



Department
for Education

Assistive Technology

Stakeholder report: Researchers

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Dave L. Edyburn, Ph.D.

University of Wisconsin-Milwaukee



Social Science in Government

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Executive Summary

Assistive technologies (AT) are specialised products designed for people with special educational needs and disabilities. This stakeholder report describes the findings of the rapid literature review relevant for researchers.

Additional stakeholder reports for administrators, developers, educators, and policymakers can be found at <https://www.knowledge-by-design.com/ukat/>

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Introduction

1 The Department for Education's Education Technology Strategy, Realising the Potential for Technology in Education, described 10 EdTech Challenges designed to catalyse activity in specific areas of the EdTech sector in ways that are aligned to the needs of teachers and students. One of these challenges focuses on needing to identify the best technology that helps level the playing field for learners with Special Educational Needs and Difficulties (SEND).

Learn More

Department for Education. (2019). Realising the Potential for Technology in Education. <https://www.gov.uk/government/publications/realising-the-potential-of-technology-in-education>

2 In order to meet this challenge it is necessary to understand the current landscape of assistive technology (AT) used in education and what impact they have on outcomes for students with special educational needs and disabilities (SEND). To this end, a rapid review of the literature on assistive technology (AT) in education was conducted over a ten-week period in February – April 2020. A final report from the project describing the findings is available for download.

Learn More

Rapid Literature Review on Assistive Technology in Education
<http://www.knowledge-by-design.com/ukat/>

3 The purpose of this stakeholder report is to provide administrators with insights about the use of AT in educational settings in order to facilitate the effective delivery of AT devices and services for pupils and learners with special educational needs and disabilities. Interested readers are encouraged to visit the project web site to query the interactive data set or contact the Principal Investigator with questions or requests for custom searches of the knowledge base.

Learn More

Contact Principal Investigator
Dave Edyburn <edyburn@uwm.edu>

What is Assistive Technology (AT)?

4 The World Health Organization describes AT as follows:

- Assistive technology is an umbrella term covering the systems and services related to the delivery of assistive products and services.
- Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being.
- Assistive technology enables people to live healthy, productive, independent, and dignified lives, and to participate in education, the labour market and civic life. Assistive technology reduces the need for formal health and support services, long-term care and the work of caregivers. Without assistive technology, people are often excluded, isolated, and locked into poverty, thereby increasing the impact of disease and disability on a person, their family, and society.

Learn More

World Health Organization. (2018, May 18). Assistive technology.
<https://www.who.int/news-room/fact-sheets/detail/assistive-technology>

5 Over a lifetime, each of us will experience situations in which we personally, or, someone we know, will encounter limitations due to aging, disease, accident, or disability, that will impact the ability to perform basic life functions such as hearing, seeing, self-care, mobility, working, and participating in education. Whereas some of us may be born with a disability or disease that will require us to overcome limitations throughout our life, others will need to learn how to respond to challenges that arise from an accident or limitations that arise from simply growing older. As a result, AT has the potential to impact everyone, either directly as a personal user of AT, or indirectly, as a means of helping someone we know.

6 Realising the potential of technology in education involves maximising the application of assistive technologies to enhance academic, behavioral, social, and economic benefits

of pupils and students with special educational needs and difficulties. Historically, pupils and students with special educational needs and disabilities have had difficulty accessing the general education curriculum. This means they have been unable to achieve the same benefits from instruction as their peers.

7 The essence of assistive technology involves finding appropriate tools that enhance the functional performance of a person with a disability to complete routine tasks that are difficult or impossible. The magnitude of this task is not insignificant as there are over 25,000 assistive technology devices. When a person finds the appropriate AT, they are able to complete tasks that they previously could not complete, did slowly, or did poorly. The right AT augments, bypasses, or compensates for a disability.

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AbleData

<https://abledata.acl.gov/>

Special Educational Needs

8 Disabilities manifest themselves in many different forms and severities. As of January 2019, 1.3 million (14.9%) of all pupils in England have special education needs.

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Special Educational Needs in England: January 2019

<https://www.gov.uk/government/statistics/special-educational-needs-in-england-january-2019>

9 Whereas the impact of a disability should always be considered on an individual basis, there are general domains of functioning that are affected by a disability (see Table below). Developers interested in a specific disability category are encouraged to focus on a particular row to understand the relevant applications of AT. Developers interested in a specific domain of functioning relative to AT are encouraged to explore the table columns to understand the various groups that may benefit.

Table 1 Relevant Domains of Potential AT Application by Disability						
	Domains					
Disability	access	behavior/social	communication	independence	learning	mobility
autism spectrum disorder	•	•	•	•	•	
deafness	•		•	•	•	•
deaf-blindness	•		•	•	•	•
emotional and behavioral disorders		•			•	
hearing impairment	•			•	•	
intellectual disability	•	•	•	•	•	•
orthopedic impairments	•			•	•	•
specific learning disability	•			•	•	
speech language or communication	•	•	•	•	•	•
traumatic brain injury	•		•	•	•	•
visual impairment	•		•	•	•	•

AT Systems

10 The value and significance of assistive technology can be understood in relation to performance problems. That is, a person with a disability encounters a task they are unable to successfully complete. Following the identification of an appropriate assistive technology device, acquisition of the product, training and support in its use, a person is subsequently able to complete the same task that was previously difficult or impossible. As a result, assistive technology devices and services enhance the performance of individuals with disabilities by enabling them to complete tasks more effectively, efficiently, and independently than otherwise possible. As researchers explore AT devices they must also be mindful of measuring the influence of AT services.

Learn More

Andrich, R., Norman, G., Mavrou, K., Roentgen, U., Daniels, R., Desideri, L., ... & de Witte, L. (2019). Towards a global quality framework for assistive technology service delivery. In N. Layton, & J. Borg, (Eds.), *Global perspectives on assistive technology: Proceedings of the GReAT Consultation 2019, Volume 2* (pp. 263-269). Geneva, Switzerland: World Health Organization.

Bausch, M. E., Ault, M. J., Evmenova, A. S., & Behrmann, M. M. (2008). Going beyond AT devices: Are AT services being considered? *Journal of Special Education Technology*, 23(2), 1-16.

Coleman, M. B. (2011). Successful implementation of assistive technology to promote access to curriculum and instruction for students with physical disabilities. *Physical Disabilities: Education and Related Services*, 30(2), 2-22.

Elsaesser, L. J., & Bauer, S. M. (2011). Provision of assistive technology services method (ATSM) according to evidence-based information and knowledge management. *Disability and Rehabilitation: Assistive Technology*, 6(5), 386-401.

Hersh, M. A., & Johnson, M. A. (2008a). On modelling assistive technology systems Part I: Modelling framework. *Technology and Disability*, 20(3), 193-215.

Hersh, M. A., & Johnson, M. A. (2008b). On modelling assistive technology systems Part 2: Applications of the comprehensive assistive technology model. *Technology and Disability*, 20(4), 251-270.

Learn More (continued)

Lenker, J. A., Shoemaker, L. L., Fuhrer, M. J., Jutai, J. W., Demers, L., Tan, C. H., & DeRuyter, F. (2012). Classification of assistive technology services: Implications for outcomes research. *Technology and Disability*, 24(1), 59-70.

Maalim, M., MacLachlan, M., Long, S., O'Donnell, J., Ahern, S., & Gilligan, J. (2019). Access to assistive technology: A descriptive review and application of systems-thinking approach in the conceptualization of the assistive technology passport. In N. Layton, & J. Borg, (Eds.), *Global perspectives on assistive technology: Proceedings of the GReAT Consultation 2019, Volume 1* (pp. 489-514). Geneva, Switzerland: World Health Organization.

Malcolm, M. P., & Roll, M. C. (2017). The impact of assistive technology services in post-secondary education for students with disabilities: Intervention outcomes, use-profiles, and user-experiences. *Assistive Technology*, 29(2), 91-98.

McLaren, E. M., Bausch, M. E., & Ault, M. J. (2007). Collaboration strategies reported by teachers providing assistive technology services. *Journal of Special Education Technology*, 22(4), 16-29.

Parette, P., Peterson-Karlan, G. R., & Wojcik, B. W. (2005). The state of assistive technology services nationally and implications for future development. *Assistive Technology Outcomes and Benefits*, 2(1), 13-24.

The Importance of Theoretical Frameworks for AT

11 The importance of theoretical frameworks for AT cannot be underestimated for developing a conceptually sound AT research base. Several models can be found in the literature, including: Assistive Technology Service Method (ATSM), Human, Activity and Assistive Technology (HATT), Matching Technology with Person (MTP), as well as Student, Environment, Tasks and Tools (SETT). Yet, far too many research studies are published without a theoretical framework which diminishes the cumulative value of the knowledge base for answering fundamental questions about access, engagement, motivation, performance, and more.

Learn More

Desideri, L., Roentgen, U., Hoogerwerf, E. J., & de Witte, L. (2013). Recommending assistive technology (AT) for children with multiple disabilities: A systematic review and qualitative synthesis of models and instruments for AT professionals. *Technology and Disability*, 25(1), 3-13.

Elsaesser, L. J., & Bauer, S. (2012). Integrating medical, assistive, and universal design products and technologies: Assistive Technology Service Method (ATSM). *Disability and Rehabilitation: Assistive Technology*, 7(4), 282-286.

Federici, S., Scherer, M. J., & Borsci, S. (2014). An ideal model of an assistive technology assessment and delivery process. *Technology and Disability*, 26(1), 27-38.

Lenker, J. A., Fuhrer, M. J., Jutai, J. W., Demers, L., Scherer, M. J., & DeRuyter, F. (2010). Treatment theory, intervention specification, and treatment fidelity in assistive technology outcomes research. *Assistive Technology*, 22(3), 129-138.

Lenker, J. A., Shoemaker, L. L., Fuhrer, M. J., Jutai, J. W., Demers, L., Tan, C. H., & DeRuyter, F. (2012). Classification of assistive technology services: Implications for outcomes research. *Technology and Disability*, 24(1), 59-70.

Scherer, M., Jutai, J., Fuhrer, M., Demers, L., & Deruyter, F. (2007). A framework for modelling the selection of assistive technology devices (ATDs). *Disability and Rehabilitation: Assistive Technology*, 2(1), 1-8.

Zapf, S.A. (2016). Matching assistive technology to the student: An evidence-based assessment process. *Closing the Gap*, 35(2), 22-26.

A Critical Need for Measurement Instruments

12 There are very few instruments for measuring the implementation of AT devices and services or measuring the outcomes of AT. Whenever possible, researchers are encouraged to replicate instruments used in previous research. Significant work is needed in this area to develop instruments that have sound psychometric properties.

Learn More

Bugaj, C., & Poss, B. (2016). Multiple means of measurement: Tools for collecting and analyzing evidence of student progress. *Assistive Technology Outcomes and Benefits*, 10(1), 38-50.

Cunningham, B. J., Washington, K. N., Binns, A., Rolfe, K., Robertson, B., & Rosenbaum, P. (2017). Current methods of evaluating speech-language outcomes for preschoolers with communication disorders: A scoping review using the ICF-CY. *Journal of Speech, Language, and Hearing Research*, 60(2), 447-464.

Hoppenbrouwers, G., Stewart, H., & Kernot, J. (2014). Assistive technology assessment tools for assessing switch use of children: A systematic review and descriptive analysis. *Technology and Disability*, 26(2-3), 171-185.

Lenker, J. A., Scherer, M. J., Fuhrer, M. J., Jutai, J. W., & DeRuyter, F. (2005). Psychometric and administrative properties of measures used in assistive technology device outcomes research. *Assistive Technology*, 17(1), 7-22.

Rust, K. L., & Smith, R. O. (2005). Assistive technology in the measurement of rehabilitation and health outcomes: A review and analysis of instruments. *American Journal of Physical Medicine & Rehabilitation*, 84(10), 780-793.

Watson, A. H., & Smith, R. O. (2012). Comparison of two school-based assistive technology outcome instruments. *Technology and Disability*, 24(1), 83-92.

Zapf, S. A., Scherer, M. J., Baxter, M. F., & Rintala, D.H. (2016). Validating a measure to assess factors that affect assistive technology use by students with disabilities in elementary and secondary education. *Disability and Rehabilitation: Assistive Technology*, 11(1), 38-49.

AT Research Methodology

13 At this time, only a small number of AT interventions can be documented as having a moderate or strong evidence base. This finding, within the context of a rapid review of the literature study, is congruent with previous AT evidence synthesis reviews. The overall level of evidence concerning the effectiveness of AT is generally low because most primary studies have methodological limitations (e.g., insufficiently powered research designs, small numbers of subjects, inadequate descriptions of participants' functional limitations and/or the study contexts, inadequate attention to reporting effect sizes and the confidence intervals of the observed changes). Resolving these issues will take concerted efforts by researchers, journal editors, and reviewers to apply evidence

standards when judging the publication worthiness of new research studies.

Learn More

Anttila, H., Samuelsson, K., Salminen, A. L., & Brandt, Å. (2012). Quality of evidence of assistive technology interventions for people with disability: An overview of systematic reviews. *Technology and Disability*, 24(1), 9-48.

Scherer, M., Smith, R. O., & Layton, N. (2019). Committing to assistive technology outcomes and synthesizing practice, research and policy. In N. Layton, & J. Borg, (Eds.), *Global perspectives on assistive technology: Proceedings of the GReAT Consultation 2019, Volume 1* (pp. 196-217). Geneva, Switzerland: World Health Organization.

Williamson, T., Kenney, L., Barker, A. T., Cooper, G., Good, T., Healey, J., ... & Ryan, J. (2015). Enhancing public involvement in assistive technology design research. *Disability and Rehabilitation: Assistive Technology*, 10(3), 258-265.

Highest Quality Evidence Concerning AT Outcomes

14 The results of this rapid review of the AT literature discovered 24 studies that were coded as a systemic review or meta-analysis with effect sizes or evidence obtained from at least one well-designed randomized clinical trial (RCT). These works represent the highest-quality evidence to-date concerning the outcomes of AT.

Learn More

Alzrayer, N., Banda, D. R., & Koul, R. K. (2014). Use of iPad/iPods with individuals with autism and other developmental disabilities: A meta-analysis of communication interventions. *Review Journal of Autism and Developmental Disorders*, 1(3), 179-191.

Anttila, H., Samuelsson, K., Salminen, A. L., & Brandt, A. (2012). Quality of evidence of assistive technology interventions for people with disability: An overview of systematic reviews. *Technology and Disability*, 24(1), 9-48.

Boot, F. H., Owuor, J., Dinsmore, J., & MacLachlan, M. (2018). Access to assistive technology for people with intellectual disabilities: A systematic review to identify barriers and facilitators. *Journal of Intellectual Disability Research*, 62(10), 900-921.

Learn More (continued)

Cerga-Pashoja, A., Gaete, J., Shishkova, A. & Jordanova, V. (2019). Improving reading in adolescents and adults with high-functioning autism through an assistive technology tool: A cross-over multinational study. *Frontiers in Psychiatry*, 10, article 546, 1-10.

Curran, M., Walker, E. A., Roush, P., & Spratford, M. (2019). Using propensity score matching to address clinical questions: The impact of remote microphone systems on language outcomes in children who are hard of hearing. *Journal of Speech, Language, and Hearing Research*, 62(3), 564-576.

Dunst, C. J., Trivette, C. M., Hamby, D. W., & Simkus, A. (2013). Systematic review of studies promoting the use of assistive technology devices by young children with disabilities. *Practical Evaluation Reports*, 5(1), 1-32. Asheville, NC: Orelena Hawks Puckett Institute.

Ganz, J. B., Morin, K. L., Foster, M. J., Vannest, K. J., Genç Tosun, D., Gregori, E. V., & Gerow, S. L. (2017). High-technology augmentative and alternative communication for individuals with intellectual and developmental disabilities and complex communication needs: A meta-analysis. *Augmentative and Alternative Communication*, 33(4), 224-238.

Gentry, T., Kriner, R., Sima, A., McDonough, J., & Wehman, P. (2015). Reducing the need for personal supports among workers with autism using an iPod touch as an assistive technology: Delayed randomized control trial. *Journal of Autism and Developmental Disorders*, 45(3), 669-684.

Gothwal, V. K., Thomas, R., Crossland, M., Bharani, S., Sharma, S., Unwin, H., ... & Dahlmann-Noor, A. (2018). Randomized trial of tablet computers for education and learning in children and young people with low vision. *Optometry and Vision Science*, 95(9), 873-882.

Kasari, C., Kaiser, A., Goods, K., Nietfeld, J., Mathy, P., Landa, R., ... & Almirall, D. (2014). Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, 53(6), 635-646.

Knight, V., McKissick, B. R., & Saunders, A. (2013). A review of technology-based interventions to teach academic skills to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 43(11), 2628-2648.

Learn More (continued)

Lane, J.P., & Stone, V.I. (2015). Comparing three knowledge communication strategies diffusion, dissemination and translation through randomized controlled studies. In D. Sik-Lanyi et al., (Ed.), *Studies in Health Technology and Informatics Ebook Volume 217: Assistive Technology* (pp. 92-97). Amsterdam: IOS Press.

Livingstone, R., & Field, D. (2014). Systematic review of power mobility outcomes for infants, children and adolescents with mobility limitations. *Clinical Rehabilitation*, 28(10), 954-964.

Morash-Macneil, V., Johnson, F., & Ryan, J. B. (2018). A systematic review of assistive technology for individuals with intellectual disability in the workplace. *Journal of Special Education Technology*, 33(1), 15-26.

Morin, K. L., Ganz, J. B., Gregori, E. V., Foster, M. J., Gerow, S. L., Genç-Tosun, D., & Hong, E. R. (2018). A systematic quality review of high-tech AAC interventions as an evidence-based practice. *Augmentative and Alternative Communication*, 34(2), 104-117.

Muharib, R., & Alzayer, N. M. (2018). The use of high-tech speech-generating devices as an evidence-based practice for children with autism spectrum disorders: A meta-analysis. *Review Journal of Autism and Developmental Disorders*, 5(1), 43-57.

Perelmutter, B., McGregor, K. K., & Gordon, K. R. (2017). Assistive technology interventions for adolescents and adults with learning disabilities: An evidence-based systematic review and meta-analysis. *Computers & Education*, 114, 139-163.

Pimperton, H., Kyle, F., Hulme, C., Harris, M., Beedie, I., Ralph-Lewis, A., ... & MacSweeney, M. (2019). Computerized speechreading training for deaf children: A randomized controlled trial. *Journal of Speech, Language, and Hearing Research*, 62(8), 2882-2894.

Romski, M., Sevcik, R. A., Barton-Hulsey, A., & Whitmore, A. S. (2015). Early intervention and AAC: What a difference 30 years makes. *Augmentative and Alternative Communication*, 31(3), 181-202.

Savage, M. N., & Taber-Doughty, T. (2017). Self-operated auditory prompting systems for individuals with intellectual disability: A meta-analysis of single-subject research. *Journal of Intellectual & Developmental Disability*, 42(3), 249-258.

Learn More (continued)

Stone, V. I., Lane, J. P., Tomita, M. R., Nobrega, A. R., Flagg, J. L., Leahy, J. A., ... & Usiak, D. J. (2015). Effectively communicating knowledge to assistive technology stakeholders: Three randomized controlled case studies. *Assistive Technology Outcomes and Benefits*, 9(1), 98-159.

Thomas, R., Barker, L., Rubin, G., & Dahlmann Noor, A. (2015). Assistive technology for children and young people with low vision. *Cochrane Database of Systematic Reviews*, 6, Art. No.: CD011350. DOI: 10.1002/14651858.CD011350.pub2

Wood, S. G., Moxley, J. H., Tighe, E. L., & Wagner, R. K. (2018). Does use of text-to-speech and related read-aloud tools improve reading comprehension for students with reading disabilities? A meta-analysis. *Journal of Learning Disabilities*, 51(1), 73-84.

Wren, Y., Harding, S., Goldbart, J., & Roulstone, S. (2018). A systematic review and classification of interventions for speech-sound disorder in preschool children. *International Journal of Language & Communication Disorders*, 53(3), 446-467.

Exemplary AT Methodological Studies

15 Researchers may be interested in exploring several exemplary studies in order to gain new insights about research methodologies. (The following list is by no means comprehensive. These studies are merely suggestive of new approaches to research, development, and dissemination.)

Learn More

Caporale, B.A. (2013). AAC and autism report: Implementing evidence-based strategies in the classroom. *Closing the Gap*, 32(1), 5-11.

Curran, M., Walker, E. A., Roush, P., & Spratford, M. (2019). Using propensity score matching to address clinical questions: The impact of remote microphone systems on language outcomes in children who are hard of hearing. *Journal of Speech, Language, and Hearing Research*, 62(3), 564-576.

Learn More (continued)

Csapo, A., Wersenyi, G., Nagy, H., & Stockman, T. (2015). A survey of assistive technologies and applications for blind users on mobile platforms: A review and foundation for research. *Journal on Multimodal User Interfaces*, 9(4), 275-286.

Gabbert, D. (2017). Assistive technology outpacing disease progression: A longitudinal case study. *Assistive Technology Outcomes and Benefits*, 11(1), 1-16.

Knight, V., McKissick, B. R., & Saunders, A. (2013). A review of technology-based interventions to teach academic skills to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 43(11), 2628-2648.

Murray, J., Martin, A., Pennington, L., Marshall, J., Enderby, P., & Goldbart, J. (2014). A case study template to support experimental design in augmentative and alternative communication and assistive technology. *Disability and Rehabilitation: Assistive Technology*, 9(1), 60-69.

Torrens, G. E. (2018). The order and priority of research and design method application within an assistive technology new product development process: A summative content analysis of 20 case studies. *Disability and Rehabilitation: Assistive Technology*, 13(1), 66-77.

Participatory Design Methodologies

16 Sometimes researchers include development work as part of their research studies. In order to produce AT products that meet the needs of people with special needs and disabilities, best practice indicates that it is essential to involve potential users in the iterative design process. It is not appropriate to test AT products on able-bodied people asking them to simulate a disability. Increasingly, children are being engaged in the design of new technologies.

Learn More

Allsop, M., Gallagher, J., Holt, R., Bhakta, B., & Wilkie, R. (2011). Involving children in the development of assistive technology devices. *Disability and Rehabilitation: Assistive Technology*, 6(2), 148-156.

Learn More (continued)

Francis, P., Mellor, D., & Firth, L. (2009). Techniques and recommendations for the inclusion of users with autism in the design of assistive technologies. *Assistive Technology*, 21(2), 57-68.

Hobbs, D., Walker, S., Layton, N., & Hobbs, D. (2019). Appropriate assistive technology co-design: From problem identification through to device commercialisation. In N. Layton, & J. Borg, (Eds.), *Global perspectives on assistive technology: Proceedings of the GReAT Consultation 2019, Volume 2* (pp. 342-358). Geneva, Switzerland: World Health Organization.

Light, J., Page, R., Curran, J., & Pitkin, L. (2007). Children's ideas for the design of AAC assistive technologies for young children with complex communication needs. *Augmentative and Alternative Communication*, 23(4), 274-287.

Williamson, T., Kenney, L., Barker, A. T., Cooper, G., Good, T., Healey, J., ... & Ryan, J. (2015). Enhancing public involvement in assistive technology design research. *Disability and Rehabilitation: Assistive Technology*, 10(3), 258-265.

Design Research Methodologies

17 AT Researchers may wish to explore methodologies associated with design research as an approach to agile development while simultaneously collecting user data about the need and function of the new product to obtain social validity data.

Learn More

Creer, S., Cunningham, S., Green, P., & Yamagishi, J. (2013). Building personalised synthetic voices for individuals with severe speech impairment. *Computer Speech & Language*, 27(6), 1178-1193.

Geist, L. A. (2010). The design and development of CollaborAT: A groupware solution for IEP teams supporting school-age students who use assistive technology (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 3397203)

Learn More (continued)

Huo, X. (2011). Tongue drive: A wireless tongue-operated assistive technology for people with severe disabilities (Doctoral dissertation). Available from *ProQuest Dissertations & Theses Global database*. (UMI No. 3535880)

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.



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<mailto:robert.rodney@education.gov.uk> or www.education.gov.uk/contactus

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