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Teaching children with disabilities using eye-controlled computer.

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Abstract. The technology of computer eye-tracking works, and actually works well but it remains unclear how people with disabilities actually use eye-tracking in a real day-to-day context. This study explores the meaning of teaching children with severe disabilities using eye-tracking. 14 teachers were interviewed about their reflections and experience of teaching and supporting the pupil with an eye-controlled computer. The essence, of teaching pupils how to use an eye control computer using eye controlling is both to understand what the pupil does with the computer, and also what the pupil wants to express through the computer. With the introduction of eye gaze technology, there is opportunities to express pupil´s wishes and emotions to some extent. The learning situation therefore involves more than learning the eye-control technique and acquiring knowledge of different subjects; it is also an existential situation.

Keywords. Eye Tracker Control System, children with disabilities, education,

Background

Imagine you have severe physical disabilities, without speech, profound motor impairment, communication impairment, and totally dependent on other people in all everyday activities. You are probably involved in few activities and tend to have a passive role in social relations (Raghavendra, Virgo, Olsson, Connell, & Lane, 2011). You are unable to operate a computer using your body movements, and communication is only possible with your eyes and facial expressions. Is it possible that you could participate in society based on your own terms?

Swedish laws and school policies state that children with disabilities should have equal opportunities to participate in all aspects of school life, and schools are responsible for adjusting everyday schoolwork as required to meet each student´s needs and abilities. But is this possible in view of these children´s severe physical disabilities?

This preliminary study, which has not yet been published, is part of an intervention program to integrate eye-tracking computers into the school and at home for children with severe disabilities. Eye-tracking technology allows users to interact with objects on a computer screen by moving their eyes. It is made possible by using an inbuilt camera in the screen that reads where on the screen the person is looking, to a precision of a few millimetres. The gaze replaces the computer mouse and keyboard as the input method (Majaranta et al., 2011).

We know that the technology of computer eye-tracking works, and actually works well. We also know that severely disabled children, despite their serious afflictions, can become more competent at controlling with their eye gaze over time (Borgestig,

Falkmer, & Hemmingsson, 2013). But it remains unclear how people with disabilities actually use eye-tracking in a real day-to-day context. That a technology works does not necessarily mean it is practical in everyday life. This study focuses on eye-tracking in a school setting, and more specifically, it explores the meaning of teaching children with severe disabilities using eye-tracking. For teachers, this is a new technology and a new learning situation. It is therefore important to learn from the teachers' experience and consider how the technology is working in the real day-to-day school context.

Method

To answer the questions and to understand this everyday experience, a phenomenological lifeworld perspective was chosen (Dahlberg, Dahlberg, & Nyström, 2008). The study was conducted in Sweden at nine schools for children with various special needs. In these schools, nine pupils, aged between 6 to 12 years, were part of an intervention program to integrate eye-tracking computers in school and at home. The pupils had cerebral palsy, and were in profound need of assistance for all everyday activities, and none of them were capable of speech. Their teachers were interviewed about their experience of teaching these pupils with the help of eye-tracking. A total of 14 people participated in the study, 10 teachers and four teacher assistants. Their experience ranged from four to 39 years; five were male and nine were female. All teachers invited agreed to participate. Every teacher was interviewed twice; first when the eye-controlled computer was introduced to the pupil in the classroom, with a follow-up interview six to eight months later. The interviews were conducted as an open dialogue, seeking the informant's reflections and experience of teaching and supporting the pupil with an eye-controlled computer.

The first interview centred on apprehensions and expectations of implementing an eye-controlled computer in the classroom. All the participants chose to meet at their work place. The interviews lasted between 60 and 90 minutes and were recorded with a digital voice recorder. The interviews were conducted as an open dialogue, seeking the informant's reflections and experience of teaching and supporting the pupil with an eye-controlled computer. To get background information about the phenomenon all interviews began with the question: ´Can you tell me about an ordinary day with the pupil". Thereafter, open questions were asked on several sub-areas to get an insight into the phenomenon and the informant's individual experience. Every direct question was followed up by open-ended questions. The goal of the follow-up questions was partly to gain richer explanations of the experience and partly to "bridle" the interviewer´s self-understanding, ensuring it was the voice of the informant's lifeworld that stood out. Participants were encouraged to provide concrete examples to avoid thematized descriptions and general arguments.

The interview text was analysed using the phenomenological reflective lifeworld approach described by Dahlberg et al. (2008) to find the essence and meaning structure of teaching pupils with the help of eye-tracking technology. The approach means that the analysis is descriptive, close to the text and describes the phenomenon without theoretical interpretations and constructions. Although the interviews were focused on the informant's lifeworld and everyday meaning of teaching how to use an eye control computer, the analysis was carried out with a scientific "bridling" attitude where the analysis all through the analysis was questioned and pondered upon. After the

interviews were read through several times to become familiar with the data as a whole, the interview text was divided into meaning units. All meaning units in all interviews were then grouped into different clusters of meaning units. To avoid theoretical explanations the meaning units and clusters were kept close to the informants' own words, with no changes in the participants' statements. After that the text was again regarded as a whole, and the clustered meanings were related to each other, to discover a new whole. The goal was not to categorize the data but instead to find the essence of the phenomenon and the meanings that constituted the actual essence. This was done by moving back and forth between the parts and the whole of the text. Analysing the text is to carrying a dialogue with it and not to quickly make definite what was indefinite. Many factors are involved in the lived experience and not just those that are convenient for the researcher. All meaning units and clusters were connected to the whole text.

Result

The essence, or the essential structure of teaching pupils how to use an eye control computer using eye controlling is both to understand what the pupil does with the computer, and also what the pupil wants to express through the computer. When operating the computer, the pupil tries to gaze-control it and the included software. It is about to practice the gaze but the teachers experience difficulties when the pupil´s gaze is not directly controllable. Instead the teachers tries to understand what the pupil see and is trying to achieve with the gaze. They do this by constantly asking questions and pointing at the screen. In a movement together with the pupil, a teacher observe the pupil´s gaze by following the mouse pointer, at the same time interpreting the pupil´s facial expression. In the learning situation, the teachers are active and constantly present in a balance between actively supporting the pupil´s gaze and at the same time not taking over the pupil´s gaze.

But behind the performance and the technique of controlling the computer is the desire of the teachers to understand what the pupils want to express through the eye control. The eye gaze technology opens up a possibility to understand the pupil´s emotions and wishes. The teachers describe it as the pupil´s "inner world" and how the inner world was previously "locked in" their own body. With the introduction of eye gaze technology, there is opportunities to express this inner world to some extent. For example, with help of the eye-controlled computer, the pupil can express pain and where the pain is situated, can indicate who he/she wants to be with in the schoolyard, or can describe how he/she experiences different activities. The learning situation therefore involves more than learning the eye-control technique and acquiring knowledge of different subjects; it is also an existential situation. The teacher becomes aware of the student's vulnerability and shut-in feeling and it arouses an awareness of and a responsibility to understand and mediate the pupil's inner world.

When teaching pupils how to use an eye-control computer, the context is crucial for the interplay between pupil, teacher and technology and for creating the motivation for the pupil to learn to gaze. The teachers found that the computer is important in all everyday school situations. This presupposes that the computer is immediately accessible and easily adapted to different situations. Classmates influence the learning situation by their fascination with the eye gaze technology, and this make the student

appear important and skilful. But the context could also hinder a meaningful interplay between pupil, teacher and technology when the computer is not integrated into the classroom or in the school's everyday life or when it takes too long to prepare the computer. In these situations, the teachers describe that the pupil lost interest of eye controlling the computer.

When the eye gaze performance is working and capable of expressing the pupil's inner world the technology is experienced as unreflected and transparent. The focus is on what the pupil wants to express and mediate. You could say, with Don Ihde´s (1990) words, that the eye gaze technology became embodied in the pupil. The eye gaze technology became part of the way the pupil relates to the world. The technology withdraws into the background and is barely noticed. Instead the teacher see through the technology and mediating a human experience. However, the eye gaze technology could and often drop in its level of transparency. It change the character of the pupil´s and the teacher's relation to the eye gaze computer. The technology is visible and an obstacle to expressing the inner world.

Discussion

To enable the technology to become more embodied, the software needs to be designed not just from a strictly school subject perspective; it should also be designed to more easily let the pupil express the inner world i.e. the pupil´s emotions, and wishes. Examples from the gaming world, such as virtual reality games, could be used as a source of inspiration. The eye-controlled computer needs to be more mobile and easily adaptable to different school situations. The computer needs to have a faster boot-up time and the computer must be used for the school's everyday activities.

In summary, when introduced to an eye-controlled gaze computer, the pupils can, despite severe disabilities control the computer and express things that would be very hard, if not impossible without this computer. The pupils go from being able to do almost nothing to something. That is a huge step for the pupil but also for the teacher.

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