Digital Technology in the Learning of Students with Autism Spectrum Disorders (ASD) in Applied Classroom Settings

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Abstract: This paper describes a research study that is a stepping stone to further research on the affordances of digital technologies in the learning of students with Autism Spectrum Disorders (ASD). The study is framed around the modern understanding of technologies as cognitive tools for learning based on the theory of social and cultural mediation of children's development and learning (Vygotsky, 1978), together with Activity Theory (Engestrom, 2001). The study focuses on the day-to-day reality of the use of computer and other digital technologies to assist the classroom learning of children with ASD. A series of observations, semi-structured interviews with teachers and video recordings have been undertaken to capture the ways that technologies have been utilised to support learning of children with ASD in a classroom setting.

Introduction

Autism is a lifelong developmental disorder. People with autism spectrum disorders (ASD) form a diverse group but all exhibit the triad of impairments: impaired social interaction, impaired communication and exhibit repetitive behaviours and/or restricted interests (Cumine, Leach, & Stevenson, 1998). Additionally, it is common for students on the autism spectrum to have particular sensory sensitivities.

The number of students diagnosed with ASD is increasing. The prevalence of autism is stated as 1 in 160 Australian children aged between 6-12 years (MacDermott, Williams, Ridley, Glasson, & Wray, 2006). The Australian Government has responded to the expansion of the number of diagnosed individuals with ASD, and the increasing public profile, by allocating $190 million across a range programs (DEEWR, 2008).

Meeting the needs of students with ASD in the inclusive setting, based on non-categorical learning approaches, can be problematic as many of these students may not respond to regular pedagogy because of the characteristics of ASD. Instead these children's specific style of learning calls for an emphasis on individualisation, structure and visual support (Attwood, 2000). However, the "limited provision of existing software designed for users with autism tends not to directly address the autistic condition as such" (More, & Taylor, 2000, p.172).

The study of affordances of digital technologies or computer tools (Jonassen, 2000) in supporting the learning of students with ASD is a newly developing area where much research is still yet to be done (Sansosti, & Powell-Smith, 2008). This paper reports on the development of a research project that will collect empirical evidence of the ways that technologies have been used in applied educational settings for children with the ASD in Australia.

Technology and the students' learning

Research in the area of digital technologies and ASD identifies predominantly clinical studies recognising the effectiveness of a variety of newly emerged approaches. For example, Computer Assisted Instruction (CAI) was found effective in developing reading skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005; Luckevich, 2008; Tuedor, 2006), and vocabulary, language and listening skills (Massaro, & Bosseler, 2006). The visual learning dimension incorporated in digital technologies is supportive of the visual modality of students with ASD (Shane, & Ducoff, 2008; Wetherby, & Prizant, 2000). Electronic screen media were used for video modelling of social skills and Social Story development which supported the learning of basic communication competencies (Sansosti & Powell-Smith, 2008), task completion and activity schedules (Mechling, Gast, & Cronin, 2006; Kimball, Kinney, Taylor & Stromer, 2006). The virtual environments were successfully used to develop symbolic play skills (Herrara, Alcantud, Jordan, Blanquer, Labajo, & De Pablo, 2008) and social skills (Moore, Cheng, McGrath, & Powell, 2005).

However, arguments exist that the study of the effectiveness of such technologies, based on these studies, is not sufficient, because of the inability to generalise results across the ASD population (Mineo, Ziegler, Gill, & Salkin, 2009; Jacobsen, Foxx, & Mulick, 2005; National Research Council, 2005). People with ASD do not form a homogenous group and the type of technology which suits one student with ASD may not necessarily meet the learning needs of another student with ASD.

Nearly all of the available research concentrates on discrete clinical trials with small numbers of participants (usually 1, 2 or 3), which have examined very specific skills. There are few studies that have been carried out in the applied setting of an authentic classroom environment where it would be harder for the teacher to maintain the fidelity of the intervention. One of the few studies which implemented a low technology intervention (interactive books with visual supports and music) in a classroom setting with a group of students with autism, found that it was hard for the teacher to control the exact number of questions from each intervention session to the next (Carnahan, Basham, & Musti-Rao, 2009). The authors' solution to this finding was to institute total CAI and remove the 'human element' such as the teacher, from the applied setting and segregate students to computer-centred, non-social environments. However, the use of CAI and removal of the human element has potential consequences as to the effects on service delivery. Specifically, "teachers could easily segregate children to computer-centred, non-social environments" (Carnahan, et al., 2009, p.85). The study of technology integration in special education has to take into account the social reality of modern classroom, particularly in the view of a recently noted "shift from an individual perspective towards an interactional and systemic point of view in special educational needs research" (Ghesquière, & Van der Aalsvoort, 2009, p.217).

Teachers and technology

Although digital technologies have the potential for supporting academic and social needs of students on the Autism Spectrum, teachers may find the technology intimidating; they may have trouble finding the time to gather content and become familiar with the software or to redevelop teaching aids given the lack of suitable commercially available resources (Stromer, Kimball, Kinney, & Taylor, 2006; More, & Taylor, 2000). Coleman-Martin, Heller, Cihak, & Irvine (2005) concluded that teachers were not willing to create PowerPoint presentations because of lack of knowledge of the program and/or limited time.

Most of the research to date has concentrated on the use of individualised computer programs (Kinney, Vedora, & Stromer, 2003). These researchers acknowledged that they did not know how a teacher could employ individual programs in a classroom setting. Research also demonstrated that some teachers prefer low-technology strategies over high-technology strategies that are often perceived as hard to implement (Judge, 2006).

Also few research studies report on the social validity of the intervention in the classroom and teachers are rarely interviewed as to whether they feel that the technology is useful or effective in increasing learning in group settings (i.e. classroom context), as opposed to individual interventions that are predominant in the research. It is important to implement technological assistance within the social-cultural contexts of an authentic educational setting and assess whether it is useful in the learning environments informed by advanced pedagogies based in social support and collaborative learning (Vygotsky, 1993).

What is needed is a learning environment that could maintain the level of teacher interaction whilst incorporating digital technologies that teachers could readily implement in the applied setting. Research needs to focus on design that is valid for the classroom as teachers would not be able to recreate the controlled conditions

of the research and would not be able to maintain the fidelity and control necessary to reproduce the results from the clinical trials.

The Study: Approach and methodology

The theoretical framework of the study is based on the view of children's learning and development as a socially and culturally mediated process (Vygotsky, 1978). This socio-cultural theory proved to be "a useful framework for research on special needs education" as being able "to describe the complexity and the recursiveness of the social reality under study". (Ghesquière, & Van der Aalsvoort, 2009, p.217). Within this view the digital technologies are seen as educational tools for supporting children's learning (Jonassen, 2000). This theoretical approach, together with Activity Theory (Engestrom, 2001) will be used to explore a range of complex interacting factors that might affect the use of digital technologies in the classroom environment. Three levels of the context are considered: individual, classroom and whole school contexts. At the individual level, the use of digital technologies will be analysed as a teaching and learning tool that can assist in achieving the teacher's pedagogical goals and the student's learning. At the classroom level, the interactions between the students, teacher and the technologies will be analysed. The wider level of analysis will allow examination of factors such as educational policies and guidance at school, local and national levels, school ICT policies, teacher professional development and collaboration. This framework will inform the data collection and analysis.

The aims

This research project will move beyond clinical-based research that has dominated this field, and look at the day-to-day reality of how digital technologies are used in a classroom context with students who have ASD. First it will identify the types of digital technologies used in schools for students with ASD. Then it will present the ways in which teachers in schools for students with ASD in NSW, Australia, have identified and experimented with digital technologies to suit the needs of their individual students. It will use a social cultural theoretical perspective to analyse the complexities of classroom contexts and the incorporation of digital technologies within day-to-day teaching and learning for students with ASD.

Participants and setting

Students

The participants will include students ranging from Kindergarten to High school age enrolled at a school specifically for students diagnosed as being on the autism spectrum. Students' abilities range from low functioning to high functioning with a number working toward part inclusion into regular schooling contexts. The school incorporates a base school and three satellite schools. All students at the base school will be observed as well as two further classes of students purposively chosen from 2 of the satellite schools. Teachers of these classes have been identified as using technology in their pedagogy.

Teachers

Six classroom teachers and a speech pathologist will be involved in the research. Four teachers are located at the base school and are guided and supported in their technology use by the speech pathologist. The other two teachers are located at satellite schools in the community. The speech pathologist and satellite teachers, one of whom is the leader of the technology team, will be interviewed by the researchers.

Setting

The study will be undertaken in three settings in a large region in NSW that enrol children with ASD across a range of age groups. Each class has an enrolment of up to 7 students with a one full-time teacher and one full-time teacher's aide. All teachers and aides are experienced in providing educational programs specifically for students with ASD. The time for 3 - 4 visits to each setting will be negotiated with the principal and the staff.

Research design and instruments

As pointed out by Ghesquie`re, Maes, and Vandenberghe (2009, in Ghesquière, & Van der Aalsvoort, 2009), in special education, "the complexity of studying schools as a system requires qualitative case studies involving

interviews, observations, and field participation" (p.217). This study is designed as a qualitative research that includes a number of case studies. There will be three types of data collected for this project

Observations

Firstly, four visits to each site will be made with 1-2 hours of observation conducted per visit. Observations will focus on how teachers, in early childhood to secondary classrooms, support the use of a variety of digital technologies in their classroom, and the level of student engagement.

Semi-structured interviews

Secondly, semi-structured interviews with classroom teachers and the speech pathologist will be conducted. Discussion will include the innovative ways technologies are being used and teachers' perceived effectiveness, linked to identified individual student learning and behavioural needs.

Visual Evidence

Thirdly, photographs and video footage of the use of digital technologies will be taken to support researchers in clearly identifying and recalling types of technologies, and to provide visual evidence of how teachers use the technologies.

Discussion

The research literature to date in the area of affordances of computer technology has shown that many students with ASD enjoy technology. The relative ease with which these technologies use clear rule-based systems make digital and visual technology an ideal way to support individuals with ASD in various areas of functioning (Golan LaCava, & Baron-Cohen, 2007). Thus, it has been found in the clinical trials that the use of predictable, routine, systems-oriented visual technologies can help support the learning of students with ASD (Kinney, Vedora, & Stromer, 2003; Coleman-Martin, Heller, Cihak, & Irvine, 2005; Luckevich, 2008; Tuedor, 2006).

Most studies involve some social validity data in which structured questionnaires are employed to have teachers and/or parents rate the efficiency and effectiveness of the specific intervention and/or software that has been employed in the research study (Tuedor, 2006; Lacava, Golan, Baron-Cohen, & Smith-Myles, 2007). However, most of the researchers caution about the generalisation of their findings to the applied setting of the classroom and suggest that there may be significant barriers that classroom teachers face in the ability to apply these research findings to their every day practice.

For any new innovation for students with special needs, the degree to which treatments/interventions are easy to use, and can be used by typical teachers in natural applied settings, is paramount and this is missing from the extant literature. Because of the emphasis on strictly controlled single subject multiple baseline methodology, there is little data as to how digital technologies can improve learning in group situations in classroom settings which is the most common educational placement for students with ASD.

Previous studies that have examined the use of digital technologies in the regular school settings (Robinson, & Sebba, 2010) found that teachers who exhibited the joint characteristics of confidence in the classroom combined with confidence and knowledge about digital technologies, were more likely to build the use of technologies into their teaching and were also more likely to employ a greater range of technologies. However, the studies addressing teacher competency in digital technologies and students with ASD are few.

Conclusion

The research project outlined in this paper has promise in that it will tackle the problems in design, methodology, and social validity for children with autism spectrum disorders in natural educational settings and will examine the implementation of the technology from the perspective of the natural people in these settings, classroom teachers

The innovative design allows for an evaluation of the usability, accessibility and effectiveness of digital technologies in an applied setting. The study will go beyond the narrow confines of the single subject multiple baseline methodologies that typically focus on narrow individual skills for very small numbers of participants. It will include methodologies of proven strength from other discipline areas such as the social sciences and education. It will have the potential to add to the literature on the application of digital technologies to everyday classroom use to a specific group of students (ASD) who, because of their particular learning styles and characteristics, have benefitted from digital technologies.

Acknowledgements

This research has been supported by Technologies and Learning Research Group, Information and Communication Technologies Research Institute Grant and Seeding Grant from Faculty of Education, University of Wollongong, awarded to Dr Dixon and Dr Verenikina.

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