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Yakkundi, A., Dillenburger, K., Goodman, L., & Dounavi, K. (2017). User Centered Reading Intervention for Individuals with Autism and Intellectual Disability. In *Harnessing the Power of Technology to Improve Lives* (Vol. 242, pp. 249-256). (Studies in Health Technology and Informatics; Vol. 242). IOS Press.
<https://doi.org/10.3233/978-1-61499-798-6-249>

Published in:

Harnessing the Power of Technology to Improve Lives

Document Version:

Peer reviewed version

Queen's University Belfast - Research Portal:

[Link to publication record in Queen's University Belfast Research Portal](#)

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User Centered reading intervention for individuals with autism and intellectual disability

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Abstract. Individuals with autism and intellectual disability (ID) have complex learning needs and often have difficulty in acquiring reading comprehension skills using conventional teaching tools. Evidence based reading interventions for these learners and the use of assistive technology and application of behaviour analysis to develop user-centered teaching is discussed in this paper.

Keywords. Autism, intellectual disability, reading, behaviour analysis, Headsprout®

Introduction

Autism spectrum disorder (ASD) encompasses a wide range of individuals with the triad of impairments in social, communication ability and having repetitive behaviours with varying degrees of learning ability. Individuals on the high functioning end tend to have a higher than average Intelligence quotient (IQ), whereas the moderate and severe end of the spectrum are accompanied with ID according to the classification by Diagnostic and Statistical Manual of Mental disorders, fifth edition [1]. Individuals with autism and intellectual disorder have a delayed and very often limited academic achievement. Despite educational provisions pupils on the moderate and severe end of the spectrum fail to acquire meaningful reading and comprehension skills [2].

Reading and comprehension skills in individuals with Autism and ID

Children with autism face challenges in reading for understanding due to their deficits in communication, social interactions, imaginative skills, and cognitive processing [3]. Although ASD encompass students with a wide range of ability and difficulties, most individuals on the spectrum have impaired reading comprehension ability at some level, in comparison to age-matched peers [4]. The severity of ID also directly affects the reading ability of the students on the autism spectrum, due to their deficiency in language skills as well. There are however considerable variations in the component reading skills of children on the spectrum. In a study conducted with 41 students with autism, 65% had impaired reading comprehension and a third severely impaired [4].

Historically the importance of literacy for students with disability has been underemphasized, however it is now a primary objective in most educational settings. Under the No Child Left Behind Act [5, 6] in the United States of America, all students including those with disability are expected to gain reading proficiency. It is the ethical right of students however great is their disability to have access to appropriate tools to learn reading and other academic skills.

Purposeful effort must be made to provide user centered reading interventions for pupils with autism and ID. The key to appropriate teaching lies in careful and ongoing

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assessment of each student's reading ability linked to a flexible and individualised reading programme rather than the delivery of a prescriptive programme.

Applied behaviour analysis (ABA) for user centered interventions

Applied behaviour analysis (ABA)-based interventions are developed to suit each user's needs and learning pace. These interventions record baseline level of skills, followed by data on skills acquisition during treatment phase, as well as generalisation and maintenance data. Progress is monitored continuously to facilitate adaptations to intervention strategies [7], thus, exemplifying high-quality user-centered design. ABA is increasingly used for comprehensive early intervention for children with autism in home, centre, or school settings [8, 9]. Positive outcomes have been demonstrated for cognitive, language, adaptive, and academic skills [10]. While ABA-based interventions are widely used in North this is not the case yet within most UK schools [11]. This paper reviews the evidence for reading instructions for pupils with autism and ID and the use of assistive technology.

Methods

The research focusses on 1) the success of different ABA-based strategies in reading comprehension interventions for students with autism and ID and 2) computer-based programs for teaching reading and comprehension to these students.

Key words

The following key words and combinations were used to carry out the literature searches:

ASD/autism, Intellectual Disability, reading and Evidence based

ASD/autism, Intellectual Disability reading and ABA

ASD/autism, Intellectual Disability reading, comprehension, and ABA

Computer/Technological intervention, reading, ASD with ID

Literature/data collection methods

Relevant scientific data banks were searched using Pubmed, Google scholar, Google, and Menderley, Proquest, ERIC (Education Resources Information Center), and Scopus. Information was derived from books, articles, journal papers, reviews articles and theses, snowballing to webpages, contacting experts in the field, and by searching reference lists of primary studies, review articles, and textbook chapters. Unpublished 'grey' literature that was not indexed by other databases was accessed conference proceedings on the Web of Science.

Selection criteria

Inclusion criteria: 1) Articles published until December 2016, 2) Studies with evidence-based methods for teaching reading and reading comprehension to individuals with autism and ID, 3) English language publications and 4) Systematic reviews, meta-analysis, single system design studies, and clinical trials.

Exclusion criteria: 1) ASD/autism without ID and reading/reading comprehension, 2) Studies that focussed only on high functioning autism or Asperger's and reading/comprehension. Studies that were carried out in a diverse range groups including individuals with autism and ID and had high functioning autism or Asperger's as one group/arm within the study were included however and 3) Non-English language publications

Papers were shortlisted if the abstracts described selection criteria, therapeutic regimens, information regarding the study design and methods, the characteristics of participants (pupils, disability diagnosis, age), interventions, comparison groups, and outcomes of interest. These were further scanned and the full papers included if they provided details on the program of intervention, implementation of the program with methodology details, dependent and independent variables, assessment methods and tools, description of the outcome, and data analysis.

Results

ABA-based methods used for reading and comprehension for autism with ID

There were 26 papers on interventions with evidence-based strategies to teach reading and comprehension to students with autism and intellectual disability. The National Reading Panel [14] recommends five components of reading instructions: phonemic awareness, phonics, vocabulary, fluency, and comprehension. The two main sections of evidence based strategies are outlined below.

Functional literacy

Considerable research on teaching reading to students with intellectual disability focuses on sight word instruction [15]. The purpose of teaching sight words is to promote independence in functional daily living skills. Sight word learning for individuals with moderate and severe disabilities is very effective, however there is limited information on generalisation and functional use of the learnt skills [15]. Synthesis of studies carried out on students with learning disability suggests that approaches using NRP recommendations may also be suitable methods for teaching reading comprehension for students with autism [16, 17].

Teaching to read words that have functional significance in daily living skills based on the sight-reading ability has been investigated specially in individuals with autism and moderate or severe ID and is extensively reviewed in 2 papers [15, 17]. The most common instruction methods used for functional reading are: 1) Systematic instruction including task analysis or massed trials, systematic prompting, and feedback [17], 2) Time delay as an instructional procedure to teach literacy to students with severe disabilities [18], and 3) Read aloud using objects to answer questions was employed, in a study of 4 students to demonstrate the effect on comprehension [19]. A system of least prompt was incorporated to promote listening comprehension for students with significant intellectual disability by inserting a rule for answering “Wh” questions (who, what, where, when, why) in the teaching strategy; functional relation between the intervention and number of correct unprompted responses to comprehension questions was demonstrated.

Direct instruction

Direct Instruction (DI) is a research-based comprehensive curriculum design and instructional delivery as well as assessment method [20]. Although not specifically designed for students with autism, its explicit instruction base has attracted researchers and educators to tailor DI programs for teaching literacy skills to pupils with autism.

The DI program, ‘Early Interventions in Reading’ provides systematic and explicit instruction in multiple content strands (i.e. concepts of print, phonological and phonemic awareness, oral language, letter and word recognition, vocabulary, fluency, and comprehension). The intervention comprising of 240 lessons was built on a curriculum previously validated with students without disability and has been adapted by Allor et al. [21] to suit pupils with ID in their studies. An additional 60 lessons, were created in a new package; ‘Foundation Level’ [21] also containing an oral

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language component. Lessons have detailed and explicit instruction with a fast-pace, to maximize student engagement and motivation. The comprehensive intervention addresses all the components of reading. Each lesson encompasses multiple strands and 8 to 10 brief word level activities gradually increasing in difficulty across the curriculum. The word recognition (i.e., sight words) and fluency are addressed through repeated reading in unison, paired reading, and independent timed reading. Comprehension activities start with listening comprehension progressing to reading comprehension later in the curriculum [22].

Flores and Grantz used the direct instruction based reading programmes *Corrective Reading Comprehension Level A* [23, 24] and *Language Learning* [23] to provide reading and comprehension interventions to students with autism and ID. In all the studies the students achieved the mastery criteria and demonstrated literacy gains in the researchers defined measurement probes.

Interventions based on direct instruction to improve reading comprehension of 4 students with autism/developmental delay (DD) assessed specific instructional strands of reading as well as of statement inferences, using facts, and analogies demonstrated an improvement in all areas that was maintained for one month after the intervention stopped [23]. Oral language acquisition of 3 further students with autism/DD was elevated following interventions provided using the DI package *Language for Learning* [25]. In a different study the same authors successfully used either *Language for Learning* or *Corrective Reading Thinking Basic: Comprehension Level A*, with 18 elementary school children with autism/DD [24], in a group intervention and the participants gained skills and retained them for a further 4 weeks once the intervention ceased.

Computer-assisted instruction systems

The last two decades have seen a big increase in technological advancement and the use of computers and electronic gadgets are now an integral and often essential part of school and home-based interventions [26]. Computer assisted instruction (CAI) is deemed as particularly effective for individuals with autism as software can be programmed to establish a clear and unambiguous routine, free of distraction, offering stimulus selectivity, and repeated practice of the same lesson, where necessary [27]. In addition, the use of software programs to perform certain tasks like providing immediate reinforcement, collecting data, systematically fading prompts saves teacher time [28]. This time instead can be used to address other issues like improve learning behaviour, analysis of programs and data, making the teaching process more effective for the learner and the teacher alike [28].

The emergence of computer-assisted instruction (CAI) offers a potential solution to some of the challenges associated with teaching academic skills, to children with autism [28]. A few studies about computer assisted reading interventions (n=12) report promise of CAI for autism students with severe ID. For example, a study to assess the syntactic awareness via computerised learning of words program, n=9 students with profound language impairment, showed some improvements in basic word order and expression of meaning [29]. A review of evidence based identified 10 studies that provided CAI successfully targeting communication skills to a total of 70 participants with mild, moderate, or severe autism [27]. Studied targeted multiple communication skills; vocabulary to teach receptive language, frequency of vocal imitations of sentences, and syllables, social conversation initiations, phonological awareness, decreasing echolalia and inappropriate speech. Effectiveness was demonstrated across

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the skill areas tested and using computer, mouse, keyboard, and microphone using HyperStudio, PowerPoint and Baldi/Timo programs [27]. Increase in participant utterances was more when a speech feature was enabled. Certainty of evidence analyses based on the use of experimental designs and controls identified two studies as conclusive, 6 as suggestive and 2 inconclusive [27].

Headsprout® Early Reading Program (HER)

Headsprout® Early Reading Program (HER) is an ABA-based, CAI that encompasses all the elements of reading and comprehension interventions [30]. HER's learning frame work includes explicit and systematic presentation of stimuli, reduced errors and error corrections sequences, mastery criteria and guided practice to fluency and cumulative review and application. HER is suitable for non-readers too and targets all the components of reading instructions: phonemic awareness, phonics, vocabulary, fluency, and comprehension (Fig 1). It consists of 80 sessions that can be individualised and adapted to the learners' pace [31, 32]. HER was not originally developed for children with special needs and there is ample evidence of its success with typically developing children [31, 33].

Teachers, teaching assistants, and parents can be actively involved for participation in the students learning process [34]. The fundamental reading skills, including letter names and sounds, instruction comprehension, oral responding and speaking aloud skills are systematically taught. Interactive animations and story line make reading activity fun and interesting. The program comes with companion workbooks which can be printed and used in off-computer tasks, adding variety, and further strengthening the learned concepts. A case study from David Gregory School, Paramus, New Jersey reported reading and comprehension progress of students with learning difficulties of age range 6-14 years benefiting from the use of *Headsprout® Early Reading and Comprehension Program* [35]. Grindle et al. [36] have demonstrated the effectiveness of Headsprout® in teaching 4 children diagnosed with autism and moderate difficulties attending an ABA curriculum. There is emerging evidence that the Headsprout® platform would be useful for struggling readers with a preliminary evidence of its suitability for teaching reading and comprehension to pupils with autism and intellectual disability. A preliminary study using the HER program was carried out with a single participant, a 9-year-old student with autism who had poor reading skills [37]. At the end of the intervention, the student's ability to read using dependant measures of 4 words sets and four HER short stories based on the word sets demonstrated improved reading accuracy and some indication of generalisation of word set reading skills. A study using HER for reading intervention for 4 students (4- 7 years-old) with autism attending an ABA curriculum in a school setting [36] showed how each student completed the HER program of 80 lessons, comprising of 15-20 min session every day. Standardised reading ability tests were employed pre- and post-intervention. All students showed an improvement in word recognition over the 14-week intervention period, maintained eight weeks after the end of intervention. ABA strategies were used to address any challenging behaviours and teaching initial learning behaviour of attending to the lesson and the use of computer [36]. Plavnick et al. [38] used the HER program to teach independent reading skills to 4 children with autism in conjunction with the behaviour interventions to address the disruptive challenging behaviour and promote reading skills. The interventions were successful in promoting engagement with reading program and eliciting correct responses per min. A concomitant decrease in disruptive and task-interfering behaviour was observed. Another study demonstrated gain in reading skills of 3 individuals with autism and ID using behavioural

interventions of contingent reinforcement and match to sample training for HER sessions [39].



Figure 1. Reading subskills taught using HER program through lessons 1 to 80.

Discussion

Individuals with more severe disabilities often receive inadequate academic instruction and therefore educators need programs that address the needs of these diverse learners [22].

The application of principles of ABA that have been successfully used to support students with autism in other areas (e.g., communication, learning outcomes) should be considered for future research as components of user centered reading comprehension interventions for students with autism and ID. Behavioural interventions help reduce disruptive or challenging behaviours and can be designed for each individual's learning pace and skills.

Computer-based HER proves to be successful and easy to administer. When used in conjunction with off screen generalisation of the computer acquired reading skills learning can be consolidated. Future research should explore the use of iPad for HER sessions particularly for individuals with autism with moderate and severe intellectual disability, having difficulty with mouse operating skills.

Acknowledgements

This research was supported by funding from the charity RESPECT and the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under REA grant agreement no. PCOFUND-GA-2013-608728'

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doi:10.1007/s10864-015-9244-x