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Technology as a Vehicle for Inclusion of Learners with Attention Deficits in Mainstream Schools

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Best Research Paper Award Winner

Abstract

The potential of technology for supporting educational processes of participation, collaboration and creation is widely accepted. Likewise have digital tools proved to enhance learning processes for disabled learners (e.g. supporting dyslexia students with digital tools such as text-to-speak-programs or writing-support programs). A currently topical group, politically and educationally, in the discourse of inclusion is learners with extensive developmental and attention deficit disorders (e.g. Attention Deficit Hyperactivity Disorder (ADHD), Attention Deficit Disorder (ADD), Autism Spectrum Disorder (ASD), Autism etc.). This paper investigates the potential of technology for supporting the inclusion of this group in the general school system, i.e. into mainstream classes, using technology as a tool to join, participate and contribute – and as a vehicle for general human growth in their learning community. The paper presents the primer results and describes and discusses the challenges of both teachers' and learners', involved in the inclusion process. Finally, on the basis of findings, a typology of tools is suggested, which may support inclusive teaching and learning for the target group in question.

Keywords: technology, inclusion, special educational needs learners, attention deficit, empowerment

Introduction

In 2012 the Danish Government passed a law on inclusion, which requested public schools in Denmark to include 97% of all learners in the mainstream education system. As a consequence, many learners, who earlier visited special schools and had Special Educational Needs (SEN) teachers, now had to be included in mainstream classes with mainstream teachers. This is a challenge for the schools, for the SEN

learners, for the mainstream learners and for the teachers involved. While pointing to the lack of specific tools as well as competences in teachers for handling inclusion of children with extensive developmental and attention deficit disorders, school leaders and teachers are looking for new ways to handle this challenge. It's a very broad group of SEN learners, who appears to have learning problems and struggling with problems such as: Lack of attention, selective and continuing attention and response inhibition as well as lacking ability for planning, promoting, strategic thinking, change in attention, flexibility in working memory, self-regulation and self-monitoring (Hansen & Sneum, 2008). The investigation, on which this present piece of research is based, is part of a work package in a wider research project, Ididact, which employs ICT as a vehicle in the challenge of inclusion of learners with extensive developmental and attention deficit disorders (focus learners) in mainstream schools. Ididact is a research project, running three years (2013-2015), funded by the Ministry of Education (MBU). The project seeks to test and develop new methods and digital tools that may promote inclusion and differentiation in the teaching and learning. Ididact facilitates action learning at 11 schools and collect data with 46 teachers' in 15 classes. The interventions in the classroom are tried out with more than 500 learners age 6 to 16 years – including 58 learners with extensive developmental and attention deficit disorders (focus learners).

The Salamanca Declaration (UNESCO, 1994) and United Nations Convention on the Rights of Persons with Disabilities (United Nations, 2006) prescribes, that all states should provide an inclusive educations system, where disabled children are able to access inclusive education where they live and receive individualised support required within the general education system. Ainschow (Ainschow & Booth, 2002) defines inclusion as "the continuous process of increasing the presence, participation and achievements of all children and young people in local community schools". Qvortrup (2012) introduces three levels of inclusion, which he argues may form different kinds of inclusion: (a) Physical inclusion is when the learners is (passively) present at school; (b) Social inclusion is when the learners is (actively) present and seems part of the social community that exists among peer at the same age (the student have friends); (c) Academic inclusion is when the learners participates (actively) in the educational programme, contributes to the assignments and achieves learning results from that. To some extent we are able to directly measure these levels of inclusion: Is the student present in the classroom, does he/she collaborate or play with peers, and does he/she receive good grades? However, Alenkær (2010) presents yet another attractive definition of inclusion, which places the individual in the centre stating that an

individual is only, in a qualitative sense, fully included, when he/she experiences him/herself as physically, socially and academically included. The authors of this paper hold the position that a process of inclusion may also be viewed as a learning process – a kind of socialisation process, in which learners are developing to become capable human beings, who achieve knowledge and competences through experiences – academically, socially & culturally (Lave & Wenger, 2005). To design a learning context, in which this is possible, it is useful to distinguish between what's important for an individual and what is important in a community. Finally, it is important to assess which learning competences all stakeholders need in order to become an empowered human being in the complex and constantly changing world of today. The envisioned learning goals of a person's inclusion and development process may be characterised by a set of vital features and values, all of which find support in various learning theoretical positions (Voldborg & Grum, 2011).

It is important to be heard (Dysthe, 2003), recognized (Honneth, 2007), get experiences (Dewey, 2005) and opportunity to explicate these experiences (Vygotsky & Lindquist, 2004) to get courage and ability to join learning and life with an identity as a learning human being. It is important that these actions take place in a process of negotiation with other learners (Lave & Wenger, 2005), in which the individual learn to take the perspective of others (Mead, cited in Dysthe, 2003). The learning process must be scaffolded (Bruner, 1999) and must be conducted in the zone of proximal development (Vygotsky, cited in Lindquist, 2004), resulting in the learner's experience of being immersed in a feeling of flow (Csikszentmihalyi, 2005). Viewed in this perspective, the learner develops competences and awareness of competences. In other words, the goal of inclusion is, that the learner obtains L2L-competences (Sorensen, 2006) and becomes an active, empowered, independent, participating citizen in a democratic society – a citizen with an ingrained motivation to take part and make a difference in democratic life (Sorensen, 2007a; 2007b). In addition, it appears important to pick up knowledge, skills and competences for investigation, problem solving, critical thinking and creativity (OECD, 2008).

The general potential of ICT for supporting educational processes of participation, collaboration and creation is widely accepted (Sorensen, 2009; Dalsgaard & Sorensen, 2008). In a more focused perspective, ICT is internationally recognised as a valuable tool for inclusion (Waller, 2013), particularly for people with disabilities, where technology can improve their quality of life, reduce social exclusion and increase participation (WSIS, 2010). There seems to be extensive evidence of the impact of ICT on: (a) motivating learners; (b) engaging low achievers; (c) supporting differentiation

between learners; (d) improving behaviour; (e) increasing confidence and management (Balanskat et al, 2006; Blamire, 2009); (f) cognitive processing; (g) independent learning; (h) critical thinking; (i) teamwork and (j) enhancing a student-centred learning approach (WSIS, 2010).

From as long list of research, benefits are reported from using a variety of ICT hardware and software tools for inclusion in education: (a) laptops (Corn et al, 2012); (b) tablets (Clark & Lucking, 2013; Flewitt et al., 2014); (c) learning platforms and mobile technologies (Naismith et al, 2006; Passey, 2010); (d) virtual learning environments (VLEs), large multi touch surfaces, multi media rich resources (Waller, 2013), electronic visual scheduling systems (McKnight & Davies, 2012); (e) collaborative learning technologies (Balanskat et al, 2006); (f) assistant technologies (Winther & O'Raw, 2010; Shaw & Levis, 2006; Mavrou, 2012).

We may assume that the recognized benefits themselves of using these technologies also automatically would give rise to new pedagogical approaches. But this does not seem to be the case, one major reason being a lack of ICT competence development amongst teachers. The majority of teachers have not been introduced to these technologies and are not skilled in utilizing their potential in the special pedagogic optic, which is required for the target group in question. According to the European Commission (2013) the potential and benefit for inclusive learning of ICT is not realized, as in many cases appropriate pedagogic methodology and models that truly integrate and operationalize the potential of ICT in a strategy of inclusion, still remains to be generated (Waller, 2013).

Research Design

Very few research projects and research designs provide a holistic view of the complex challenge of using ICT in inclusive education (ibid.). It is difficult to capture the complexity of the research field with its many influencing factors. Therefore, in an attempt to meet this challenge, the methodological approach of "Educational Design Research" (EDR) as introduced by McKenney and Reeves (2012) is applied. EDR may be defined as a "genre of research, in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigations, which yields theoretical understanding that can inform the work of others" (ibid. p.7). Ididact is an iterative and explorative qualitative research project, where data is collected in a real school context. It is a case study in the frame of Action Research (AR) (Jungk & Müllert, 1998; Tofteng et al., 2012) and EDR using a hermeneutical, phenomenological interpretation of data. It is crucial for our data

collection, that the unfolding research process goes hand in hand with the involved teachers' work and interventions into the field of study, so the process becomes a learning endeavour in terms of learning how to work with SEN learners and integrating ICT in the classroom. Therefore, we designed this piece of research using an AR/EDR approach, where the researchers are included as participants – and professional dialog partners and facilitators of the transformation processes – at the schools involved. In the present case we are studying the problem in its real life context: The mainstream Classroom, where the borders between phenomenon and context are unclear. We attempt to collect data from multiple sources, and bring them together in a data triangulation.

Analysis and Findings

The data production and collection was done using various methods and instruments, all of which evolved within the following four themes of interventions as presented below:

1. The challenges of the teachers, when including the focus learners

The teachers were challenged with:

1. A feeling of deficiency in terms of their own professional knowledge about methods, tools, experience and competences in their educational practice in terms of working inclusive with ICT and focus learners;
2. Understanding focus learners needs, behaviour, interruptions, relations, abilities and offered conditions;
3. Responsibility for a high academic level, appropriate attention and a pleasant learning environment;
4. Lack of participation/responsibility for developing inclusive schools from colleagues, leaders and parents.

2. The challenges (as viewed by teachers) of the focus learners in terms of learning and schooling

The pre test indicated that the challenges of the focus learners varied widely: Generally they were challenged in proportion to memory, attention, persistence, concentration, hyperactivity, impulsivity, behaviour or social competences. The majority had problems with attention, 50% struggled with hyperactivity, and 25% of the group showed behavioural disorders. They were all challenged in proportion to memory, concentration and persistence. 75% had relatively weak – and not age corresponding –

pro-social competences. Knowledge from the pre test was used to guide the teachers in selecting inclusive ICT based interventions. In the post test a significant reduction was documented in the level of attention problems, hyperactivity, impulsivity and behaviour problems, while no or minor change in pro-social behaviour, emotions and problems with peers was observed.

3. The experiences of the teachers, using inclusive ICT based interventions

Through triangulation of data following types of interventions and technologies was found:

Table 1: The experiences of teachers, using inclusive ICT based interventions

Intervention	Used technology/ICT	Impact of ICT on focus learners
Structure & Overview	Timer Digital planning and management: Timetable for lessons or projects Learning Management Systems (LMS) Digital templates for assignments	Plans with strictly time schedule for lessons and activities have a positive impact on participation, self-monitoring and task solving. Especially a timer showing remaining time for a task is a valuable tool. Digital templates enable to work independently and structured with assignments and LMSs help to organise and find learning content.
Shielding & Focus	Earmuff (with/without music) Teacher-microphone and learner-receiver Periodic, individual work on iPad or computer	Teacher-microphone/learner-receiver has a positive effect on focus learners' attention. Restless learners became calm, felt concentrated and able to work with the tasks. Sensible learners felt the raised teacher voice annoying. Using iPad or computer generally increased concentration and focus.
Comprehension & Differentiation	Multi-media rich materials to the learners (screen casts, video instructions, sound instructions) Text-to-Speech Digital learning resources Digital books/texts Flipped Learning Game based Learning	Flipped learning, scalable templates and multi-media rich assignment for the learners had a positive impact on the learner's participation and contribution. Concepts are trained successful using Google picture searching and repetition in online game based learning tools. A few learners tested a game based learning environment for mathematics with positive impact with respect to focus, concentration, persistence and problem solving.
Production & Dissemination	Multi-media rich assignments from the learners: Text, Pictures, Photos, Voice clip answers, Video clip answers, Graphics, Animations Assistive tools: Text-to-Speech, Speech-to-Text,	According to both learners and teachers, the production of multi-media rich assignments increases motivation and engagement for almost all students. Learners challenged in their short time- and working memory, do not benefit from this opportunity without other additional interventions. High impact is observed with the assistive tools.

Collaboration & Knowledge Building	Pre-dictation Cloud based file management and file sharing Digital portfolio Virtual presence	In the LMS learners communicate and collaborate with their peers more concentrated and focused (if the task is well designed, structured and tailored to their needs). They store assignments online, return to them for repetition/remembering concepts, and get help from peers or teachers through lurking in the shared content or communication in chat or mail system.

Teachers uses a variety of hardware (e.g. PCs, laptops, iPads, Nexus-tablets) and create interventions for the entire class, but observe specific benefits and challenges for the focus learners in terms of ability to participate and contribute in the learning community. In some cases one-tool-to-one-learner is planed, in other cases one-tool-to-two-learners, or one-tool-to-three-learners. Both teachers and learners express, that ICT in education is a highly motivating factor. Applications, digital learning resources and templates help all focus learners and function as drivers through the various tasks. Computers are useful for writing and working in larger projects, while tablets are valuable as a multi-media production tool, a training tool, a pause tool or a private planning tool. While learners working one-to-one or one-to-two are more likely to participate, focus learners disappear from the task when working one-to-three. In the final survey the teachers express that they during the interventions experienced less noise and disruption (50%), less exclusion of the focus learners (40%), higher professional competence with respect to including the focus learners (50%) and improved conditions for the focus learners' time spend in school (80%).

4. The experiences of the focus learners, using inclusive ICT in their learning processes

Through interviews with both focus and mainstream learners it became clear, that they all felt a higher degree of pride in their schoolwork when using ICT. One focus learner expresses happiness and joy, when she – using ICT – succeeds in solving a task. There is also indication that the focus learners' need for help decreases, as they seem to be able to work more independently. The learners recommend wider use of compensatory applications and tools for structuring and managing time. They express more joy and engagement when using computers and iPads, and appreciate their cloud based LMS, as they are able to access resources and assignments – and to collaborate with peers. The teacher-microphone/learner-receiver tool is popular, as "the teacher became more clear, and the headset was good, when one had to be concentrated" (focus boy, age 14). The learners also convey challenges and implications when using ICT in the school. This is primarily in relation to the teacher's

lack of ICT skills, the teacher's unfocused use of ICT, and finally, unstable ICT infrastructures in the schools.

Discussion

From the perspective of Ainschow's definition of inclusion (2002), the schools in this inquiry may be viewed, to a certain extent, to succeed with increasing the presence, the participation and the achievements of learners with attention deficits in local community schools and mainstream classes. But in what sense were the learners included, and in what ways were the ICT interventions significant? Following Qvortrup's distinction between physical, academic and social inclusion (2012), it is fair to say that most of the interventions primarily had an impact on the physical and academic inclusion, and less so on the social inclusion dimension. Using ICT for, not only *shielding & focusing*, but also for *structure & overview,* seems to help focus learners to join and participate in classes in more smooth and quiet ways, spawning more attention and causing less conflict. These two intervention types may be viewed as basic conditions for SEN learners to participate and physically join, in fruitful ways, educational activities in the classroom, together with their peers. They know what to do, how to do it, when to do it, why they do it, with whom they do it – and for how long, using what. The teachers have gained increased insights into the special needs area. Thus, their abilities had grown in terms of being able to create a learning environment, more accessible to the focus learners. As recommended by Dysthe (2003) and Honneth (2007), the SEN learners appeared to be heard and recognized as who they were, thus, accepted as a legitimate participant of the community (Lave & Wenger, 2005). Distracting impressions were minimized, and focus increased. It may be said that they had been moved to a position, from which they were ready for academic inclusion.

In other words, it may be concluded that when the focus learner is well supported, he is able to participate and contribute in academic activities in the classroom. The focus learner's use of ICT as a tool for wider *comprehension & differentiation*, *production & dissemination* is useful, when he/she as a consumer is facing new learning challenges, or when he/she as a producer explicate his knowledge. Both processes benefit from compensatory digital tools, such as e.g. Text-to-Speech, Speech-to-Text or Pre-Dictation. The general difficulties of the focus learners in terms of lacking attention, concentration, memory, persistence and arousal (Hansen & Sneum, 2008) seem to impose a challenge, when they are participating in learning activities. But we might say that a mix of multimodalities and compensatory tools seem to have a positive effect

and stimulate them, not only to stay focused, but also to produce outputs more easily – i.e. working in flow (Csikszentmihalyi, 2005). A future research challenge will be to investigate the reason for this. For now there is sufficient ground to conclude that use of ICT interventions for *comprehension & differentiation*, *production & dissemination* does in fact increase the chance of academic inclusion of the focus learners.

Learners and teachers agree that it is easier to collaborate and share content, when using ICT. Low achievement learners lurk to the assignments of peers and learn from them strategies for solving their own tasks. However, to be socially included is not equal to taking part of collaborative tasks in school (Alenkær, 2010). One also has to be selected as a friend, to contribute in discussions and take part in the social activities in pauses and after school. No indications that the ICT interventions had an impact concerning social inclusion, and our pre/post test showed no significant progress in the learners social and pro-social behaviour. However, we did register indications that the knowledge/insight of the teacher with respect to the special needs and strategic use of five types of interventions of the focus learners, did inspire the focus learners to participate more equally and be less excluded in the classroom: "Structure & Overview, Shielding & Focus, Comprehension & Differentiation, Production & Dissemination, Collaboration & Knowledge Building". We propose use of and further investigations into using this five-types-model of including, ICT based interventions. We are discussing, if the model has an incorporated progression like a hierarchy of needs (Figure 1 left), or it should be presented more dynamically (Figure 1 right). This issue still remains to be decided through future research.

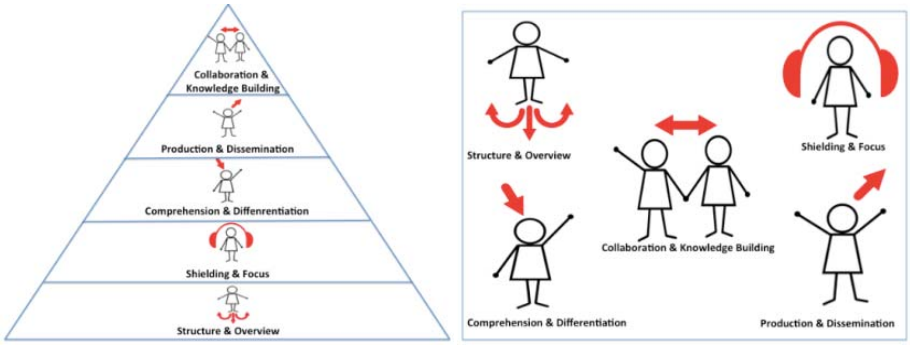

Figure 1. Iterations of a five-type-model of including ICT based interventions – hierarchy left and dynamic right

Similarly, following Alenkær's definition of *full inclusion* (2010), it is also part of our future research challenge to examine, to what extent using use of the ICT based interventions enhances the focus learner's self awareness in terms of experiencing himself/herself physically, socially and academically included. The EDR approach has worked well for this study. The teachers gained new knowledge about the focus learners' special needs, and about ICT as a vehicle for inclusion. Together with the researchers they also developed new methods in their practise. The researchers recognized the teachers' challenges and scaffolded them in their further development of practice. The teachers discussed the new methods and experiences with their colleagues and the researchers, and – exactly like the focus learners – they became empowered to act and enhance their daily practise, using ICT based interventions and developing sustainable L2L competences (Sorensen, 2006).

Conclusion

This paper reported on an investigation of using ICT for inclusion of learners with extensive developmental and attention disorders in mainstream schools; In other words, the ICT potential for increasing these learners' presence, participation, contribution and achievements in the school context. The general results of this investigation points to ICT interventions as effective tools to empower, hand in hand, teachers and learners in the meeting with this challenge.

In sum, our research on ICT as a vehicle for inclusions indicates:

1. interventions with ICT have high impact on physical and academic inclusion, while less so on social inclusion;
2. using ICT for shielding, focusing, structuring and over viewing helps focus learners to join, participate, and maintain attention, while to some extent avoiding conflicts;
3. specific planning and strict time schedules for lessons and activities, supported by digital assignments in LMS/VLE systems enhance participation, attention and self-monitoring in task solving;
4. use of ICT enhance comprehension, differentiation, production, dissemination and compensation and promote the learners' abilities to participate and contribute;

5. the teacher's knowledge of the learners' special needs, and the teachers' use of the five types of interventions did have a positive effect in terms of supporting focus learners' to participate more equally in the classroom.

While our pre/post test showed no significant progress in the learner's social and pro-social behaviour, no indication was found of ICT interventions having an impact on social inclusion.

This paper finalizes by suggesting an ICT-pedagogical strategy containing a typology of tools and interventions: Structure & Overview, Shielding & Focus, Comprehension & Differentiation, Production & Dissemination, Collaboration & Knowledge Building. Utilizing this typology in the pedagogical strategy is likely to enhance the process of inclusion in classrooms of learners with extensive developmental and attention disorders.

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