thematic analysis revealed three main themes related to content, design, and usability.

Theme 1: Content clarity. Participants rated the instructional information provided by the app as trustworthy, factual, and useful for learning about ADHD symptoms and support options. The information was found to be relevant and easy to understand, although some participants advised simplifying the technical terms for a wider audience.

> *"The app provided clear and solid information. I felt more secure in my grasp of ADHD after reading through everything. (P03)*
>
> *"It clearly explained the symptoms to both teachers and parents. It wasn't very technical, but it was still educational." (T08)*

Some participants stated that while the overall content was outstanding, having simpler language alternatives would benefit families with diverse educational levels.

> *"I believe the content is good, but perhaps some of the wording could be made simpler to make it easier for more people to understand." (P11)*

Theme 2: User-friendliness. Many users expressed appreciation for the design of the application, describing it as modern, clean, and user-friendly. The use of color, typography, and imagery was noted as enhancing both comprehension and engagement, particularly among users who were less familiar with digital tools.

> *"I really liked how the app looked—it's not cluttered, and the colors helped me to know where to focus. Even though I'm not good with technology, I didn't feel lost at all. The layout and pictures made it easy to follow." (T04)*
>
> *"It felt more like something I could use comfortably, because of the colors and layout, rather than like a medical tool." (P09)*
>
> *"I'm not someone who uses apps often, but this one felt friendly. The icons and colors helped me understand what each part was for." (T12)*

Theme 3: Transition from paper stress to digital ease. Participants commended the usefulness and usability of the app, pointing out its clear design, even for those with less experience with technology. Teachers appreciated the rapid feedback and time savings over paper-based tools, while parents reported how simple it was to access the components on their phones, including the brief tutorial or training for new users.

> *"It would be fantastic if I could start an application, navigate through the items, and immediately see the results." (T01)*
>
> *"I occasionally have more than twenty-five students in my class. I need something brief, understandable, and clear. Interpreting scoring tables is not something I have time for." (T06)*
>
> *"A system with color coding is simpler to comprehend. I can tell that it's serious if I see red or yellow. It's preferable to worrying." (P02)*
>
> *"I can use it whenever I want as long as it's on my phone. I don't need to wait for someone to give me an explanation." (P01)*

Participants suggested several important improvements to enhance the usability and accessibility of the ADHD Scanning app and highlighted the need for a more stable and responsive system to ensure uninterrupted operation. It was also reported that the booklet should have larger font sizes to make the content and visual aspects simpler to read. These adjustments would greatly improve the user experience and improve the screening and monitoring of ADHD by teachers and parents.

These qualitative findings align with key constructs from the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). Participants' emphasis on ease of use, reduced cognitive burden, and intuitive design reflect high levels of perceived usefulness and perceived ease of use—central predictors of user acceptance in TAM [34]. Moreover, the social influence and facilitating conditions mentioned by participants, such as institutional support and peer acceptance, correspond to UTAUT dimensions that influence behavioral intention to use technology in educational and healthcare settings [35].

5 DISCUSSION

5.1 Development of the ADHD scanning app

The design of the ADHD Scanning app represents a significant advancement in the early identification and surveillance of ADHD within community-based primary care and school settings. By converting traditional rating scale assessments into visually intuitive formats, such as color-coded systems, the interpretability and accessibility of symptom assessments are enhanced for non-specialist users, including parents and teachers [36]. This approach is aligned with the need for practical tools that facilitate symptom recognition and encourage timely intervention [37].

One of the key challenges when using ADHD rating questionnaires is the difficulty faced by parents and teachers in interpreting the results accurately. To address this issue, the ADHD Scanning app employs the PBRI model, which is based on a seven-color scale resembling a 'traffic light' system, ranging from white (no symptoms) to navy (very severe symptoms). The use of a seven-color scale in the ADHD Scanning app aligns with evidence supporting the effectiveness of color-coded feedback systems in enhancing communication; research has shown that color-coded tools, such as medication labels and danger sign stickers, can significantly improve caregiver understanding and promote timely medical responses [38, 39]. These tools leverage color as a visual cue to make complex information easier to comprehend and act upon. In educational settings, color-coded 'traffic light' systems have been implemented to provide clear, accessible feedback, suggesting potential for adaptation to health-related communication [40]. By using a similar approach, the ADHD Scanning app simplifies the interpretation of the severity of ADHD by transforming numeric scores into a visually intuitive format. Although existing electronic systems for information sharing between parents and teachers may not inherently use color-coded feedback, they highlight the feasibility of cross-setting collaboration. Parents have expressed strong preferences for color-coded action plans when managing chronic conditions such as asthma, a finding that underscores the value of visually clear communication tools [41]. The ADHD Scanning app leverages this aspect, providing a standardized, color-coded framework that supports consistent understanding among parents, teachers, and healthcare professionals.

The multi-informant input structure of the ADHD Scanning app captures behavioral data from both teachers and parents. This approach is aligned with research indicating that gathering observations from multiple contexts can enhance diagnostic accuracy [42]. Since it integrates perspectives from both the home and school environments, the app has improved sensitivity and provides a deeper understanding of the child's behavioral patterns. With a value for the index of item-objective congruence (IOC) of 0.87, the app demonstrates strong content validity, meaning that that its items are appropriate for screening and match the intended conceptualizations well.

In addition to screening, the ADHD Scanning app also functions as an educational resource. The findings of this study reveal that parents and teachers had significant gaps in their understanding of ADHD, similarly to other research on the significance of health literacy in delayed diagnosis and treatment [7]. To address this issue, the app includes videos, infographics, and interactive lessons with the aim of improving users' understanding of ADHD symptoms and management strategies. Digital learning tools have been shown to enhance knowledge retention and user confidence, particularly when they present content in a visually engaging format [43].

The pilot study identified a group at high risk of ADHD-related symptoms among school-aged children using the ADHD Scanning app. The results showed that inattention was the most common symptom, with 46.67% of children identified as high-risk and 20.00% as at-risk. For hyperactivity/impulsivity, 33.33% were classified as at-risk, 16.67% as high-risk, and 50.00% as within the normal range. Furthermore, 46.67% of children were found to be at risk of oppositional defiant behaviors, with 10% classified as high-risk. These findings are consistent with recent epidemiological data; a 2023 meta-analysis reported that among children under 12, the prevalence of the inattentive subtype of ADHD was 33.2%, while the rate for the hyperactive-impulsive subtype was 30.3%, and that for the combined subtype was 31.4% [44]. In addition, a 2023 study found that children with ADHD are at increased risk of also having a significantly higher rate of ODD compared to control groups [45].

The marked improvement in post-module scores compared to pre-module scores demonstrates the effectiveness of the learning module in deepening participants' knowledge and understanding. This positive trend, observed consistently among all participants, highlights the value of well-structured, focused educational tools in supporting knowledge acquisition. These results are in line with existing evidence that targeted ADHD educational interventions can benefit teachers from a range of backgrounds [46]. Research suggests that interactive digital modules and structured training sessions significantly enhance both knowledge retention and confidence in managing ADHD-related challenges in educational settings [47].

5.2 User satisfaction with the ADHD scanning application

The user satisfaction with the ADHD Scanning app was high in regard to its content, design, and usability. Participants rated the content accuracy very highly ($M = 4.67$, $SD = 0.54$), indicating that the findings of the screening process were accurate and clinically relevant. Users also appreciated the app's simple interface, as supported by studies stressing the value of user-centered, visually appealing digital health solutions [48, 49]. The high overall satisfaction score ($M = 4.54$, $SD = 0.50$) further reflects the app's perceived usefulness in both home and school settings.

The app's educational resources, which included an ADHD handbook, videos, and tests, were well regarded in terms of helping users understand and manage ADHD. The PBRI model was particularly lauded for simplifying SNAP-IV data and making them more understandable to parents and teachers. While certain information needed to be simplified for users with low literacy levels, the usability evaluations remained high in regard to simplicity of use ($M = 4.43$, $SD = 0.84$), convenience ($M = 4.47$, $SD = 0.81$), and stability ($M = 4.40$, $SD = 0.84$). The ADHD Scanning app has potential as a reliable and user-friendly tool for early ADHD screening and can effectively bridge the gap between professional assessment and community-based monitoring.

From a theoretical perspective, the positive reception of the ADHD Scanning app is consistent with established digital health adoption frameworks. According to the TAM and the UTAUT, key constructs such as perceived usefulness, perceived ease of use, and social influence significantly predict users' intention to adopt new technologies [34, 35]. These models have been widely applied to the evaluation of mHealth applications and educational technologies, where ease of use, usefulness, and trust were significant predictors of adoption [50–53]. The pilot findings suggest that the app's culturally adapted interface, color-coded design, and ease of navigation helped

minimize user resistance and promote engagement. These observations support further development and cross-cultural validation of the app in line with established mHealth adoption frameworks across diverse settings.

6 CONCLUSION

As an exploratory Phase 1 study with a limited sample, the findings presented here provide initial insights but are not yet generalizable. Consistent with psychometric development guidelines, this study represents a formative step in tool design, with future phases needed to establish reliability, validity, and diagnostic accuracy [54]. Phase 2 of this study will involve a larger, more diverse sample of 420 participants across multiple primary schools to enhance representativeness. Planned validation activities include test-retest reliability, exploratory factor analysis for construct validation, and comparison with clinical benchmarks such as DSM-5-based assessments conducted by physicians. These efforts align with recent digital health tool validation standards emphasizing empirical rigor and cross-context applicability [55]. Ensuring accessibility is crucial, especially for children from ethnic minority backgrounds who often face barriers to timely ADHD care. By providing culturally adapted mobile applications, we can offer engaging and relevant interventions that help overcome these challenges and promote equitable access to support [56]. The next iteration will also explore bilingual functionality, adaptive feedback modules, and personalized support features to improve accessibility and user engagement in both educational and healthcare ecosystems.

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9 APPENDIX A

9.1 mERA checklist mapping for the ADHD scanning app study

mERA Item	Description/How Addressed in this Study
1. Infrastructure	Conducted in Chiang Mai, Thailand; participants had access to smartphones and the internet
2. Technology platform	Cross-platform mobile app developed for both Android (v7.0+) and iOS (v12.0+) and distributed via direct institutional download; not yet available in public app stores
3. Interoperability	The app was a stand-alone tool and was not integrated with EHR systems
4. Intervention delivery	Delivered via smartphones after in-person orientation; the app provided ADHD screening and feedback
5. Content	Included a screening tool, ADHD symptom information, and care recommendations for parents and teachers
6. Usability testing	Assessed via a user satisfaction questionnaire (n = 30); overall high usability reported
7. User feedback	Collected through interviews and surveys; used to refine content and navigation
8. Access by individual participants	Access to the app was via QR code or a direct link shared during training sessions
9. Cost assessment	Development funded by university grant; minimal costs for implementation
10. Adoption inputs	30-minute training session provided to participants before app use
11. Limitations for delivery at scale	While the app supported both Android and iOS, future deployment via public app stores and integration with health systems will be needed for broader adoption
12. Contextual adaptability	Interface designed in Thai; easily modifiable for other regions/languages
13. Replicability	Development process followed user-centered design; detailed documentation available upon request
14. Data security	No PII collected; data anonymized and stored securely; approved by Ethics Committee (BCNT09/2567)
15. Compliance with national guidelines	Ethical approval obtained; procedures aligned with national and WHO ethical standards
16. Fidelity of the intervention	All features were implemented as planned; no deviations from the original protocol

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