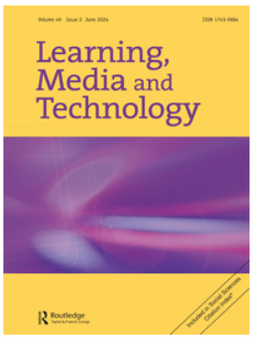

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Screens, teens and their brains. Discourses about digital media, learning and cognitive development in popular science neuroeducation

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ABSTRACT

Contemporary education in Sweden is characterized by two parallel processes: the implementation of digital tools in the classroom, on the one hand, and an increased emphasis on brain-based learning, on the other. Proponents of the latter strand of 'neuroeducation' claim that digital media might have harmful effects on learning and cognitive development. How do they then deal with school digitalization? By examining popular science books by influential neuroscience actors in the Swedish educational context, this study identifies two diverging discourses where digital technologies are discussed both as distractions in the classroom and as promising tools for personalized and self-optimizing learning. This ambiguity reflects a cautious criticism against school digitalization as overhastly, a critique that is also emphasized in recent policy changes in the Swedish school system. The article concludes that the impact of brain-based perspectives on educational digitalization policy have positioned neuroscience actors as a new kind of digital experts.

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Introduction

In this article, we are interested in the intersection of two ongoing processes in the Swedish school system: firstly, the turn towards school digitalization and, secondly, the increased interest in neuroeducation, i.e., how brain-based knowledge can improve education. Lately, a neuroeducational discourse has been being established in teacher training and schools around the country (Aronsson 2019; Levinsson and Norlund 2018) and we find it relevant to study what it has to say about the turn towards digital education and how it handles common worries about digital distractions and their negative impact on young people's abilities to concentrate and learn. In the public debate, digital technologies in the classroom are claimed to cause distraction that risks harming the cognitive abilities of children and adolescents (Grigic Magnusson et al. 2023; Wikström et al. 2022). Are these worries reflected in the neuroeducational discourse at all, and if so, how do neuroeducators tackle the accelerated pace of digital technologies in classrooms? The aim of the article is to examine how school digitalization, and in particular the effects of digital media on the cognitive abilities of students, are depicted in some of the most prominent Swedish popular science texts in the neuroeducational discourse.

The digitalization of the public school system has been an ongoing project in Sweden since the 1970s (Hylén 2011; Rahm 2019) but has intensified in later years through initiatives such as One

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Laptop per Child (Islam and Grönlund 2016; Tallvid 2015), the implementation of digital learning management systems for administration and communication (Hillman, Bergviken Rensfeldt, and Ivarsson 2020) and an increased focus on digital competence in the national curricula (Forsman 2018). For proponents of school digitalization, digital technologies are believed to have the ability to improve an outmoded model of education and remake educational practices into forms better suited to the twenty-first century. In this discourse, digital tools and systems are often promoted as a kind of 'quick fix' for any perceived difficulties within compulsory education (Ideland, Jobér, and Axelsson 2021) – 'a solution in search of a problem', as put by Selwyn and Jandrić (2020, 997). Sweden strives to be at the forefront of the digitalization process, and education is 'identified as instrumental for the digital transformation of Swedish society, and efforts are made to accelerate the digitalization of the educational system' (Ljungqvist and Sonesson 2022, 89; see also Wikström et al. 2022).

Lately, however, a less enthusiastic approach towards digital tools and systems in education is expressed also within the policy sector. The national strategy on school digitalization that was presented by the Swedish National Agency for Education in 2022 was remitted by the government since it did not address the possible harmful effect of digital technologies on learning. In a press release, the minister of education, Mats Persson, explains that the digitalization of education has been somewhat hasty and suggests that the strategy needs to be revised to take into account 'important perspectives from for example cognition science about how the learning of children and students are affected by digital tools' (Swedish Ministry of Education and Research, 2 March 2023).[1] Another example concerns an often discussed suggestion of a smartphone ban in the classroom that is now partly realized in the Swedish Education Act, which allows teachers and headmasters to decide whether or not smartphones should be permitted in the classroom and even confiscate phones if they find it necessary (Grigic Magnusson 2022).

The meeting between this more hesitant perspective of digital technologies in relation to learning and the ongoing school digitalization implies a tension that teachers, students, and school management must navigate (see e.g., Grigic Magnusson et al. 2023; Wikström et al. 2022). In the study by Peter Wikström et al., interviews were carried out with representatives from each of these groups about the use of smartphones in the classroom. One of the interviewed headmasters mentions the criticism against smartphones in the classroom coming from 'brain scientists', which the authors interpret as 'popular media discourse' motivated with reference to cognitive or neuroscientific ideas (2022, 5). Among the prominent voices in this brain science-oriented media discourse is liberal politician and writer Isak Skogstad who argues, with reference to findings from neuroscience, that we should 'throw the computers out of the classroom':

> Students are children and their brains are not fully developed. In fact, the part of the brain that regulates children's ability to plan and consider consequences is not fully developed until well after the age of twenty. It is thus only rational to assume that children always will prefer Snapchat over algebra. The idea that you can multitask effectively is just a myth without support in evidence. (*Göteborgs-Posten*, June 18, 2017).

His argument can be situated in a longer history of media resistance where the introduction of new communication technologies raises public concerns or even 'moral panics' if their use gives rise to behavior that is considered problematic, not least when it comes to the use of media by children and young people (Drotner 1999; Syvertsen and Enli 2020; Wikström et al. 2022). But in contrast to earlier debates about harmful effects of media, the risks related to digital media usage are increasingly explained with reference to the underdeveloped brains of young people, where vital cognitive functions such as attention and concentration are believed to be negatively affected in environments suffused with distractions from social and online media (Forsler and Guyard 2020; Mills 2014; Vanden Abeele and Mohr 2021).

The growing interest in neuroscientific knowledge in relation to education can be seen as significant for the 'age of biology', where the workings of the brain are conceived as foundational to understanding human nature (Pitts-Taylor 2010; Rose 2013). In particular, the concept of brain

plasticity, which refers to 'the capacity of the brain to modify itself in response to changes in its functioning or environment' (Pitts-Taylor 2010, 636), has been claimed to have significance in education (Jolles and Jolles 2021). If the brain is plastic, it implies that 'the opportunities of changes validate the educational role in contrast with genetic determinist arguments; brain structure and neural circuits may be remodelled by experiences of learning, in a proactive way' (García Carrasco, Serrano, and García 2015, 163–164). The interest in findings from neuroscience in the field of education has given rise to a new academic field, *neuroeducation*[2], which is an interdisciplinary field involving perspectives from psychology, neuroscience, and education, with the aim to improve learning and educational settings (Ansari, Smedt, and Grabner 2012; Clark 2015; Feiler and Stabio 2018; Jolles and Jolles 2021; Norlund and Strömberg 2018). This, in turn, has paved the way for a market of commercial 'brain-based' material in schools, such as popular neuroscience books, self-help workshops, and brain-training products (Busso and Pollack 2015; Howard-Jones 2014; Levinsson and Norlund 2018; Sylvan and Christodoulou 2010).

In Sweden, the neuroeducational discourse has gained a particularly strong foothold in educational politics by acting as a counterpart to the traditional sociocultural pedagogy, which is nowadays often accused of being inefficient, 'non-scientific', and based on a left-wing ideology rather than evidence-based and more reliable pedagogical knowledge (Aronsson 2019; Edling and Liljestrand 2020). The growing interest in neuroscientific knowledge to support learning abilities can also be seen as an extension of the rise of measurement culture in education over the last few decades (Biesta 2010; Levinsson and Norlund 2018), a trend that researchers suggest is especially prominent in Sweden due to the past decade's decline in PISA results, which is used to motivate an emphasis on assessment and evidence-based learning (Lundahl and Serder 2020). In line with this development, it was decided in a political agreement after the general election in Sweden 2022 that teacher training should be reformed to include cognitive science (*Tidöavtale*t, 14 Oct 2022). The resolution follows an earlier promemoria from the Swedish Ministry of Education and Research suggesting that research about the brain that affects learning should be considered 'basic knowledge' in future teacher training programmes (2021, 108). In light of the pronounced course towards both school digitalization and brain-based education in Sweden, we consider it relevant to focus our study on digital media in the neuroeducational discourse on the Swedish educational context.

Brain functions and media effects

In many countries, not only in Sweden, explaining digital media effects with reference to brain functions has become so common in the public debate that it embodies a taken-for-granted truth, a discourse. Discourse is defined in this article as that which governs how a topic can be meaningfully talked about and the concept is used to guide the analysis rather than to perform a discourse analysis in the stricter sense. That excessive use of smartphones affects young peoples' brains and learning abilities is a statement that makes sense to most people today, and therefore belongs to the discourse of media effects (Vanden Abeele and Mohr 2021). Furthermore, as Foucault (1980) points out, a discourse is defined not only by what is being said but also by what remains unsaid, which for the purpose of this article means that we are also interested in those instances where digital media or media effects are not mentioned or merely superficially discussed.

Discourses are however not only about language, i.e., what is said or unsaid, but are also materialized through practices and technologies (understood here as assemblages of, for instance, ideas, experts, equipment, and rules) and implemented in specific institutional settings, such as schools, thereby regulating the conduct of individuals (Ball 2012; Rose 2007). The process to regulate the conduct of individuals is not only imposed from above but also increasingly performed through self-regulation practices. Individuals discipline themselves due to incentives to act in certain ways. Improving the body and brain is currently a strong incentive in society and neuroscientific findings are being adopted in many contexts, not only education, to optimize the performance of the human brain. This also reveals a contemporary biopolitical economy, stressing individual

responsibility for one's own health and progress (Pitts-Taylor 2010; Rose 2013) as well as media habits (Guyard and Kaun 2018; Haider and Sundin 2022).

Since social norms are not encoded at birth, self-regulation techniques must be taught to children and have thus become integrated in the realm of education (Peters 2017). Paired with the recent educational interest in neuroscience, these ideas of self-regulation have informed 'a variety of brain-targeted teaching resources and brain-training programs, as well as educational and social policies directed at children's brains for cognitive enhancement, emotional self-regulation and other forms of educational performance improvement' (Williamson 2019, 70). Combining education and neuroscience is, however, complicated. Educational researchers have for instance highlighted problems involved in translating the different languages used in the two disciplines (Busso and Pollack 2015; Clark 2015; Jolles and Jolles 2021; Pasquinelli 2012). In the meeting of these languages, neuroscientific rhetoric may confer a sense of scientific legitimacy at the expense of pedagogy. As put by Busso and Pollack (2015), 'the nuances of what constitutes scientific "proof" are easy to misunderstand, especially by educators who are not intimately familiar with standards of scientific evidence and who may be dazzled by the neuroscience language and images on offer' (172). The difficulties of transferring neuroscientific language and discoveries into teachers' day-to-day practices open up for misinterpretations and simplifications, often referred to as 'neuromyths'. Common examples of such myths include the belief that children have different learning styles or that the left/right hemispheres have different functions and that people are either 'left-brained' or 'right-brained' (Dekker et al. 2012; Jolles and Jolles 2021; Lethaby and Harries 2016; Norlund and Strömberg 2018).

Some neuromyths occurring in popular science and the media debate include ideas about digital media effects, for example the belief that digital media can 're-wire' children's brains and cause them to become addicted, an assertion that lacks evidence in scientific research (Kardefelt-Winther 2017; Mills 2014). While our study does not set out to expose or disprove myths about media effects in the neuroeducational discourse, the analysis will uncover popular beliefs about the effects of media on the brain that can be utilized in further research in this area.

Studying popularized approaches to neuroeducation

In this article, we examine how the effects of digital media on learning are described in *popular science* approaches to neuroeducation rather than in neuroeducation as an academic field, since it is in these mainstream and popularized forms that teachers are most likely to be reached by neuroeducational ideas (Busso and Pollack 2015; Clement and Lovat 2012; Howard-Jones 2014; Jolles and Jolles 2021). A common feature of the material produced by popular science neuroeducators, apart from being accessible, are similarities with self-help literature, in particular the inclination towards self-regulation and the provision of guiding principles for self-improvement that, according to Madsen (2015), characterizes self-help literature.

We have chosen to analyze a selection of popular science books that we consider to be part of the neuroeducational discourse in Sweden but we have also looked at other types of material from the same authors (websites, lectures, interviews, etc.) to situate the material in a broader context.[3] Authors with a strong media presence in the debate on school digitalization in Sweden are considered more influential and have been prioritized in the selection. The reason we have chosen books as our main object of study is that this medium is generally recognized among the public as more reliable and authoritative than, for example, websites. The selected books are targeted either directly at schools or at a general audience. The latter category might not focus specifically on educational settings but has nonetheless gained influence in schools due to high exposure in mass media. For example, Hansen's book *Skärmhjärnan*, although not originally targeted towards schools, has been rewritten for a younger audience and accompanied with a teacher manual for classroom discussions. Schools are offered free copies of the book (as well as another of his books about healthy brain habits), for the cost of transportation and administration (SCRIIN

2023). Currently half of the middle schools in Sweden have ordered the books, which suggests that brain-based perspectives on learning and health are well established in Swedish schools. Within this brain health discourse, organizations promoting physical exercise and limited screen time (such as SCRIIN and Generation Pep who, together with the publisher, initiated the project with free books for schools) have become important stakeholders in the educational debate in Sweden.

Below follows a presentation of the books selected for the analysis, along with a short description of the authors and the books (Table 1).

Methodologically, the study uses critical textual analysis with the objective to investigate how school digitalization, and in particular the impact of digital media on the cognitive abilities of students, are portrayed in the material. We aim to identify discursive statements in the books that are considered 'natural' or taken for granted. We also pay attention to affinities with other popular genres, such as self-help literature, especially concerning how self-regulation is treated in the material. Here, the analysis focuses specifically on interdiscursivity, the way in 'which discourses, genres and styles are drawn upon in a text and how they are articulated together' (Fairclough 2010, 7). An interdiscursive approach also makes visible how neuroscientific rhetoric is used as a truth discourse, and how it can be understood in the context of the Swedish education system as a counter discourse to the sociocultural tradition of pedagogy. Furthermore, we highlight recurring metaphors in the books. Given the need to translate facts established by brain research into terms that laymen can understand, popular neuroscience commonly uses metaphors to describe

Table 1. Material selection: six popular science books on neuroeducation.

Author	Title and year	Book description
Anders Hansen[4] has a medical degree and works as a psychiatrist, author, speaker, and consultant.	*Skärmhjärnan: hur en hjärna i osynk med sin tid kan göra oss stressade deprimerade och ångestfyllda* (2019) [The screen brain: how a brain out of sync with its time can make us stressed, depressed, and anxious]	The book does not specifically address schools but a wider audience. The main argument is that excessive use of screen-based media might harm the brain.
Martin Ingvar is a neuroscientist and *Gunilla Eldh* is a journalist in medicine and health. They have co-authored several popular science books about the brain.	*Hjärnkoll på skolan: och varför barn behöver dig för att* lära (2014) [On track with brain-based schooling: and why children need you to learn]	The book presents a brain-based perspective of the Swedish school, and argues that since motivation is crucial for learning, insights from brain research is needed.
Torkel Klingberg is a professor in cognitive neuroscience. He has also been involved in the development of the digital app Vektor (training tool for early math learning).	*Hjärna, gener & jävlar anamma: hur barn lär (2016)* [Brain, genes and fighting spirit: how children learn]	The book discusses how children learn and the importance of 'grit' from a neuroscience perspective. It also discusses ways to train the brain through digital learning tools and evaluate different apps and games.
Sissela Nutley is a researcher in cognitive neuroscience and works as an author, speaker, and consultant.	*Distraherad: hjärnan, skärmen och krafterna bakom (2019)* [Distracted: the brain, the screen, and the forces behind]	The book discusses screen time and young people's brains on a general level. As the title suggests, the main claim throughout the book is that digital technologies distract its young users.
Anette Prehn[5] is a sociologist and works as an author, speaker, and consultant.	*Hjärnsmart pedagogik: stimulera barns lärande, empati, inre lugn och* självkontroll *(2018)* [Brain smart education: stimulate the learning, empathy, inner peace, and self-control of children]	The book is structured around five different 'destinations' in the brain: amygdala, the working memory, the frontal lobe, hippocampus, and autonomous neuroplasticity. It is targeted towards teachers for all age groups.
Bertil Thomas (ed.), *Rolf Ekman, Axel Eriksson, Joanna Giota, Carl-G Gottfries, Anders Hill & Per-Olof Nilsson*. The authors of this anthology are all researchers within either neuroscience, education, or technology science.	*Hjärnan och lärandet: kunskaper för framtidens skola (2020)* [The brain and learning: knowledge for the future school]	The book is intended as a textbook for teacher students, and it presents an introduction to neuroscientific findings with relevance to educational practices.

the brain and its functions in a more accessible way (Jordynn and Appelbaum 2010). Although metaphors seem to simply explain certain knowledge easier, in this case the effects of media in educational settings, they also shape understandings of the described phenomena. This means that '[w]hich metaphors become accepted can have implications not only for how we think about and understand the world, but also for how we act, the institutions we build and how we organize our societies' (Machin 2012, 164).

More concretely, we have focused on two themes in the material that answer to the overall question of how popular science neuroeducation in Sweden addresses the accelerated pace of digital technologies in the classroom, namely (1) how the material discusses digital technologies in relation to learning/cognitive development and in what situations/contexts they are mentioned, and (2) the assumed effects of media usage on the brain and how these effects are suggested to be handled or utilized for learning.

Diverging discourses on digital media, learning and cognitive development

In the material, the ongoing digitalization of Swedish schools is described as a matter of using digital technologies in the classroom, rather than as a comprehensive transformation process pushed into schools by education policy and the edtech industry. Administrative tools, investments in digital infrastructure, or policy changes are hardly mentioned at all. The focus is on technologies designed for educational purposes (such as e-learning material, laptops, or tablets) and, in particular, devices being brought in from the outside to the classroom, mainly smartphones. As we will show, these technologies are considered by the authors as sources of distraction that hinder concentration and deep learning.

The authors are, however, keen to emphasize that they are not against digitalization per se, even though they express concerns about the present situation and advocate a more careful stance and rigorous testing of new technologies before they are implemented in schools. One of the authors, Sissela Nutley, writes: 'I, at least, think it is stupid to take a chance' (2019, 110) and suggests that before being implemented in schools, all digital tools should be tested 'scientifically', referring to evidence-based learning. At the same time, she maintains that 'no one wants to go back in time' and stop using digital media altogether (196). Another author likewise regrets the way digital technology has been implemented in schools so far, and compares distributing computers in classrooms without considering how they should be used with 'putting a TV in the nursery and expecting that the children after a few years show up at the breakfast table with a PhD dissertation in their hand' (Klingberg 2016, 170). Still, he shares the notion that a future without digital media is unthinkable, and rather enthusiastically imagines a future school where digital technologies can be used in better ways to make education more efficient.

The analyzed material thus exposes an ambiguous approach to educational technologies in learning environments. There is an agreement that digital technologies might have a potential, but at present they are insufficiently evaluated. In the following, we will discuss how this ambiguity unfolds into diverging discourses where digital media on the one hand is described as hindering cognitive development and on the other, as promising tools to optimize learning abilities. The analysis is divided into three sections where the first discusses how the material frames *technologies in the classroom and beyond*, focusing mainly on smartphones as sources of distraction. The second section considers how *technologies of self-regulation* are suggested in the material as strategies for handling these distractions. Technologies are understood in this section not as devices but in the Foucauldian sense as practices employed by students to mitigate harmful media use. However, the discourse of self-regulation also contains elements of optimization where digital tools are imagined as potential tools or *brain-training technologies*, which is explored in the third section. Finally, in a concluding discussion, we reflect on the ambiguous discourses on digital technologies and learning that feature in the material and on the growing impact of neuroducation in the Swedish school system.

Technologies in the classroom and beyond

The digital device that is given most attention in the material is by far the smartphone. The core problem with smartphones is described as the constant interruptions they cause through notifications which obstruct focused thinking and 'trigger thoughts and daydreams that interrupt primary tasks' (Nutley 2019, 96). Digital devices can even distract by their very presence, as when smartphones are kept in a pocket on quiet mode (e.g., Hansen 2019, 63; Nutley 2019, 96; Thomas et al. 2020, 150). The impulse to reach for the phone, although it is turned off, is described as a form of addiction caused by repeated use of media that activates the brain's reward system; five of the authors (Hansen 2019, 70, 137; Ingvar and Eldh 2014, 74; Nutley 2019, 95–98; Prehn 2018, 126–127; Thomas et al. 2020, 151) recommend a ban on smartphones in the classroom. The discussion centres not only on smartphones *in* the classroom, but also on the consequences of everyday smartphone use for educational situations. Hansen, for example, suggests that excessive use of smartphones and other screen media leads to sleep disorders that might negatively affect concentration and memory abilities, making it worth considering from 'a school perspective' (2019, 87).

The sense of disapproval regarding uncontrolled use of (in particular) smartphones reveals an anxiety related to assumptions about young people's impulsivity and inability to delay gratification. More precisely, younger generations brought up in 'a culture of immediacy' (Tomlinson 2007) are considered unfit for schoolwork that, according to the authors, is demanding and requires the ability to delay rewards – only later in life will it be possible to see the benefits of their efforts. Since children and adolescents have underdeveloped frontal lobes, which is 'the part of the brain that is placed behind the forehead and helps us break impulses and delay gratifications' (Hansen 2019, 129–130), the ability to resist attending to their smartphones is judged as inadequate.

This concern is reflected also in relation to educational technologies, especially in relation to laptops that enable – even encourage – multitasking. Students dividing their attention between different tasks, such as listening to a lecture while simultaneously writing an e-mail, seems to trouble the authors (e.g., Hansen 2019, 64). Prehn coins the term 'optline' (short for 'optional line') to describe this state where the potential for online activities is ever present, and argues that 'to allow a more or less constant optline state is to counteract the full focus of students' (2018, 126). Although she admits that laptops can be useful for seeking information ('I am *not* striving to place computers and information search in the "naughty corner"', she stresses on page 126), she still considers it risky to 'allow students to zap and surf during valuable lesson time' (126). Private surfing on laptops during class further distracts not only the multitasking user but also students nearby whose eyes are drawn to the screen (e.g., Nutley 2019, 103). The problems associated with these kinds of distractions are explained by the notion that the brain cannot focus on more than one thing at a time (e.g., Hansen 2019, 63).

The authors' concerns about distractions, from both smartphones and laptops, can further be related to the idea of a blurred line between private and 'professional' use of digital technologies, as described by Olin-Scheller et al. (2021). Texting with friends, surfing on social media or shopping sites, etc., allow students to maintain a personal space within the classroom, which is a place that traditionally has banned private activities. These activities are therefore perceived as deeply problematic, a concern that recalls past media panics about, for example, video game violence or internet pornography. The current 'screen time panic' (Forsler and Guyard 2020), however, is less focused on supposedly dangerous media *content* and more on its addictive *use*. Excessive use of digital media, especially concerning young people, is often connected to popular ideas about media addiction (Kardefelt-Winther 2017; Vanden Abeele and Mohr 2021). The assumption found in the material about students not being able to resist private media activities during class likely stems from such ideas. In the next section, we will discuss how this fear is connected to a growing interest in healthy use of digital media, based on technologies to support self-regulation.

Technologies for self-regulation

In line with contemporary biopolitics, self-regulation has become the main strategy for coping with unhealthy use of digital media (Guyard and Kaun 2018; Haider and Sundin 2022; Syvertsen and Enli 2020; Vanden Abeele and Mohr 2021). Assessments of excessive and futile media use are often based on self-perception, and recent studies have shown 'that people consider managing their screen time a personal responsibility, and interpret failure to adequately do so as a result of their lack of self-control' (Vanden Abeele and Mohr 2021, 1538). As a response to this concern among the public, a new industry of 'digital wellbeing interventions' has appeared, including digital detox programs, self-help guides, and software applications blocking or limiting certain content (Biedermann, Schneider, and Drachsler 2021; Vanden Abeele and Mohr 2021). Likewise, the authors of the books analyzed in this study put the responsibility to resist digital temptations on the individual. They do not suggest, for instance, policy regulations regarding digital technologies in education (although they recommend a ban on smartphones in the classroom), but rather emphasize intrinsic motivation and provide readers with 'help to self-help' as in other types of self-help literature (see Madsen 2015).

The main self-regulation technique recommended in the books is the use of checklists, directed at individual teachers, parents, and students. In particular, adults are addressed with recommendations to limit unhealthy media use among the younger generations. For instance, Thomas et al. conclude their book with a list of advice that concerns media use both in schools and at home, particularly emphasizing restricted use of digital media in the classroom where smartphones should be turned off and kept 'out of reach' of students (2020, 152). Hansen likewise summarizes the points made in his book with a list of 'good advice in a digital era' (2019, 187–189), such as turning off notifications in learning environments and keeping smartphones away from the bed. The most elaborate checklist is presented by Nutley (2019, 213–216), who gives detailed advice on taking a healthier approach towards screen time, especially in everyday life.

These guidelines have an aura of self-evidence that speak to people's common sense and lived experience. They also come with a promise of increased control and self-improvement. On the grounds of brain plasticity, neuroscience offers opportunities for change, thus challenging biological reductionism. If the structure of our brains is not fixed at birth, as was once believed, but changes throughout life in relation to external stimuli, our ways of thinking and acting are not fully determined by our genes (Jolles and Jolles 2021; Pitts-Taylor 2010; Rose 2013). This line of reasoning fits well into a neoliberal narrative which holds that 'anyone can become anything', where it is up to the individual to determine their own success in life. As Pitts-Taylor argues, the perspective of brain plasticity is often 'deployed to encourage us to see ourselves as neuronal subjects, and is linked to the continued enhancement of learning, intelligence, and mental performance' (2010, 639).

To explain brain plasticity, the brain is presented as a part of the body that, just like any other muscle, needs regular exercise to develop optimally. In this analogy, digital media is often metaphorically compared with sugar or candy, i.e., something that is hard to resist but at the same time harmful. This metaphor appears frequently in the material, especially Nutley and Hansen repeatedly write about smartphones as candy (or drugs) in the sense that they are equally addictive. Hansen explains that the desire both for calories and for stimuli from digital devices can be attributed to 'the evolutionary algorithm that was developed to avoid starvation' (2019, 17) which causes problems in today's society where there is an abundance of both sugar and media. In this environment, the author suggests, we need to develop strategies of self-regulation both in relation to sugar and when it comes to the digital temptations that speak to the brain's reward system. In a YouTube video targeted at children and their parents, Hansen opens with the line: 'You can think of the smartphone as candy … it triggers a series of deep-rooted mechanisms that makes it hard to resist' (Generation Pep 2020).

Consequently, the material under study not only stresses the harmful effects of media but is also characterized by a biopolitical discourse on optimization, where the brain is described in biological terms as a muscle in need of exercise. In this quest for self-improvement, digital media is paradoxically positioned both as a threat to the developing brain and – as discussed below – as a potential tool for training it.

Brain-training technologies

While the checklists in the books described above are focused on the present situation, the discussion of technologies as tools for brain-training is more future oriented, both in terms of development (in that these tools are not yet realized) and when it comes to the effort involved (in that brain-training aims for long-term effects while self-help advice is focused on short-term effects, such as improved sleeping quality). In this more techno-optimistic line of reasoning, media technologies are discussed as tools that can be used to increase motivation and improve cognitive functions, in particular memory and attention. Klingberg, for example, imagines a school where digital technologies can be used to make education more efficient and personalized: 'In a sci-fi version of the future school, every individual could be scanned with an MRI, in order to tailor a learning tool that can optimize the learning for this specific individual' (2016, 173).

Common examples of imagined learning tools are brain-training apps and also emerging solutions such as AI-based teaching programs and smart robots. Thomas et al. discuss how AI-based teaching programs and smart robots could offer possibilities to improve teaching and make it more enjoyable:

> Imagine how fun it would be to learn English, Swedish or mathematics with a cheerful, humorous, encouraging, understanding and patient robot that you can talk with, who can correct all your mistakes, who never gets upset, who always has time, who does not judge you, who does not yell at you, who does not grade you but always encourages your efforts and advancements' (2020, 131).

While this is still a dream for the future, there is one already existing media technology that is mentioned in this brain-training discourse, namely computer games. Computer games are acknowledged as having 'motivating elements' that can be used to optimize learning. Motivation is described here in terms of a search for rewards or 'dopamine showers', a chemical reaction in the brain that stimulates the inherent willingness to work towards a certain goal (Nutley 2019, 186; Hansen 2019, 148–149; Ingvar and Eldh 2014, 17–18, 90; Thomas et al. 2020, 131). Ingvar and Eldh even claim that 'game developers have understood how the brain functions regarding motivation' while unfortunately 'this basic knowledge is not included in Swedish teacher training' (2014, 17–18), indicating that game developers in some respects are better educators than trained teachers and teacher educators.

The arguments for implementing these kinds of brain-training software and devices in education are similar to those being put forth by the edtech industry and policy makers. If properly used, computerized training can personalize learning and be adapted to the individual student's learning process. Without technological innovations, schools would need to '[increase by] tenfold the amount of special needs teachers', as Klingberg (2016, 170) puts it, but with the help of adaptive technologies students can get customized support and thus reach their full potential. Klingberg further stresses that this enables successful teaching methods to be spread globally, describing how a 'smartphone screen in Kenya can be used to present a lecture by a Harvard professor and a tablet in the Australian wilderness can provide the same tools for mathematics training as in the rest of the world' (168).

This idea of education as context independent indicates a kinship between the two processes discussed in the article, namely neuroeducation and school digitalization. Like Klingberg, representatives from the edtech industry tend to stress the scalability of their products by focusing on knowledge *transfer* rather than knowledge *production*. The idea that best practice can be exported

internationally reveals a decontextualized view on learning that fits the global edtech market much better than an understanding of education as socially and culturally situated. It thus aligns with a broader discursive shift in education where a 'more traditional view of schooling with an emphasis on the transmission and memorisation of factual knowledge' is promoted in favor of socio-cultural pedagogies (Haider and Sundin 2022, 91). This critique of progressive pedagogies is put forth in the material as one of the arguments for neuroeducation by describing contemporary schools as 'battlefields of ideology, current affairs or pedagogical doctrines [that] need new oxygen from cognitive neuroscience' (Ingvar and Eldh 2014, 8). School digitalization and neuroeducation thus converge in the criticism against socio-cultural pedagogies as inefficient and old-fashioned, but while the edtech sector promotes digital tools as an already existing solution, neuroeducation describes them as future promises.

Concluding discussion

In this article, we have examined popularized approaches to neuroeducation in relation to digital technology. Schools today, not least in Sweden, are characterized by a growing presence of digital devices, tools, and systems, which in turn can be considered inconsistent with an understanding of digital media as causing impairment of the cognitive abilities of young people. The analyzed material reveals diverging discourses about digital technologies in education where, on the one hand, digital technologies are seen as distractions in relation to schoolwork or as a premature experiment and, on the other hand, as promising tools for personalized, motivating, and efficient learning. The first (negative) perspective is visible when the authors discuss the current situation with students using laptops or smartphones both in the classroom and at home. The second, more optimistic, perspective appears when the authors picture an imagined future where digital technologies are used to their full potential. Both perspectives relate to theories of brain plasticity, meaning that the structure of the brain is changeable and that certain areas can either shrink or be enlarged depending on how these areas are stimulated.

When we started working with this material in 2020, we were struck by how hesitant the authors were to discuss the overall idea of school digitalization. We interpreted this avoidance as a sign of digitalization itself being such a powerful discourse that to challenge it was associated with the risk of appearing reactionary and against progress. The fear of sounding old-fashioned is evident in the material, which tends to describe digitalization as an inevitable and almost autonomous process that will take place regardless of what we think about it and where institutions who fail to keep up with this development will be left behind, education being no exception. That the future of education is digital resembles the vision put forth by companies in the edtech sector, but has also dominated education policy which generally presume that 'there are no alternatives' (Selwyn et al. 2020, 4). For neuroeducation, positioned as the 'future' of education, it might have been difficult and perhaps also futile to challenge this narrative.

However, recent national policy changes suggest that it might not be impossible. As mentioned in the introduction, the coming national strategy on school digitalization in Sweden was disputed on the grounds of not taking into account perspectives from neuroscience on the effects of digital media on the brain. In a similar vein, changes in the Swedish Education Act nowdays allows teachers and headmasters to decide how to handle smartphones in the classroom. These policy changes indicate that in parallel to the ongoing digitalization of the Swedish school, neuroeducators are becoming an increasingly important voice in the educational debate that reinforces public concerns about digital media effects and might contribute to a challenge of the digital imperative that elsewhere dominates in society.

In conclusion, we suggest that in the knowledge paradigm that dominates contemporary society, where biological explanation models constitute 'an unparalleled truth discourse' (Rose 2013, 7), influential neuroscience actors constitute an important group of 'digital experts'. Contrary to previous experts in the field who, according to Ljungquist and Sonesson, 'profit from an uncritical

approach to digitalization' (2022, 99), these new digital experts assume a more catious stance where they criticize what they see as an overhasty digitalization of the Swedish school system. From this position they give advice on when and how to use digital devices, not least when it comes to children and adolescents. While much of their advice reflects the ambiguity of digital technologies in the public debate – as, on the one hand, promising better and more efficient learning and, on the other hand, threatening the developing brains of young people – there are also signs, especially within education, that the pendulum is about to swing in favor of brain-based perspectives.

Notes

1. All citations from articles, policy documents or books in Swedish have been translated into English by the authors
2. Also referred to as *educational neuroscience*, *Mind, Brain and Education* or *brain-based education*.
3. Some of these authors are active in the public debate and often invited as neuroscience experts in the mass media (Hansen; Klingberg; Ingvar & Eldh; Nutley). Others promote their own books and services as lecturers and consultants through their own company websites (Nutley - sisselanutley.com; Prehn - brainsmart.today; Thomas, Ekman, Eriksson, Giota, Hill & Nilsson – neuroforum.se).
4. In the analysis, we refer also to a videoclip where Hansen is explaining his approach to digital media to a younger audience, produced by the NGO Generation Pep who advocates physical exercise for children.
5. Prehn is a sociologist and not formally educated within neuroscience. She resides in Denmark, but her book is translated into Swedish and distributed by one of the biggest publishers of educational and academic literature in Sweden (Studentlitteratur) and can therefore be considered part of the Swedish neuroeducational landscape.

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References

Ansari, Daniel, Bert Smedt, and Roland Grabner. 2012. "Neuroeducation – A Critical Overview of An Emerging Field." *Neuroethics* 5 (2): 105–117. https://doi.org/10.1007/s12152-011-9119-3.

Aronsson, Lena. 2019. "När förskolan möter neurovetenskap: Kunskapsteoretiska möten i teori och i praktik." [When preschool meets neuroscience: Knowledge theory encounters in theory and practice]. PhD diss., Stockholm University.

Ball, Stephen J. 2012. *Foucault, Power, and Education*. New York: Routledge.

Biedermann, Daniel, Jan Schneider, and Hendrik Drachsler. 2021. "Digital Self-Control Interventions for Distracting Media Multitasking – A Systematic Review." *Journal of Computer Assisted Learning* 37 (5): 1217–1231. https://doi.org/10.1111/jcal.12581.

Biesta, Gert. 2010. *Good Education in an Age of Measurement: Ethics, Politics, Democracy*. Boulder, Colorado: Paradigm Publishers.

Busso, Daniel S., and Courtney Pollack. 2015. "No Brain Left Behind: Consequences of Neuroscience Discourse for Education." *Learning, Media and Technology* 40 (2): 168–186. https://doi.org/10.1080/17439884.2014.908908.

Clark, John. 2015. "Philosophy, Neuroscience and Education." *Educational Philosophy and Theory* 47 (1): 36–46. https://doi.org/10.1080/00131857.2013.866532.

Clement, Neville D., and Terence Lovat. 2012. "Neuroscience and Education: Issues and Challenges for Curriculum." *Curriculum Inquiry* 42 (4): 534–557. https://doi.org/10.1111/j.1467-873X.2012.00602.x.

Dekker, Sanne, Nikki C. Lee, Paul Howard-Jones, and Jelle Jolles. 2012. "Neuromyths in Education: Prevalence and Predictors of Misconceptions among Teachers." *Frontiers in Psychology* 3: 429. https://doi.org/10.3389/fpsyg.2012.00429.

Drotner, Kirsten. 1999. "Dangerous Media? Panic Discourses and Dilemmas of Modernity." *Paedagogica Historica* 35 (3): 593–619. https://doi.org/10.1080/0030923990350303.

Edling, Silvia, and Johan Liljestrand. 2020. "Let's Talk About Teacher Education! Analysing the Media Debates in 2016-2017 on Teacher Education Using Sweden as a Case." *Asia-Pacific Journal of Teacher Education* 48 (3): 251–266. https://doi.org/10.1080/1359866X.2019.1631255.

Fairclough, Norman. 2010. *Critical Discourse Analysis: The Critical Study of Language*. 2nd ed. London: Taylor & Francis Group.

Feiler, Jacob B., and Maureen E. Stabio. 2018. "Three Pillars of Educational Neuroscience from Three Decades of Literature." *Trends in Neuroscience and Education* 13: 17–25. https://doi.org/10.1016/j.tine.2018.11.001.

Forsler, Ingrid, and Carina Guyard. 2020. "Screen Time and the Young Brain – a Contemporary Moral Panic?" In *Making Time for Digital Lives: Beyond Chronotopia*, edited by Anne Kaun, Christian Pentzold, and Christine Lohmeier, 25–42. Lanham: Rowman & Littlefield.

Forsman, Michael. 2018. "Digital Competence and the Future Media Citizen. A Preliminary Conceptual Analysis." *The Journal of Media Literacy* 65 (1 & 2): 24–28.

Foucault, Michel. 1980. *Power, Knowledge: Selected Interviews and Other Writings 1972-1977*. 1. American ed. New York: Pantheon.

García Carrasco, Joaquín, María Jose Hernández Serrano, and Antonio Victor Martín García. 2015. "Plasticity as a Framing Concept Enabling Transdisciplinary Understanding and Research in Neuroscience and Education." *Learning, Media and Technology* 40 (2): 152–167. https://doi.org/10.1080/17439884.2014.908907.

Generation Pep. Aug 13, 2020. "Anders Hansens Skärmskola - Vad är det bästa tipset för att minska sin stillasittande skärmtid?" [Anders Hansen's brain school – What can you do to limit your sedentary screentime?] http://www.youtube.com/watch?v=S4GPv-qYiSw.

Grigic Magnusson, Anita. 2022. "Användning av mobiltelefoner i den digitaliserade skolan: Elever och lärares perspektiv." [The use of Mobile Phones in the Digital School: Perspectives from Students and Teachers]. PhD Diss., Göteborg University.

Grigic Magnusson, Anita, Torbjörn Ott, Ylva Hård Af Segerstad, and Sylvana Sofkova Hashemi. 2023. "Complexities of Managing a Mobile Phone Ban in the Digitalized Schools' Classroom." *Computers in the Schools. Ahead-of-Print*, 1–21.

Guyard, Carina, and Anne Kaun. 2018. "Workfulness: Governing the Disobedient Brain." *Journal of Cultural Economy* 11 (6): 535–548. https://doi.org/10.1080/17530350.2018.1481877.

Haider, Jutta, and Olof Sundin. 2022. *Paradoxes of Media and Information Literacy: The Crisis of Information*. Oxon, New York: Routledge Taylor & Francis Group.

Hansen, Anders. 2019. *Skärmhjärnan: hur en hjärna i osynk med sin tid kan göra oss stressade deprimerade och ångestfyllda [The Screen Brain: How a Brain out of Sync with its Time Can Make us Stressed, Depressed and Anxious]*. Stockholm: Bonnier fakta.

Hillman, Thomas, Annika Bergviken Rensfeldt, and Jonas Ivarsson. 2020. "Brave New Platforms: A Possible Platform Future for Highly Decentralised Schooling." *Learning, Media and Technology* 45 (1): 7–16. https://doi.org/10.1080/17439884.2020.1683748.

Howard-Jones, Paul A. 2014. "Neuroscience and Education: Myths and Messages." *Nature Reviews Neuroscience* 15 (12): 817–824. https://doi.org/10.1038/nrn3817.

Hylén, Jan. 2011. *Digitaliseringen av skolan [The Digitalization of School]*. 2nd ed. Lund: Studentlitteratur.

Ideland, Malin, Anna Jobér, and Thom Axelsson. 2021. "Problem Solved! How Eduprenuers Enact a School Crisis as Business Possibilities." *European Educational Research Journal* 20 (1): 83–101. https://doi.org/10.1177/1474904120952978.

Ingvar, Martin, and Gunilla. Eldh. 2014. *Hjärnkoll på skolan (och varför barn behöver dig för att lära) [On Track with Brain Based Schooling: And why Children Need you to Learn]*. Stockholm: Natur och kultur.

Islam, Sirajul M., and Åke Grönlund. 2016. "An International Literature Review of 1:1 Computing in Schools." *Journal of Educational Change* 17 (2): 191–222. https://doi.org/10.1007/s10833-016-9271-y.

Jolles, Jelle, and Dietsje D. Jolles. 2021. "On Neuroeducation: Why and How to Improve Neuroscientific Literacy in Educational Professionals." *Frontiers in Psychology* 12: 752151. https://doi.org/10.3389/fpsyg.2021.752151.

Jordynn, Jack, and L. Gregory Appelbaum. 2010. ""This is Your Brain on Rhetoric": *Research Directions for Neurorhetorics*." *Rhetoric Society Quarterly* 40 (5): 411–437. https://doi.org/10.1080/02773945.2010.516303.

Kardefelt-Winther, Daniel. 2017. "How Does the Time Children Spend Using Digital Technology Impact Their Mental Well-Being, Social Relationships and Physical Activity? An Evidence-Focused Literature Review." Innocenti Discussion Papers no. 2017-02. Innocenti. Florence: UNICEF Office of Research.

Klingberg, Torkel. 2016. *Hjärna, gener & jävlar anamma: hur barn lär [Brain, Genes and Fighting Spirit: How Children Learn]*. Stockholm: Natur & Kultur.

Lethaby, Carol, and Patricia Harries. 2016. "Learning Styles and Teacher Training: Are We Perpetuating Neuromyths?" *Elt Journal* 70 (1): 16–27. https://doi.org/10.1093/elt/ccv051.
Levinsson, Magnus, and Anita Norlund. 2018. "En samtida diskurs om hjärnans betydelse för undervisning och lärande: Kritisk analys av artiklar i lärarfackliga tidskrifter. [A Contemporary Discourse on the Importance of the Brain for Teaching and Learning: A Critical Analysis of Articles in Teachers Press]." *Utbildning Och Lärande / Education And Learning* 12 (1): 7–25.
Ljungqvist, Marita, and Anders Sonesson. 2022. "Selling out Education in the Name of Digitalization: A Critical Analysis of Swedish Policy." *Nordic Journal of Studies in Educational Policy* 8 (2): 89–102. https://doi.org/10.1080/20020317.2021.2004665.
Lundahl, Christian, and Margareta Serder. 2020. "Is PISA More Important to School Reforms Than Educational Research? The Selective use of Authoritative References in Media and in Parliamentary Debates." *Nordic Journal of Studies in Educational Policy* 6 (3): 193–206. https://doi.org/10.1080/20020317.2020.1831306.
Machin, David. 2012. *How To Do Critical Discourse Analysis: A Multimodal Introduction*. London; Thousand Oaks, Calif.: Sage.
Madsen, Ole Jacob. 2015. *Optimizing the Self: Social Representations of Self-Help*. London: Routledge.
Mills, Kathryn L. 2014. "Effects of Internet Use on the Adolescent Brain: Despite Popular Claims, Experimental Evidence Remains Scarce." *Trends in Cognitive Sciences* 18 (8): 385–387. https://doi.org/10.1016/j.tics.2014.04.011.
Norlund, Anita, and Marianne Strömberg. 2018. "En Kritisk in- Och Utzoomning Av Ett Hjärnbaserat Synsätt På Elever." [A Critical Zoom on a Brain-Based View on Education]." *Nordisk Tidskrift För Allmän Didaktik* 4 (1): 18–33. https://doi.org/10.57126/noad.v4i1.12211.
Nutley, Sissela. 2019. *Distraherad: hjärnan, skärmen och krafterna bakom [Distracted: The Brain, the Screen, and the Forces Behind]*. Stockholm: Natur & Kultur.
Olin-Scheller, Christina, Marie Tanner, Stig-Börje Asplund, Janne Kontio, and Peter Wikström. 2021. "Social Excursions During the In-Between Spaces of Lessons. Students' Smartphone Use in the Upper Secondary School Classroom." *Scandinavian Journal of Educational Research* 65 (4): 615–632. https://doi.org/10.1080/00313831.2020.1739132.
Pasquinelli, Elena. 2012. "Neuromyths: Why Do They Exist and Persist?" *Mind, Brain, and Education* 6 (2): 89–96. https://doi.org/10.1111/j.1751-228X.2012.01141.x.
Peters, Michael A. 2017. "From State Responsibility for Education and Welfare to Self-Responsibilisation in the Market." *Discourse: Studies in the Cultural Politics of Education* 38 (1): 138–145. https://doi.org/10.1080/01596306.2016.1163854.
Pitts-Taylor, Victoria. 2010. "The Plastic Brain: Neoliberalism and the Neuronal Self." *Health* 14 (6): 635–652. https://doi.org/10.1177/1363459309360796.
Prehn, Anette. 2018. *Hjärnsmart pedagogik: stimulera barns lärande, empati, inre lugn och självkontroll [Brain Smart Education: Stimulate the Learning, Empathy, Inner Peace and Self Control of Children]*. Lund: Studentlitteratur.
Rahm, Lina. 2019. "Educational Imaginaries: A Genealogy of the Digital Citizen." PhD Diss. Linköping University.
Rose, Nikolas. 2007. *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton: Princeton UP.
Rose, Nikolas. 2013. "The Human Sciences in a Biological Age." *Theory, Culture & Society* 30 (1): 3–34. https://doi.org/10.1177/0263276412456569.
SCRIIN. 2023. Skärmhjärnan till Sveriges alla skolor [The screen brain to all schools in Sweden]. https://www.scriin.org/skarmhjarnan.html.
Selwyn, Neil, Thomas Hillman, Rebecca Eynon, Giselle Ferreira, Jeremy Knox, Felicitas Macgilchrist, and Juana M. Sancho-Gil. 2020. "What's Next for Ed-Tech? Critical Hopes and Concerns for the 2020s." *Learning, Media and Technology* 45 (1): 1–6. https://doi.org/10.1080/17439884.2020.1694945.
Selwyn, Neil, and Petar Jandrić. 2020. "Postdigital Living in the Age of Covid-19: Unsettling What We See as Possible." *Postdigital Science and Education* 2 (3): 989–1005. https://doi.org/10.1007/s42438-020-00166-9.
Swedish Ministry of Education and Research. 2021. "Ökad kvalitet i lärarutbildningen och fler lärare i skolan." [Increased quality in teacher education and more teachers in schools]. No. U2021/00301.
Swedish Ministry of Education and Research. 2023. "Förslag på nationell digitaliseringsstrategi skickas på remiss." [Suggested national digitalization strategy remitted]. https://www.regeringen.se/pressmeddelanden/2023/03/forslag-pa-nationell-digitaliseringsstrategi-skickas-pa-remiss/.
Sylvan, Lesley J., and Joanna A. Christodoulou. 2010. "Understanding the Role of Neuroscience in Brain Based Products: A Guide for Educators and Consumers." *Mind, Brain, and Education* 4 (1): 1–7. https://doi.org/10.1111/j.1751-228X.2009.01077.x.
Syvertsen, Trine, and Gunn Enli. 2020. "Digital Detox: Media Resistance and the Promise of Authenticity." *Convergence* 26 (5-6): 1269–1283. https://doi.org/10.1177/1354856519847325.
Tallvid, Martin. 2015. "1:1 i klassrummet: analyser av en pedagogisk praktik i förändring." [1:1 in the Classroom: Analyses of a Pedagogical Practice in Transformation]. PhD Diss., Göteborgs Universitet.

Thomas, Bertil, Rolf Ekman, Joanna Giota, Per-Olof Nilsson, Anders Hill, Carl-G Gottfries, and Axel Eriksson. 2020. *Hjärnan och lärandet: kunskaper för framtidens skola. [The Brain and Learning: Knowledge for the Future School]*, edited by Bertil Thomas. Stockholm: Liber.

Tomlinson, John. 2007. *The Culture of Speed: The Coming of Immediacy. Theory, Culture & Society (London), 99-0948605-9*. London: Sage.

Vanden Abeele, Mariek, and Victoria Mohr. 2021. "Media Addictions as Apparatgeist: What Discourse on TV and Smartphone Addiction Reveals About Society." *Convergence* 27 (6): 1536–1557. https://doi.org/10.1177/13548565211038539.

Wikström, Peter, Susanne Duek, Marie Nilsberth, and Christina Olin-Scheller. 2022, 15 Sep. "Smartphones in the Swedish Upper-Secondary Classroom: A Policy Enactment Perspective." *Learning, Media and Technology*, 1–14. https://doi.org/10.1080/17439884.2022.2124268.

Williamson, Ben. 2019. "Brain Data: Scanning, Scraping and Sculpting the Plastic Learning Brain Through Neurotechnology." *Postdigital Science and Education* 1 (1): 65–86. https://doi.org/10.1007/s42438-018-0008-5.