How Urgent is Mobile Authentication in Special Need/Education? A Review Systematic of Cyber Security and Psychological Approach

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Abstract: The use of mobile apps due to the Covid-19 pandemic for the distance learning process, learning media, entertainment, and payment instruments creates an awareness of how urgently cyber security is needed in special education. Students, teachers, parents, and therapists, in special education who has interests and have the responsibility data, must be kept confidential or protected as the authenticity of their work, as well as the diversity of levels of disability, trying to study in a systematic review through scientific journal searches related to contemporary mobile authentication methods, authenticity. The review was conducted through several scientific search engines and mobile apps. The results show that authentication is a challenging study for mobile app (computing) developers but it is not easy to facilitate the unique, diverse needs of disability, and the privacy of personal data is still not following cyber security standards while the need for mobile apps in the health and education sectors is growing rapidly.

Keywords: Cyber Security, Mobile apps, Authenticity

INTRODUCTION

Why does education need to be wary of cyber security? There are at least three basic reasons, namely phishing, malware, and low awareness of cyber security. In 2017 a survey showed that education, health and social services are second only to the financial sector which is vulnerable to cybercrime attacks (https://www.savoystewart.co.uk/blog/sectors-really-prioritising-cyber-security). In the 2021 survey, the education sector has even become the top cyber attack due to the influence of the pandemic (https://www.cobalt.io/blog/top-cybersecurity-statistics-for-2022) especially related to phishing attacks commonly occur across email, mobile, social media, and phone calls. Cyber security vulnerability in education is triggered by the use of mobile apps as a medium and learning process (Mkpojiogu et al., 2021).

South-East Asia in the context of internet use in terms of number (10.23 hours per day achieved by the Philippines, 3.19 hours for Indonesia, and 2.29 hours on average for other countries in the world) and internet use for social media (4.49 hours per day achieved by the Philippines, 3.19 hours per day in Indonesia, and 2.29 hours per day for the world). Countries in Southeast Asia, including Indonesia, are recorded higher than the world average in terms of internet access and social media (https://www.reportingasean.net/in-numbers-a-look-at-southeast-asias-online-behaviour/). Ironically, 73.5% of the 533 parents of students with disabilities in Indonesia admitted to having difficulty accessing the internet as a learning medium, especially during a pandemic and parental learning involvement (Group, 2021; UNESCO, 2021).

Best practice from several countries outside Southeast Asia with low socioeconomic backgrounds, smartphones and mobile apps are used as good media, especially when it comes to maintaining social distancing. The mobile app is a medium that can be used optimally and

dynamically related to learning, telehealth or telemental health. The use of mobile apps in the learning process during a pandemic requires integration between sectors such as health (therapists, doctors, rehabilitation/clinics, caregivers); school (teachers, parents, peers/community); as well as mobile app developers (computing and human factors). The increasing implementation of education with special needs, especially in higher education, inclusive schools, or homeschooling as providers of education with special needs and the needs of the community for people with disabilities makes cyber security in the use of mobile apps need to be studied in this review. What can be done about mobile apps for people with disabilities?

Authentication is one of the cheapest and preventive ways related to cyber security. The matter related to authentication behavior have become an interesting discussion for people with disabilities because they are related to access, which is especially challenging for mobile app developers. Basically, the need for authentication is access to declare user access with an on time code for data security and internet network. In line with the survey results from Savoy-Steward and Cobalt, this search was carried out through three sectors related to authentication through mobile apps for disabilities, namely the sectors: computing, health, and education.

METHOD

We used the search method of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses – PRISMA. The data is selected through four stages, namely: identification-entering keywords in search engines; screening-choice of manuscripts according to the intended theme; eligibility-by removing or sorting articles that are suitable and not suitable/excluded for sure reasons; to included-to get articles that match what we want (Moher et al., 2009). In the excluded process, the reasons for the inappropriate articles were varied, including: there was an application development that did not explain authentication, while another article developed an attractive authenticated mobile app that was not aimed at users with disabilities.

Eligibility Criteria and Information Sources

In this review, a search was conducted from two study sources, namely: scientific writing studies and mobile app studies related to criteria and information about disability.The search was conducted through several search engines: ACM, Researchgate, Google Scholar, and Sciencedirect, Eric, Springer, and Pubmed. The search is carried out by typing the keywords "mobile app authentication for disability", "special education", "dyslexia", "cerebral palsy", "Autism spectrum disorder", "alcoholic", "anxiety", "suicide", "dyscalculia", "dysgraphia", "elderly", "negative emotion", "grief", divorce", "spouse death", depression, "bipolar", "OTP", "biometric", "PIN", "gesture", etc.

Scientific Review

Inclusion criteria considered (1) target population: students with special need or disability; (2) primary outcome measures that target specific psychological disorders or symptomatology (i.e., anxiety, depression, social anxiety, stress, PTSD, alcohol abuse); (3) mobile app targeting physical or medical conditions (e.g., dyslexic, dysgraphic, dyscalculia, mental health, autism, cerebral palsy, etc.); (4) types of authentikasi through mobile applications (e.g. OTP, PIN, password, biometric etc); (5) mobile app in; computing, health, and education; (6) literature pertinent 2012-2022 year; (7) written in English; (8) published in the selected scientific databases. Exclusion criteria consisted in (1) study protocols; (2) no authentication; (3) not for disability, mental health, clinics, etc;

Mobile App Review

Inclusion criteria considered (1) Available on PlayStore/AppStore; (2) Good rating (i.e, 4s); (3) Ada keterangan (Education, Health, Community, etc); (4) Registry (username, password, mobile number, etc); Authentication (password, otp, pin, email, etc). Exclusion criteria consisted in (1) The system cannot be operated; (2) Non-Indonesian or English
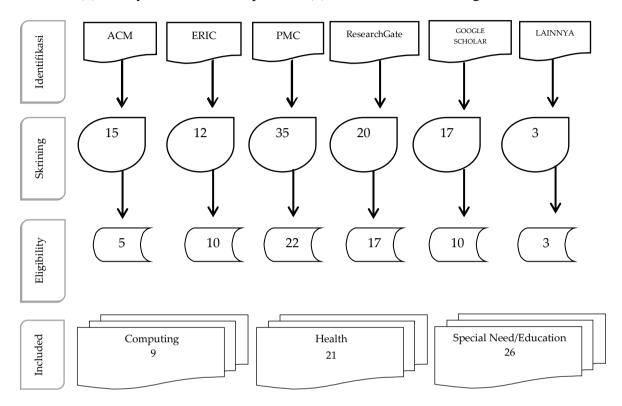

Figure 1. Flow Diagram Systematical Review

RESULT AND DISCUSSION

Result(S)

The theoretical basis in Mobile App development is the human factor approach. The human factors needed are related to behaviour, physical characteristics, movement, cognitive, or human emotions as users of the applications that are built. It is easy if these factors are owned by the average person such as personal identity – name, place of residence, address, etc.; ability to remember – date of birth, name of father or mother; pets, etc.; emotional expression – laughing, smiling, frowning, etc. The challenge for mobile app developers is when the human factor approach is only owned by some and even becomes a person's characteristic because of a disability or condition. The challenge becomes more interesting when, for example, an application for autism is developed. For example, the application development described by Kumar, K. P. & Sivanesan, P. (Sandeep et al., 2022) is related to autism spectrum disorder (ASD). The human factor principle used is when the subject experiences an enthusiastic condition (interested or focused on one thing/object) so that the physician will give signs or reactions, for example: squeezing, outward appearance, vocal gestures, signs and positions, and eye. This happens because physically ASD needs to focus.

Application development for people with disabilities is not enough for pre-clinical testing (with a certain time and amount) because of course it needs to be adjusted to the complexity of the needs and feedback provided by users. For example in ASD which is also accompanied by cerebral palsy or hyperactivity, where there is likely to be a more complex

challenge related to changes in the pupil of the eye. This is a reasonable reason why an application test stops at prototype testing.

Table 1 shows that the disability category is developed by application developers based on human factors or existing situations and requires application and testing of prototypes to be made. Authentication based on biometrics is something that attracts developers to make prototypes for people with disabilities. It takes a fairly complex effort and requires a cross-professional and disciplinary approach to be able to capture the needs of people with disabilities. What should be understood that developers are very aware of disability is a condition that the privacy and security of user data must be maintained. However, this remains a challenge for application developers to solve the complexities of user/disability needs.

Table 1. Mobile App Developer for Disability

NO	Category	Author	App Authentication
1	Memory & Cognitive	(Liebers & Schneegass, 2020)	Audio & body reflection
2	Negative Emotion	(Nicholson et al., 2013)	Anger, Worthwhile, and Apprehension
3	Elderly/Parkinson/Tremor & DASH	(Kieran et al., 2022)	Feet authentication
		(Qiu et al., 2019)	Swipe
		(Fuglerud & Dale, 2011)	OTP
		(Island & Lewis, n.d.)	Glass Device (VR)
		(Iqbal et al., 2020)	Fingerprint & GPS
4	Dyslexia	(Renaud et al., 2020)	OTP & password (assisstive tech.)
5	Visual Impairment	(Warnars et al., 2021)	Braille ((assisstive tech.)

Searching journals related to the use of mobile apps in the health sector is quite time consuming. This is due to the difference in health on a large scale or can be classified as general to clinical-based application development. The basis for classifying disability is based on principles in the clinical field, namely: health promotion, intervention, and curation.

The use of mobile apps in the pandemic era has also triggered several clinical actors in the pandemic era for reasons of social distancing and health services. There are two applications that are widely used in health monitoring or surveys, namely m-Health apps for general data collection from the respondents being studied. General data such as biodata, physical data, to disease monitoring such as in the long term of more than three months can be done. Regarding disability, this application can still be used, especially for long-term monitoring related to care monitoring of disability conditions, identification of accessibility, to complaints of people with disabilities in the pandemic era.

The use of mobile apps in the field of clinical intervention arises when a disabled community needs services or assistance (eg alcoholics, Alzheimer's sufferers, cerebral palsy, athletes, young mothers in order to learn to care for newborns or community mothers from rural or social backgrounds low-income families who require certain education) as well as interactive between community members and therapists. Apps in this category can also be useful for analysts to identify phrases or tweets that indicate abnormal or harmful behavior (suicide/depression).

A mobile app for the curation category is needed for people with disabilities who are in a condition of recovery, close monitoring, or rehabilitation. Monitoring pediatric patients who specifically require personalized counseling and intervention is assisted by this mobile app. Types of disability and services that appear in this category are coping strategies, consultation with experts in critical situations, as well as interactive between therapists/doctors/experts and caregivers or families in dependent conditions (unconscious, depression and suicide attempts, or critical situations).

Table 2. Mobile App for Health Disability

NO	Category	Author	Model
1.	Promotion/Mental Health/Education/Preventif	(Dantas et al., 2020)	Survey & health needs
		(Nicholas et al., 2017)	Survey & needs identified
		(Christy & Pillai, 2021)	Communication
		(Barbaro & Yaari, 2020)	Communication
		(Macmillan Uribe et al., 2021)	Education & communication
			Fun education
		(Christakis et al., 2019)	Accessibility
		(Radcliffe et al., 2021)	
2	Intervention of Risk Behavior	(Werner-Seidler et al., 2020)	Interactive
		(Jiam et al., 2017)	Interactive
		(Kantorski et al., 2020)	Interactive
		(Omaki et al., 2017)	Enrich languages
		(Christakis et al., 2019)	Interactive
		(Garc et al., n.d.)	Depression analysis or suicidal tendencies from comments or complaints
3	Curation/Rehabilitation/Recovery	(Zhang et al., 2020)	Interactive
		(Gupta et al., 2018)	Critical situation
		(Domhardt et al., 2021)	Communication
		(Meheli et al., 2022)Meheli, S.	Personalize
		(Lem et al., 2021).	Emphaty
		(Brodbeck et al., 2021)	Coping
		(Dulin et al., 2021)	Long term monitoring
		(Braund et al., 2022)	Long term monitoring

In the pre-pandemic era, this application was intended for personal assistance in critical situations so that users needed prompts or detailed guidance. Video on camera is needed to facilitate the remote process. In its development, mobile apps in this category are mostly used for assistance that requires high priority and secures privacy, so that users can personally disclose their secrets without having to provide their identity. In its development, users can choose a therapist or doctor according to their character or choice without having to share their identity even without a login and password. In terms of confidentiality and authentication, the developer hides the user's number and authentication is only enough to write a pseudonym or first name. There is no registration process for the installation of this application.

Regarding the user and the type of disability, this category is used for children with Down syndrome who need to be on camera to practice speaking and interacting with the other person or therapist. Face to face support (on camera) is also needed to assist users in situations of grief due to a spouse death or divorce.

Table 3. Mobile App for Special Need/Education

NO	Category	Author	Model
1	Community Development/Partisipation	(Zamin, 2019)	Interactive & feeling expression
2	Knowledge/Academic	(Laamanen et al., 2021)	Assessment
		(Whitelock et al., 2020)	Assessment
		(Uotinen et al., 2021)	Assessment
		(Madeira et al., 2015)	Knowledge
		(Sung, 2020)	Academic
		(Muhammad Faizan Khan et al., 2017)	Spelling
		(Cahyana et al., 2021)	Integrated learning
		(Novia et al., 2021)	Learning engagement
		(Bouck et al., 2018)	Manipulation
		(Vieira et al., 2018)	Literacy
		(Rahim et al., 2018)	Enhancing
		(da Silva et al., 2018)	Improvement
		(Abid et al., 2019)	Improvement
		(Ariffin et al., 2019)	Improvement
		(Özbek, 2021)	Fun learning
		(Reynolds & Joseph, 2021)	Improvement
		(Arias-Marreros et al., 2020)	Improvement
		(Larco et al., 2021)	Learning process
		(Eroğlu et al., 2021)	Improvement
3	Care & Wellbeing/Support	(Rabih Nabhan & Nouhad Kamel, 2021)	Self confidence enhancing
		(Mohamed Zain & Mahmud, 2018)	Interaction & support learning
		(Wang et al., 2018)	Support
4	Outcome & Qualification/Society	(SHAH, 2020)	Self report
		(Lynch et al., 2022)	Self efficacy
		(Xie et al., 2018)	Inclusion

The basis for categorizing mobile app development in the field of special education in table 3 comes from the principle of inclusive education (Molbaek, 2018). Why use inclusive education categorization? The mobile app that was developed for Special Need/Education is basically for self-development and also for interacting with other people (non-disabled and people with different types of disabilities). Most of the development of mobile apps is in the academic field, especially for the purpose of fun learning and self-development. By writing down learning difficulties in the field of basic literacy, specific results are obtained for application development, especially related to development for dyslexia, dysgraphia, dyscalculia.

The search from the mobile app for special needs/education can be seen in table 4. Authentication analysis uses the Standards from the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-63 because it can analyze private and individual organizations and even governments in several cyber defense domains.

Table 4. PlayStore for Special Need/Education Analysis

NO	Mobile App	Mail Verification	Password	OTP	PIN	Saving Personal Data	Standar NIST SP 800-63
1	Marbel Fauna 4D – Flashcard Augmented Reality	-	-	-	-	-	-
2	Marbel Huruf 4D – Flashcard Augmented Reality	-	-	-	-	-	-
3	The Autism Helper	-	✓	-	-	✓	-
4	Psikologimu	-	✓	✓	-	✓	✓
5	Terapi Wicara Domain 2	-	-	-	-	-	-
6	Evaluation Checklist (ATEC) ASD	-	-	-	-	-	-
7	Aplikasi Sehat Jiwa New	-	-	-	-	-	-
8	Procare: Childcare App	✓	✓	-	-	✓	✓
9	Khan Academy Kids	✓	✓	-	-	✓	✓
10	Teman Bumil	✓	✓	-	-	✓	✓
11	Aku Pintar - Aplikasi Pendidikan Terlengkap	✓	✓	✓	-	✓	✓
12	Teman Diabetes	-	✓	-	-	✓	✓
13	Peduli Lindungi	✓	-	✓	-	✓	✓
14	Otsimo	-	✓	-	-	-	-
15	M-Health	-	✓	-	-	✓	-

The final result of the search lies in the NIST SP 600-83 standard test. It appears that both the product's mobile app in Indonesian and in English, even though it is available on the PlayStore/AppStore, is not necessarily up to standard. This answers curiosity about the purpose of making this review regarding whether cyber security in the development of mobile apps for disabilities is urgent? The answer is very urgent. The main urgency has actually been seen in the results of the Cobalt survey which showed that the pandemic resulted in an increase in the use of the internet, especially mobile apps for the learning process, so that the survey results led to cyber attacks in the education sector at the top.

The results of a review of scientific writings and several car apps show that the findings of mobile apps that are not standardized by NIST SP 600-83 further show that mobile app authentication for people with disabilities is urgent. As has been explained in the purpose of making authentication standards and how personal data including photos and videos both in

the authentication process and as personal data are increasingly attractive to the field of computing (application development). Meanwhile in the health sector (in its development, telehealth began to develop using health-based applications and clinical or community interests to develop interaction and confidentiality as well as personal assistance), as well as education which also requires protection related to personal data to theft of work, then of course in development. In the future, cyber security guarantees are very much needed.

CONCLUSSION
Authentication of mobile apps used by persons with disabilities or parties related to services for special needs/education in the context of application development, health, or education is very urgent, especially because the massive use of the internet during a pandemic makes these three areas vulnerable to cyber security attacks. This initial awareness is very much needed to be able to protect yourself from fraudulent phone calls, to the misuse of personal data, especially for people with disabilities.

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REFERENCES
Abid, M., Bhimra, M. A., Mubeen, M., Zahid, A. Bin, & Shahid, S. (2019). Peppy: A paper-based augmented reality application to help children against dysgraphia. *Proceedings of the 18th ACM International Conference on Interaction Design and Children, IDC 2019*, 544–549. https://doi.org/10.1145/3311927.3325311

Arias-Marreros, R., Nalvarte-Dionisio, K., & Andrade-Arenas, L. (2020). Design of a Mobile Application for the Learning of People with Down Syndrome through Interactive Games. *International Journal of Advanced Computer Science and Applications*, *11*(11), 715–721. https://doi.org/10.14569/IJACSA.2020.0111187

Ariffin, M. M., Halim, F. A. A., Arshad, N. I., Mehat, M., & Hashim, A. S. (2019). Calculic kids© mobile app: The impact on educational effectiveness of dyscalculia children. *International Journal of Innovative Technology and Exploring Engineering*, *8*(8), 701–705.

Barbaro, J., & Yaari, M. (2020). Study protocol for an evaluation of ASDetect - A Mobile application for the early detection of autism. *BMC Pediatrics*, *20*(1), 1–11. https://doi.org/10.1186/s12887-019-1888-6

Bouck, E. C., Working, C., & Bone, E. (2018). Manipulative Apps to Support Students With Disabilities in Mathematics. *Intervention in School and Clinic*, *53*(3), 177–182. https://doi.org/10.1177/1053451217702115

Braund, T. A., Zin, M. T., Boonstra, T. W., Wong, Q. J. J., Larsen, M. E., Christensen, H., Tillman, G., & O'Dea, B. (2022). Smartphone Sensor Data for Identifying and Monitoring Symptoms of Mood Disorders: A Longitudinal Observational Study. *JMIR Mental Health*, *9*(5), e35549. https://doi.org/10.2196/35549

Brodbeck, J., Berger, T., Biesold, N., Rockstroh, F., Schmidt, S. J., & Znoj, H. J. (2021). The Role of Emotion Regulation and Loss-Related Coping Self-Efficacy in an Internet Intervention for Grief: A Mediation Analysis. (Preprint). *JMIR Mental Health*, *9*. https://doi.org/10.2196/27707

Cahyana, Hidayati, H., Sanjaya, M. B., Pangestu, A. S., Sundawa, A. A., & Aritakalam. (2021). Leady: A Multisensory Approach in Mobile Application for Dyslexic Children. *CommIT Journal*, *15*(1), 31–39. https://doi.org/10.21512/commit.v15i1.6661

Christakis, D. A., Lowry, S. J., Goldberg, G., Violette, H., & Garrison, M. M. (2019). Assessment of a Parent-Child Interaction Intervention for Language Development in Children. *JAMA Network Open*, *2*(6), e195738. https://doi.org/10.1001/jamanetworkopen.2019.5738

Christy, B., & Pillai, A. (2021). User feedback on usefulness and accessibility features of mobile applications by people with visual impairment. *Indian Journal of Ophthalmology*, *69*(3), 555. https://doi.org/10.4103/ijo.IJO_1042_20

da Silva, D. P., Amate, F. C., Basile, F. R. M., Filho, C. B., Rodrigues, S. C. M., & Bissaco, M. A. S. (2018). AACVOX: Mobile application for augmentative alternative communication to help people with speech disorder and motor impairment. *Research on Biomedical Engineering*, *34*(2), 166–175.

https://doi.org/10.1590/2446-4740.06117

Dantas, L. O., Weber, S., Osani, M. C., Bannuru, R. R., McAlindon, T. E., & Kasturi, S. (2020). Mobile health technologies for the management of systemic lupus erythematosus: a systematic review. *Lupus*, *29*(2), 144–156. https://doi.org/10.1177/0961203319897139

Domhardt, M., Messner, E. M., Eder, A. S., Engler, S., Sander, L. B., Baumeister, H., & Terhorst, Y. (2021). Mobile-based interventions for common mental disorders in youth: a systematic evaluation of pediatric health apps. *Child and Adolescent Psychiatry and Mental Health*, *15*(1), 1–12. https://doi.org/10.1186/s13034-021-00401-6

Dulin, P., Mertz, R., Edwards, A., & King, D. (2021). Contrasting a Mobile App with a Conversational Chatbot for Reducing Alcohol Consumption: A Pilot Trial (Preprint). *JMIR Formative Research*, *6*, 1–13. https://doi.org/10.2196/33037

Eroğlu, G., Teber, S., Ertürk, K., Kırmızı, M., Ekici, B., Arman, F., Balcisoy, S., Özcan, Y. Z., & Çetin, M. (2021). A mobile app that uses neurofeedback and multi-sensory learning methods improves reading abilities in dyslexia: A pilot study. *Applied Neuropsychology: Child*, 1–11. https://doi.org/10.1080/21622965.2021.1908897

Fuglerud, K. S., & Dale, Ø. (2011). Secure and inclusive authentication with a talking mobile one-time-password client. *IEEE Security and Privacy*, *9*(2), 27–34. https://doi.org/10.1109/MSP.2010.204

Garc, C., Fabra, J., Bel, A., & Cerbuna, P. (n.d.). *Exploring the Risk of Suicide in Real Time on Spanish Twitter : Observational Study Corresponding Author :* 8, 1–11. https://doi.org/10.2196/31800

Group, W. B. (2021). *LEARNERS*. September.

Gupta, G., Gupta, A., Jaiswal, V., & Ansari, M. D. (2018). A review and analysis of mobile health applications for alzheimer patients and caregivers. *PDGC 2018 - 2018 5th International Conference on Parallel, Distributed and Grid Computing*, *December*, 171–175. https://doi.org/10.1109/PDGC.2018.8745995

Iqbal, S., Irfan, M., Ahsan, K., Hussain, M. A., Awais, M., Shiraz, M., Hamdi, M., & Alghamdi, A. (2020). A novel mobile wallet model for elderly using fingerprint as authentication factor. *IEEE Access*, *8*, 177405–177423. https://doi.org/10.1109/ACCESS.2020.3025429

Island, R., & Lewis, B. (n.d.). *" I ... Got my Nose-Print . But it Wasn ' t Accurate ": How People with Upper Extremity Impairment Authenticate on their Personal Computing Devices.*

Jiam, N. T., Hoon, A. H., Hostetter, C. F., & Khare, M. M. (2017). IIAM (important information about me): a patient portability profile app for adults, children and families with neurodevelopmental disabilities. *Disability and Rehabilitation: Assistive Technology*, *12*(6), 599–604. https://doi.org/10.1080/17483107.2016.1198435

Kantorski, B., Commisso, D. R., Sanford-Dolly, C. W., & Pollock, J. A. (2020). The Use of a Mobile Application to Teach Concussion-Related Health Knowledge. *The Journal of STEM Outreach*, *3*(1), 139–148. https://doi.org/10.15695/jstem/v3i1.05

Kieran, W., Khamis, M., Bretin, R., & Mathis, F. (2022). *The Feet in Human-Centred Security : Investigating Foot-Based User Authentication for Public Displays.*

Laamanen, M., Ladonlahti, T., Uotinen, S., Okada, A., Bañeres, D., & Koçdar, S. (2021). Acceptability of the e-authentication in higher education studies: views of students with special educational needs and disabilities. *International Journal of Educational Technology in Higher Education*, *18*(1). https://doi.org/10.1186/s41239-020-00236-9

Larco, A., Carrillo, J., Chicaiza, N., Yanez, C., & Luján-Mora, S. (2021). Moving beyond limitations: Designing the helpdys app for children with dyslexia in rural areas. *Sustainability (Switzerland)*, *13*(13), 1–19. https://doi.org/10.3390/su13137081

Lem, W. G., Kohyama-Koganeya, A., Saito, T., & Oyama, H. (2021). Effect of a Contact-based Educational Intervention Using Virtual Reality on the Public Stigma of Depression: A Randomized Controlled Pilot Study (Preprint). *JMIR Formative Research*, *6*, 1–12. https://doi.org/10.2196/28072

Liebers, J., & Schneegass, S. (2020). Introducing functional biometrics: Using body-reflections as a novel class of biometric authentication systems. *Conference on Human Factors in Computing Systems - Proceedings*, 1–7. https://doi.org/10.1145/3334480.3383059

Lynch, P., Singal, N., & Francis, G. A. (2022). Educational technology for learners with disabilities in primary school settings in low- and middle-income countries: a systematic literature review. *Educational Review*, *0*(0), 1–27. https://doi.org/10.1080/00131911.2022.2035685

Macmillan Uribe, A. L., Rudt, H. G., & Leak, T. M. (2021). Stakeholders' views on mobile applications to deliver infant and toddler feeding education to latina mothers of low socioeconomic status. *Nutrients*, *13*(8). https://doi.org/10.3390/nu13082569

Madeira, J., Silva, C., Marcelino, L., & Ferreira, P. (2015). Assistive Mobile Applications for Dyslexia. *Procedia Computer Science*, *64*, 417–424. https://doi.org/10.1016/j.procs.2015.08.535

Meheli, S., Sinha, C., & Kadaba, M. (2022). Understanding People With Chronic Pain Who Use a Cognitive Behavioral Therapy–Based Artificial Intelligence Mental Health App (Wysa): Mixed Methods

Retrospective Observational Study. *JMIR Human Factors*, *9*(2), e35671. https://doi.org/10.2196/35671

Mkpojiogu, E. O. C., Hussain, A., & Agbudu, M. O. (2021). Security Issues in the Use of Mobile Educational Apps: A Review. *International Journal of Interactive Mobile Technologies*, *15*(6), 124–137. https://doi.org/10.3991/ijim.v15i06.20631

Mohamed Zain, N. Z., & Mahmud, M. (2018). Acceptance and Readiness of Mobile Learning Integration Among Teachers of Dyslexic Students: a Preliminary Study. *The International Journal of Multimedia & Its Applications*, *10*(06), 157–168. https://doi.org/10.5121/ijma.2018.10613

Molbaek, M. (2018). Inclusive teaching strategies – dimensions and agendas. *International Journal of Inclusive Education*, *22*(10), 1048–1061. https://doi.org/10.1080/13603116.2017.1414578

Muhammad Faizan Khan, Muhammad Azhar Hussain, Kamran Ahsan, Muhammad Saeed, Adnan Nadeem, Syed Asim Ali, Nadeem Mahmood, & Kashif Rizwan. (2017). Augmented Reality Based Spelling Assistance to Dysgraphia Students. *Journal of Basic & Applied Sciences*, *13*, 500–507. https://doi.org/10.6000/1927-5129.2017.13.82

Nicholas, J., Fogarty, A. S., Boydell, K., & Christensen, H. (2017). The reviews are in: A qualitative content analysis of consumer perspectives on apps for bipolar disorder. *Journal of Medical Internet Research*, *19*(4). https://doi.org/10.2196/jmir.7273

Nicholson, J., Coventry, L., & Briggs, P. (2013). *Age - Related Performance Issues for PIN and Face - Based Authentication S ystems*. 323–332.

Novia, A., Chan, K. F., & Siti, S. A. H. (2021). Evaluation of Disleksia Belajar Mobile App for Assisting Dyslexic Junior School Students to Learn the Malay Language. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(3), 2230–2235. https://doi.org/10.17762/turcomat.v12i3.1172

Omaki, E., Shields, W. C., McDonald, E., Aitken, M. E., Bishai, D., Case, J., & Gielen, A. (2017). Evaluating a smartphone application to improve child passenger safety and fire safety knowledge and behaviour. *Injury Prevention*, *23*(1), 1–5. https://doi.org/10.1136/injuryprev-2016-042161

Özbek, A. B. (2021). Development of and User Experience With the Comprehension Strategies Mobile App (COSMA). *Learning Disabilities*, *19*(2), 189–206.

Qiu, L., De Luca, A., Muslukhov, I., & Beznosov, K. (2019). Towards understanding the link between age and smartphone authentication. *Conference on Human Factors in Computing Systems - Proceedings*, 1–10. https://doi.org/10.1145/3290605.3300393

Rabih Nabhan, & Nouhad Kamel. (2021). Technologically Enhanced Art Therapy: Introducing a New Synergistic Model to Enhance Morphological Awareness in Students with Dysgraphia. *LingLit Journal Scientific Journal for Linguistics and Literature*, *2*(1), 1–8. https://doi.org/10.33258/linglit.v2i1.416

Radcliffe, E., Lippincott, B., Anderson, R., & Jones, M. (2021). A pilot evaluation of mhealth app accessibility for three top-rated weight management apps by people with disabilities. *International Journal of Environmental Research and Public Health*, *18*(7). https://doi.org/10.3390/ijerph18073669

Rahim, S. K. N. A., Nasrudin, N. H., Azmi, A. Z., Mohamed, Z., & Abdullah, I. I. B. (2018). Designing Mobile Application for Dyslexia in Reading Disorder Problem. *International Journal of Academic Research in Business and Social Sciences*, *8*(1), 619–636. https://doi.org/10.6007/ijarbss/v8-i1/3836

Renaud, K., Johnson, G., & Ophoff, J. (2020). Dyslexia and Password Usage: Accessibility in Authentication Design. *IFIP Advances in Information and Communication Technology*, *593 IFIPAI*, 259–268. https://doi.org/10.1007/978-3-030-57404-8_20

Reynolds, L., & Joseph, L. M. (2021). Effects of a Mathematics App on Urban High School Students' Algebra Performance. *Contemporary School Psychology*. https://doi.org/10.1007/s40688-021-00379-0

Sandeep, K., Rohit, R., Shrikant, T., & Shilpa, R. (2022). Cognitive Behavior and Human Computer Interaction Based on Machine Learning Alghorithms. In *Scrivener Publishing*. https://eur-lex.europa.eu/legal-content/PT/TXT/PDF/?uri=CELEX:32016R0679&from=PT%0Ahttp://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52012PC0011:pt:NOT

SHAH, A. (2020). Exploration of Mobile App Asa Reporting Solution To Bullying in Indian Schools. *International Journal of Computer Application*, *5*(10), 35–57. https://doi.org/10.26808/rs.ca.i10v5.04

Sung, L. J. (2020). *Application Development for Student With Dyscalcul Ia*.

UNESCO. (2021). education and disability : The case of Colombia Emerging practices in inclusive digital learning for students. *Emerging Practices in Inclusive Digital Learning for Students*.

Uotinen, S., Ladonlahti, T., & Laamanen, M. (2021). Developing E-Authentication for E-Assessment – Diversity of Students Testing the System in Higher Education. *European Journal of Open, Distance and E-Learning*, *23*(2), 99–115. https://doi.org/10.2478/eurodl-2020-0013

Vieira, I., Moura, A., Terton, U., Bilby, M., & Barros, M. (2018). Designing gamified E-learning applications for children with down's syndrome: The case of teaching literacy and language skills. *CSEDU 2018 - Proceedings of the 10th International Conference on Computer Supported Education*, *2*(Csedu 2018), 102–113. https://doi.org/10.5220/0006684701020113

Wang, R., Wang, W., daSilva, A., Huckins, J. F., Kelley, W. M., Heatherton, T. F., & Campbell, A. T. (2018).

Tracking Depression Dynamics in College Students Using Mobile Phone and Wearable Sensing. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, *2*(1), 1–26. https://doi.org/10.1145/3191775

Warnars, H. L. H. S., Nicholas, N., Raihan, M., Ramadhan, A., Mantoro, T., & Adnan, W. A. W. (2021). Mobile Application for the Blind and Their Family. *TEM Journal*, *10*(3), 1039–1044. https://doi.org/10.18421/TEM103-05

Werner-Seidler, A., Huckvale, K., Larsen, M. E., Calear, A. L., Maston, K., Johnston, L., Torok, M., O'Dea, B., Batterham, P. J., Schweizer, S., Skinner, S. R., Steinbeck, K., Ratcliffe, J., Oei, J. L., Patton, G., Wong, I., Beames, J., Wong, Q. J. J., Lingam, R., … Christensen, H. (2020). A trial protocol for the effectiveness of digital interventions for preventing depression in adolescents: The Future Proofing Study. *Trials*, *21*(1), 1–21. https://doi.org/10.1186/s13063-019-3901-7

Whitelock, D., Edwards, C., & Okada, A. (2020). Can e-authentication raise the confidence of both students and teachers in qualifications granted through the e-assessment process? *Journal of Learning for Development*, *7*(1), 46–60.

Xie, J., Basham, J. D., Marino, M. T., & Rice, M. F. (2018). Reviewing Research on Mobile Learning in K–12 Educational Settings: Implications for Students With Disabilities. *Journal of Special Education Technology*, *33*(1), 27–39. https://doi.org/10.1177/0162643417732292

Zamin, N. (2019). Make Me Speak: A Mobile App for Children with Cerebral Palsy. *International Journal of Advanced Trends in Computer Science and Engineering*, *8*(1.4), 368–373. https://doi.org/10.30534/ijatcse/2019/5681.42019

Zhang, M., Yu, J., Shen, W., Zhang, Y., Xiang, Y., Zhang, X., Lin, Z., & Yan, T. (2020). A mobile app implementing the international classification of functioning, disability and health rehabilitation set. *BMC Medical Informatics and Decision Making*, *20*(1), 1–10. https://doi.org/10.1186/s12911-020-1019-1