Karolinska Institutet

Decision

2023-04-28

Ref: 1-322/2023

President

To
Ministry of Education

Decision on opinion on proposal for national digitalization strategy for the school system 2023–2027. (Your ref. U2022/03951, our ref. 1-322/2023)

Decision

It is resolved that Karolinska Institutet submits the attached statement.

The case

Karolinska Institutet (KI) has been given the opportunity to provide comments on the Ministry of Education's referral of the Swedish National Agency for Education's proposal for a national digitalization strategy for the school system 2023–2027. The statement has been prepared by Lisa Thorell, professor of developmental psychology; Torkel Klingberg, professor of cognitive neuroscience; Agneta Herlitz, professor of psychology; Andreas Olsson, professor of psychology, and Ulrika Ådén, professor and chief physician in neonatology.

The decision in this matter has been made by the undersigned principal Annika Östman. Wernerson in the presence of University Director Veronika Sundström after Presentation by unit manager Maria Lönn.

Annika Östman Wernerson

Maria Lönn

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Attachment:

Opinion on the Swedish National Agency for Education's proposal for a national digitalization strategy for the school system 2023–2027

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Appendix,

Opinion on the Swedish National Agency for Education's proposal for a national digitalisation strategy for the school system 2023–2027 (Karolinska Institute ref. 1-322/2023)

Summary comments

The proposed digitalization strategy presented by the Swedish National Agency for Education includes two overarching goals: 1) that all children and students should develop digital skills in order to be able to participate actively in studies, social life and working life in order to contribute to a sustainable and democratic society, and 2) that the quality of teaching, equity and goal achievement should increase by using the opportunities offered by digitalization in the various parts of the school system. In its report, the Swedish National Agency for Education describes how increased digitalization will lead to various positive effects for both schools and society. We see three overarching problems with the report:

1. The assumption that digitalization will have the positive effects effects that the Swedish National Agency for Education expects are not evidence-based, that is, not founded in scientific knowledge. We call for quantitative studies that measured the effects of various measures on knowledge acquisition as well as digital competence.
2. The Swedish National Agency for Education does not seem to be aware at all that research has shown that digitalization of schools has major, negative consequences for students' acquisition of knowledge.
3. The Swedish National Agency for Education's proposal lacks any concrete suggestions on how schools should work with the implementation of the digitalization strategy. This is despite the fact that the Swedish National Agency for Education must be very well aware that many schools (especially in vulnerable areas) have great difficulty finding qualified educators and that very few educators have received any training in how to use digital aids.

Regarding the strategy's first goal, the Swedish National Agency for Education writes that digitalization should create increased equality, and that more children develop an interest in digital technology, which in the long term should improve the supply of skills in the labor market and increase innovation in technological development. However, the digitalization that has been carried out so far in Swedish schools has largely involved switching to using digital teaching materials or that upper secondary schools lack teaching materials and instead allow students to seek their own knowledge via the internet. The digitalization strategy presents no support whatsoever for the fact that digitalization of schools will have the effects that are expected. As a reader of the report, you should therefore ask yourself the following questions regarding the strategy's first overall goal:

1. Why would increased use of digital tools in school lead to more students becoming interested in furthering their education in the field of technology?

2. Why would increased digitalization of schools contribute to a more even gender distribution in technical education?
3. Why would digitalization of schools improve the supply of skills in the labor market and increase innovation in technological development?

It is certainly possible to argue that it is important for students to develop digital competence within the framework of school, but it is unclear how the Swedish National Agency for Education believes that digitalisation of schools can improve the supply of skills in the labour market. The definition of digital competence, and how it should be measured, is also unclear. Several of the examples put forward in the Swedish National Agency for Education's proposal, such as that students should "learn to handle a digital camera" and "develop the ability to orient themselves in digital environments" (page 8), seem naive. A recently published report on the need for digital competence pointed out that the labour market has completely different needs (Makers & Shapers, 2022). Among other things, it emphasizes the importance of digital competence being developed within the framework of a separate subject, as it is more advanced knowledge that the labour market needs. They also highlight the need for continuous training of teachers in digital competence. If one wants to increase Sweden's competitiveness, it therefore seems reasonable to start by training teachers so that they can in turn develop students' competence in specific subjects, not by

implement a non-evidence-based digitalization of the school that completely permeates the entire operation, including the youngest children in preschool.

The second goal of the digitalization strategy is to increase the quality of education, equity and goal achievement by using the opportunities of digitalization in the various parts of the school system. Again, the Swedish National Agency for Education writes that the digitalization of schools will have a number of positive effects, but it does not present any research whatsoever that supports this assumption. The closest it comes is that in the final part of the strategy it states that it is important that “research and proven experience on the opportunities, challenges and risks of digitalization is available and used in the activities” (page 17).

It is noteworthy that the National Agency for Education writes that research is important but does not base its arguments on the large amount of research that actually already exists in this area. As we explain in more detail below, the research shows that there are many disadvantages to digitizing schools to the extent that has already happened in Sweden, and increased digitization risks having further negative consequences.

We believe that a focus on knowledge acquisition via printed textbooks and the teacher's subject expertise should be reintroduced instead of primarily acquiring knowledge from freely available digital sources that have not been fact-checked. For a more detailed summary of these negative effects, we refer to Klingberg (2023) and below we provide an overall account of what the research shows. It is worth noting that several of the studies we refer to were published relatively many years ago and whose results have since been confirmed in more recent studies. Knowledge about the negative effects of digitalization has therefore been available for many years, but the National Agency for Education seems to be unaware of this.

There is clear scientific support that digital tools risk impairing, rather than improving, student learning:

- Digital tools contain many distractions, which interferes concentration and working memory, which in turn impairs learning (Klingberg, 2023). For example, one study showed that when students had their computers connected during a lecture, they spent up to 40 percent of the lesson time on irrelevant things that had no connection to the teaching (Kraushaar & Novak, 2010). Another study examined the effects of letting half of the students have their laptops open during a lecture while the other half had to have them closed. After the lecture

they were asked to answer questions about the content. The students who had their laptops open performed 30 percent worse than their peers (Hembrooke & Gay, 2003). These studies concerned university-level students, and the negative impact of computers on students in primary and secondary schools is said to be even greater, as younger children have poorer executive functions (e.g., controlling and monitoring their impulses). As for students in primary school, the OECD has published a report showing that high use of computers in school has a clear negative correlation with PISA results in both mathematics and reading (OECD, 2015). Even in cases where a student manages not to be distracted by his or her own computer screen, there is a high risk of being distracted by other students' screens. If students are allowed to have their computers open during briefings, it should be expected that there will always be some students who do something other than listen to the teacher, and the risk is of course particularly high for students who already have difficulty meeting the school's knowledge requirements.

- “Multi-tasking” (doing many things at the same time) leads to poorer learning because our brains have a limited ability to hold relevant information remains in working memory (van der Schuur et al., 2015). For example, studies have shown that if young people have their mobile phones next to them when they study, they need significantly longer to learn the material. If students have to use their computers to search for information online, they will be exposed to a variety of distractors. Online advertising is now also personalized to make it even harder to resist.

- Reading and writing on a screen has negative effects on reading comprehension. It is more difficult to remember information read or written on a screen compared to information read in a book (Clinton, 2019; Delgado et al., 2018). Studies have shown that it is not only is about students being distracted by other things like happens on the computer without the effect remaining even if you limit distractions on the computer. The negative effects of reading on a screen instead of on paper are also large – the effect is 36%, which corresponds to about two years of reading development in middle school (Klingberg, 2023). The above-mentioned effects also apply to more recent studies that include students who have been accustomed to computers since an early age. Studies also show that it is worse for learning if students take notes on a computer instead of with paper and pen (Mueller & Oppenheimer, 2014). If you ask students themselves, they often state that they prefer digital tools, but when you test their abilities with objective tests, these clearly show that

they perform worse when reading and taking notes via a computer (Singer & Alexander, 2017). This also clearly shows that qualitative studies, such as interviews that only examine what students themselves think, are not sufficient to draw conclusions about the effects of digitalization on learning.

That children should use the opportunities of digitalization and seek knowledge themselves often leads to mistakes.

A large part of the digitalization of schools is that schools no longer use textbooks, not even digital teaching materials, but that students are expected to search for their own information via digital sources already at a relatively early age. This search for knowledge takes a lot of time, time that must be taken away from learning the material. For example, a study (Weinstein et al., 2010) showed that students who wrote their own questions and then answered them learned just as much as students who only had to answer the teacher's questions. However, reaching the same level of knowledge took more than twice as long for the first group. If students also, as is common in Swedish schools, first have to search for information online themselves, then create their own questions and finally answer them, this takes a lot of extra time. Ultimately, this leads to students learning less. In line with this finding, the OECD recently presented a report that showed that countries that use a lot of "inquiry-based teaching" had significantly worse PISA results (Denoël et al., 2017). In addition to the time-consuming nature of searching for one's own knowledge via the internet, this increases the risk of reading horizontally (i.e. quickly skimming many different sources) rather than vertically (i.e. seeking deeper knowledge). Students learn to prioritize quick information retrieval over deep analysis, which in turn can lead to more superficial knowledge that is lost more quickly.

When students seek their own knowledge via digital sources, there is also a great risk that what is learned is incorrect. Increasing emphasis seems to be placed on students expressing their own opinions and then finding support for these on the internet – not to first find knowledge and then base one's opinions on the knowledge that exists. The word "evidence-based" is used more and more often, but many seem to think that this means that all perspectives should be taken into account rather than that what is taught should have scientific support. Even at university level, students are finding it increasingly difficult to read longer texts and produce the

information that is relevant. Unfortunately, the Swedish National Agency for Education's own report also reflects this attitude as they present a large number of their own opinions about what effects they believe digitalization will have without presenting any support for these opinions in scientific literature. The Swedish National Agency for Education instead chooses to refer to a blog post, which shows the difficulties even for an authority to find credible sources. In summary, we think that it seems that the increased digitalization of schools has already had major negative consequences in that it conveys that knowledge is something relative - such a view is a serious threat to students' knowledge acquisition.

Young children should not use digital tools at all

International recommendations from the World Health Organization (WHO, 2019) state that children under 2 years of age should not use screens at all and during the rest of the preschool age, screen time should be limited to a maximum of 1 hour per day. Many other countries such as the USA, Canada, Australia and Norway have adopted this advice. In Sweden, the Swedish Pediatric Association is in the process of formulating similar advice. However, the Swedish National Agency for Education is going in the opposite direction and requires that all preschools must use digital tools. More quantitative and longitudinal research is needed in this area, but there are already some clear findings:

- When comparing learning by having a young child imitate a real person, a filmed person, or a recorded voice, research shows that young children have great difficulty understanding what they see on a screen (Yadav et al., 2018)

- At the age of two, children learn half as much from all 2D media and can remember it for half as long compared to interaction with live people (Moser et al., 2015). Human interaction is therefore essential for learning at this age.

- Early screen use is related to poorer language development (Madigan et al., 2020). More specifically, research has shown that when children use screens, human interaction is inhibited -
children end up in a “digital bubble” (Bochicchio et al., 2022).
Preschool has an important compensatory mission, especially for children whose mother tongue is not Swedish. Having a requirement to use digital tools in preschool, which is written into the Swedish curriculum, is therefore counterproductive.

- There is a severe staff shortage in many preschools and in our contacts with preschools it has emerged that screens are unfortunately often used to calm children with special needs who otherwise disrupt the activities. This in turn can lead to problems worsening over time (Radesky et al., 2023; Thorell et al., 2023).

Digitalization risks reducing gender equality

One of the arguments of the Swedish National Agency for Education for increased digitalization of schools is that it is thought that this will create greater equality. However, research suggests that the effects will be the opposite. In the text above, we have described research that has shown that digital tools can have serious negative effects on children's learning. These effects will of course have an even greater negative impact on students who do not have supportive parents at home who can compensate for the child spending lessons watching YouTube or playing games instead of listening to the teacher. A Swedish study showed, for example, that schools that introduced 1:1 (one student, one computer) showed worse results compared to schools that did not implement this in terms of performance in mathematics and the proportion of students who went on to upper secondary school studies in a study preparation program, but only for students with parents with low education (Hall et al., 2019). Students with parents with low education therefore seem to be more negatively affected by digitalization than those with highly educated parents, not the other way around as the Swedish National Agency for Education claims in its digitalization strategy.

Digitalization risks hitting some children particularly hard

Research indicates that the digitalization of school is particularly hard on children with special needs, such as ADHD. Children with ADHD are more easily distracted than others by irrelevant impressions and information when they have free access to a computer. Not being able to block distracting information from the computer also has greater negative effects on learning for children with special needs, as it takes longer and requires more effort for these children to reach the school's knowledge requirements.

Research also shows that the ability to perform good online searches is strongly related to our executive functions, especially our working memory capacity (Choi et al., 2019). Executive functions are among those that mature late and are not fully developed until the age of 20, which means that many schoolchildren simply do not have the cognitive capacity required to be able to search for their own knowledge via the internet.

The thesis that children should be able to learn on their own using only computers has been disproven time and again (Klingberg, 2023). The problems are particularly great for children who have delayed development of executive abilities, such as children with ADHD.

However, it should also be emphasized that digital tools, if used correctly, can be a good support for students with special needs (Klingberg, 2023). In this regard, the Swedish National Agency for Education refers to the evaluation made of the previous digitalization strategy. It points out that “two out of ten teachers in compulsory school do not have access to the digital tools they need to design teaching for students who need support interventions.” However, this new digitalization strategy does not present any proposals to address this problem.

The link between screen use and mental health

Finally, the Ministry of Education writes that they also want views on the effects that exist regarding students' cognitive development, health and well-being in relation to the use of digital tools. Providing a complete account of this here is not possible for reasons of space, but we refer to a recently published summary from the Swedish Media Council (Nutley & Thorell, 2022). This summary described a positive relationship between screen time and various aspects of mental ill health (e.g., depression, anxiety, concentration problems, low self-esteem, eating disorder problems, sleep problems) and physical ill health (e.g., obesity, myopia, poor motor skills). However, knowing exactly what causes what in these studies is difficult. There is much evidence that the causal relationships go both ways, which means that children who already have problems with mental ill health are at increased risk of using screens to a high extent and this can reinforce already existing problems. As mentioned above,

digitalization does not have the same effect on all students and those who already have difficulties are often at risk of being hit hardest. In this area, more studies are also needed that do not only focus on screen time and its effect on young people's health, but that examine more specifically what children and young people do when they use screens. Finally, it should also be pointed out that if digital tools are used more or less constantly in schools, there is a great risk that this will generalize to other parts of the children's lives. This can, for example, mean that parents find it more difficult to limit their child's screen time at home if schoolwork requires them to use a computer. If digital tools are already used for very young children in preschool, it will be impossible for parents to follow the recommendations that children should not use screens before the age of two.

The strategy completely lacks guidelines for how schools should work with digitalization.

A serious criticism of the Swedish National Agency for Education's proposal for a digitalisation strategy is that it completely lacks guidelines for how schools should work with digitalisation. This is particularly strange when in some cases they present very specific examples of working methods that have nothing to do with digitalisation. Among other things, the Swedish National Agency for Education writes that the work to counteract gender patterns "can be about how to treat children and pupils in preschool

and in the classroom, for example, how to allocate speaking space or which role models children and students can identify with." (pages 10-11). We would like to point out that although there are clear risks with digitalizing schools, there is also evidence that certain digital teaching materials can have a positive effect on learning (Clark et al. 2016). A strategy for the digitalization of schools should of course include a proposal for how political bodies, government agencies, private actors and independent researchers can collaborate to develop and evaluate effective digital teaching materials.

Closing remarks

In conclusion, we believe that the Swedish National Agency for Education's report on the digitalization of schools is very flawed as it largely ignores the research findings that show negative consequences associated with the digitalization of schools. We find it remarkable that the Swedish National Agency for Education does not

has put together a group of researchers in different research areas to work on this very important question. As stated above, we believe that the Ministry of Education has strong reasons to reject this proposal for a digitalization strategy for schools. Perhaps even more important is to require the National Agency for Education to work in an evidence-based manner (i.e. always have a scientific basis in their reports and recommendations and pay particular attention to the need for quantitative studies) and interdisciplinary in order to bring in expertise from all relevant research areas.

Finally, it should be emphasized that although digital educational materials are considerably cheaper compared to printed textbooks, research shows that they are fraught with negative consequences that can lead to increased societal costs in the long term. There are thus strong economic incentives for schools to become more digital, and earmarked resources should therefore be provided to schools so that students' needs for printed educational materials can be met. Educational research in Sweden should also be strengthened so that more focus is placed on quantitative studies that include a control group so that the effects of various reforms can be examined before they are implemented. Important political decisions regarding schools should not be made without first knowing what the research says.

We are of course available for a more in-depth discussion about the research situation if there is interest in this.

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