



OVERVIEW

for a clearer picture

No. 7

Children and digital media

An educational challenge!



diagnose:funk
Use technology wisely

Overview

Children and digital media - An educational challenge!

8 October 2024

"What we learn and what we remember makes us who we are."

Eric Kandel, neurobiologist

Summary

The diagnose:funk publication series "Overview for a clearer picture" reports on the state of research into the health effects of non-ionising radiation from mobile communications and the psychosocial consequences of digitalisation.

Overview No. 7 documents why using smartphones and other digital media too early and without regulation can have adverse effects. It focuses on findings from developmental psychology and neurobiology. It presents possible solutions for parents, educators and policymakers to protect children and adolescents from smartphone addiction.

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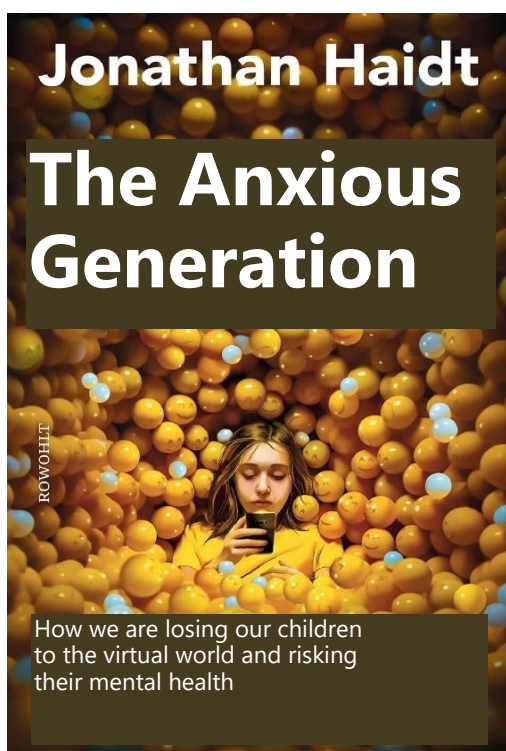
Contents

Summary	2
1 The introduction of the smartphone in 2007 - a turning point	4
1.1 "Keep your phone away from my child!"	4
1.2 Adverse effects of smartphone use	5
2 The educational catastrophe and digitalisation	8
2.1 Action is needed	10
3 The causes lie in brain development	10
3.1 What is needed for a healthy upbringing?	11
3.2 The smartphone and space-time memory: learning needs movement, breaks, leisure and boredom	12
3.3 "Man is only fully human when he plays" (Friedrich Schiller)	12
3.4 Developmental windows and the smartphone	14
3.5 The mechanism of addiction through overstimulation is known	17
3.6 Summary	18
4 The scientifically documented practical effects of digitalisation	20
4.1 Speech and language disorders	20
4.2 Reduced vocabulary	21
4.3 Loss of creativity	22
4.4 Declining school performance	22
4.5 "We are losing our children!" - alarmism or reality?	23
5 What must nurseries and schools provide in this situation?	23
5.1 The catastrophe of digital education	24
5.2 Nobody learns digitally!	25
5.3 No media autonomy without basic skills	27
5.3.1 Approaches to educating for media autonomy	27
5.3.2 A tactical shift: "accompanying media education"	28
5.4 ChatGPT makes thinking unnecessary: "AI bots undermine young people's general willingness to make an effort!"	28
5.5 Parent-school cooperation: Ireland and "Everyone else is allowed to!"	30
6 Alternatives matter: demands for education and municipal policy	31
7 Further information	32
Sources	33
Publications in the "OVERVIEW for a clearer picture" series	37

1 Smartphone introduction in 2007 - a turning point

The smartphone came onto the market in 2007. This was a turning point that continues to have a profound impact on families, their children, nurseries and schools. In his book "The Anxious Generation", US social scientist Jonathan Haidt defines this turning point as

"The complete switch from a play-based childhood, which we had for millions of years, to a phone-based childhood."

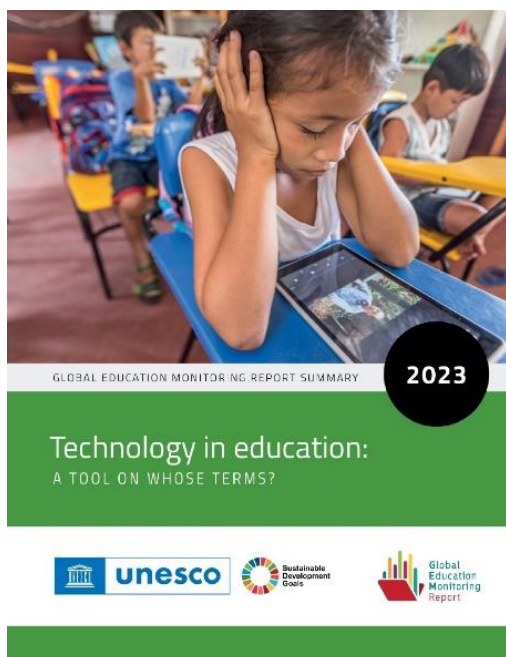


A wave of digital euphoria began in 2007: anyone wanting to prepare their children for the future had to make them media literate. Mastering the smartphone was elevated to a key skill. In 2017 the German government adopted the Digital Pact for Education. Wi-Fi in schools became a hallmark of progress. Industry promoted the narrative "Out of the chalk age". For the first time in the history of education, industry dictated how schools should educate. A network of lobbying firms formed; external funding flowed to educational researchers whose accommodating studies legitimised digitalisation. Even teachers' union newspapers adopted this narrative and often made unfounded claims about benefits: nobody wanted to seem backward.

Scientists such as Prof. Manfred Spitzer, who warned about the consequences, were ridiculed. Now we face a rude awakening. The smartphone has become a problem. It dominates the lives of most children and adolescents. Until two years ago the global trend was still: digital education, teaching with tablets and smartphones, is the ultimate advance and the way out of the educational catastrophe. Yet today, after evaluating 15 years of digitalisation, many countries that are far ahead of Germany and were repeatedly held up as models have pulled the emergency brake and are reversing digitalisation through primary school.

1.1 "Keep your phone away from my child!"

When should a child receive a smartphone? Social pressure is strong. Even very young children want one: "Everyone else is allowed to!" A worldwide



and heated debate has emerged. The surprising result: the new UNESCO education report of 2023 warns against using digital media too early. Forty experts from Germany and Switzerland call for a halt to digitalisation in educational institutions and a return to pedagogy. Radiation protection experts warn of serious harmful effects on health. Should smartphones and tablets be banned in nurseries and primary schools?

Suddenly even the mainstream media, which previously fuelled the hype, are publishing articles headed "Keep your phone away from my child" (28 February 2024). This was DIE ZEIT's headline; the Süddeutsche Zeitung followed with "Get rid of that thing" (20 April 2024).

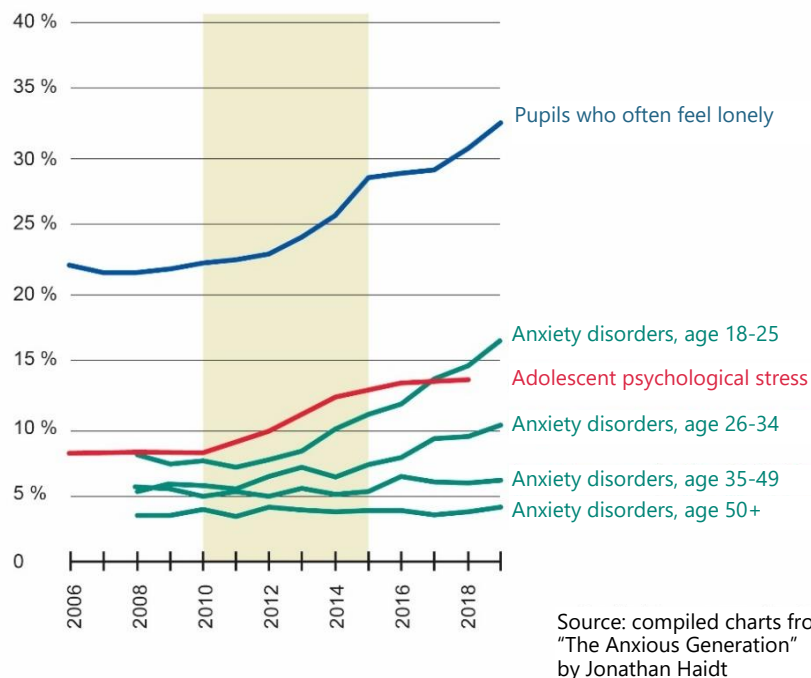
Looking back, US social scientist Jonathan Haidt assesses this turning point as follows:

*"Around 2012, young people's mental health fell off a cliff" (NZZ, 8 April 2024). His explanation: "From the beginnings of humanity until early 2010, children played, like all other mammals. This switches on their brains. Suddenly, around 2012, young people's mental health fell off a cliff. Particularly girls', but also boys'. Anxiety, depression, self-harm, suicide - all these curves shoot upwards. In 2010 there were no signs of this. So something happened around 2012. The only plausible explanation is the widespread use of smartphones combined with social networks among children from the early 2010s. I believe this is the cause of this global mental health crisis: the complete switch from a play-based childhood, which we had for millions of years, to a phone-based childhood. ... Because of smartphones and social networks, children no longer see their friends as often in real life. They no longer sleep as much. They have fewer experiences in nature and just sit in front of their screens all day. They therefore miss the broad range of experiences needed for healthy development. Their brains are configured for a life on screens. This destroys them."*¹

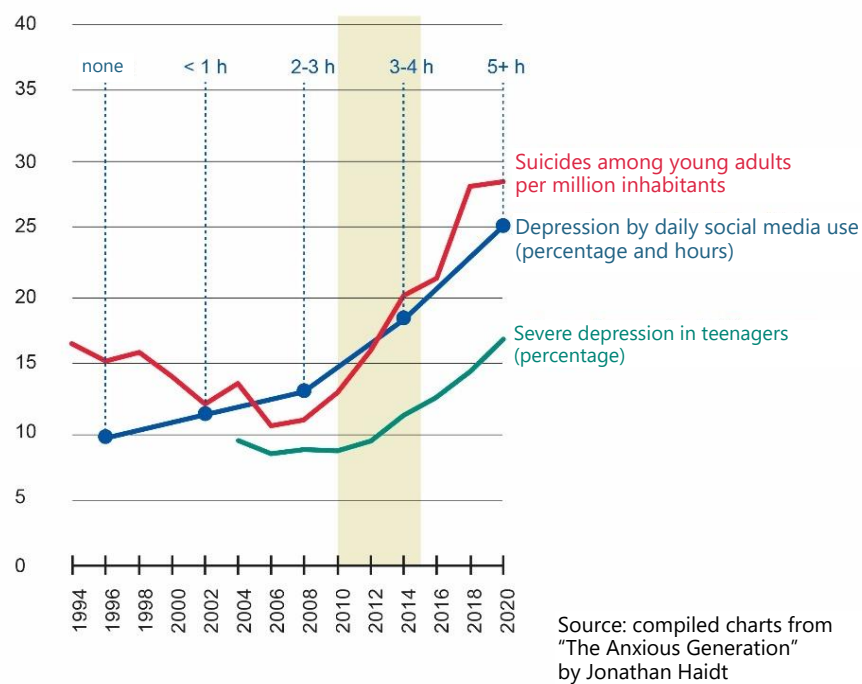
1.2 Adverse effects of smartphone use

"This destroys them!" - a harsh judgement. Haidt's team provides evidence. The charts in his book show the period of this turning point: pathological developments have increased sharply since 2010. The correlations with smartphone use are obvious. But what causal connections exist? What are the underlying causes?

Loneliness, anxiety and stress



Suicide, depression and social media



In response to the smartphone epidemic, 11 German professional associations also warn of the consequences of smartphone use in their "Guideline on dysfunctional screen use for children and adolescents": obesity, sleep disorders, eye diseases, developmental disorders, attachment disorders, behavioural disorders, internet addiction, bullying and sexual harassment, gambling, radiation exposure, and prenatal and postnatal effects of use during pregnancy.² These consequences are already present; health insurers are sounding the alarm. Children cannot cope with overstimulation and the often disturbing content of social media: they are at its mercy, even developing addiction, because they do not yet have impulse control. These consequences are no natural disaster. Psychologists, neurobiologists and doctors have increasingly warned since 2010, including Prof. Manfred Spitzer and neurobiologist Gertraud Teuchert-Noodt,³ who called for abstinence until age 14-16. Critics formed the Alliance for Humane Education in 2016.⁴ Their publications warned of the pathological effects of early screen use.⁵ They were branded backward-looking alarmists.⁶

Denmark is now reversing digital education in primary schools! In a country where over 70% of nurseries are digitalised, Social Democratic education minister Mattias Tesfaye apologised, saying digitalisation had seriously harmed children. They had been made "guinea pigs in a digital experiment" "whose scale and consequences we cannot grasp". A classroom is not an "extension of a teenager's bedroom, where people stream, play and shop". Schools had submitted to the big technology companies for too long; as a society, people had been "too infatuated with the wonders of the digital world". Schools needed to "reclaim the classroom as a place of education".⁷

A 2023 report from Karolinska University prompted Sweden to reverse digitalisation through primary school. Finland, the Netherlands, France and China are taking similar action.⁸ In the USA, the Surgeon General, the country's chief public health officer, intervened with a report on digital media's threat to the mental health of children and adolescents.⁹

In its May 2024 report, the British Parliament's Education Committee called on the government to consider banning smartphone use for children under 16, highlighting the potentially harmful effects of internet-enabled phones. Smartphone use among under-16s appeared more harmful than beneficial. Committee chair and Conservative politician Robin Walker pointed to the "clear negative impact" excessive smartphone use has on children's wellbeing.¹⁰

Germany's currently most prominent school education researcher, Prof. Klaus Zierer (University of Augsburg), concludes in his meta-study:

*"The longer children and adolescents use their smartphones in their leisure time, and the more time they spend on social media, the lower their academic performance."*¹¹

Yet Germany intends to digitalise even more, disregarding educational findings. Are we to knowingly repeat mistakes that have been corrected in other countries?

The debate remains contentious: what is the point of the so-called digitalisation of education? Can children be prepared for the future by keeping education at home, in nurseries and at school free of tablets and smartphones? Is it paradoxical to demand that children receive a smartphone or tablet only at age 14-16? Haidt calls for a social media ban until 16; the report for the French government goes as far as 18.¹²

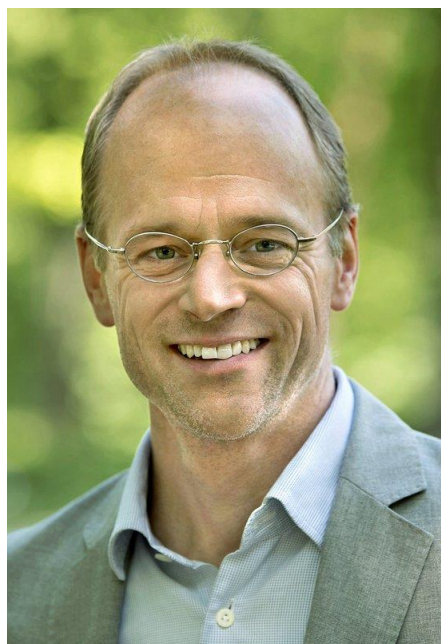
This is not so unusual or paradoxical. We often ask: when are children mature enough? An extreme example: when would we allow our children to visit Frankfurt's red-light district alone? The answer is clear: never. Children must be protected. We therefore have child protection laws on alcohol, smoking and film age ratings, for example; driving licences are available only from age 18. But digital media have no restrictions. Every child using a smartphone has unprotected access to everything. Even primary pupils watch pornography, with serious consequences. Bullying via smartphones has become a widespread problem. Jonathan Haidt describes the situation as follows:

*"We overprotect our children in the real world. On the internet, we leave them alone."*¹³

2 The educational catastrophe and digitalisation

Now there is the PISA shock too. Fewer and fewer children master basic skills such as listening, arithmetic, reading and writing. The latest PISA findings are devastating for the German education system and, above all, for young people's future. We face an educational catastrophe stretching back almost 30 years, and no German federal or state government has a plan for escaping it - quite the opposite! Every reform promises: everything will improve! Yet nothing has turned out well.

Prof. Klaus Zierer (right) writes in TAZ: "To this day there are no evidence-based approaches that help remedy the teacher shortage, show paths towards individual support in schools, and support children and adolescents comprehensively in their education."



Prof. Klaus Zierer Source: University of Augsburg

Instead, "people intoxicate themselves with a digitalisation euphoria that has already faded in other European countries because they

have realised that digital media in education are the problem rather than the solution.” (23 September 2023)

We face an educational catastrophe in which digitalisation plays a growing causal role. New, truly alarming voices now appear in the media too: “After the PISA shock: school debate in NRW - ‘Tablets in class make children less intelligent’” (Kölner Stadt-Anzeiger, 26 January 2024). “More and more children lack the words. One reason is that children spend more time on screens!” (Stuttgarter Zeitung, 26 January 2024). Berlin's Tagesspiegel even ran a full-page headline: “Social media. Are our children's brains withering?” (15 February 2024). The neurobiologist's answer in Tagesspiegel: yes, the frontal brain undergoes negative structural changes. Deficits arise before school. Remarkable statements now also appear in conservative newspapers that previously criticised the slow pace of digitalisation. The Frankfurter Allgemeine writes:

“In America, no fewer than 41 states are now suing Meta, the company behind Facebook and Instagram, because its apps endanger children's mental health. In fact, research knew surprisingly little about this subject for a long time. Increasingly, however, studies are shedding light on how social media affect the mental health of the youngest users.”

“One thing is certain: children and adolescents are currently part of a large experiment. Those born after 2010 spend their leisure time completely differently from earlier generations. They do less sport, meet friends less often and instead are online practically around the clock.”

“Primary school children spend about 45 minutes a day online, usually on tablets or computers; teenagers aged 12 and above already spend over four hours. At ages 16-18, girls spend over six hours a day on their phones. Boys spend slightly less, but play more computer games. Screen time among children and adolescents has risen considerably since the pandemic lockdowns.” The article continues:

“Adolescents look strongly to their peers and often fear missing out or being excluded. This is one reason social media are so important to teenagers. Yet studies show how problematic this is: when children and adolescents spend many hours on social media, their attention decreases, learning is disrupted and tasks are postponed. Those who spend particularly long on smartphones get poorer grades. Sleep problems arise ...

Demonising the smartphone helps little. It is important for children and adolescents to stay in touch with friends, and today they need a phone for this. A zero-smartphone rule is advisable for primary school children, but unrealistic for adolescents. Yet managing social media responsibly on their own overwhelms children and adolescents. This is also the reason for the US lawsuits: Meta is accused of ‘trapping’ children with manipulative techniques. One problem is that parents and teachers overestimate children's media literacy. A corresponding school subject has long been demanded - so far without success” (Johanna Kuroczik: The dangers of social media for children, FAZ, 15 December 2023).

2.1 Action is needed

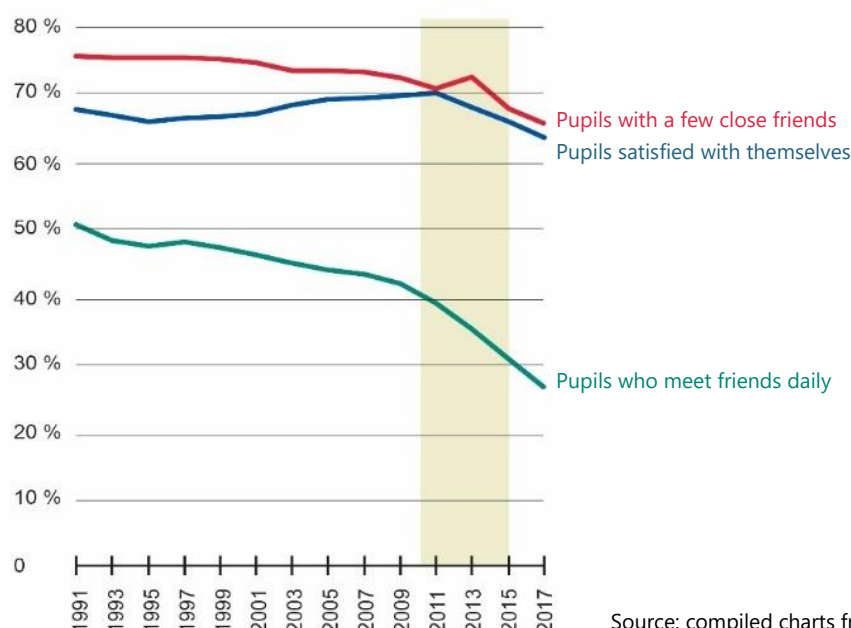
As a consequence, Prof. Christian Möller, head of child and adolescent psychiatry in Hanover, sets out the zero-smartphone rule for nurseries and primary schools in the handbook "Internet and Computer Addiction":

"Media literacy begins with media abstinence. Young children in particular need comprehensive basic sensory experiences, rather than a reduction to swiping and visual and auditory impressions. Movement and climbing trees not only promote cognitive abilities, but also prevent many lifestyle diseases, such as obesity, diabetes, cardiovascular disease and short-sightedness" (Möller 2023).¹⁴ According to Möller, digital media in early childhood adversely affect language acquisition, writing, reading, creativity and the development of intelligence.

3 The causes lie in brain development

Why have our children not become more intelligent or happier since the smartphone was introduced? The findings of Haidt's research, shown in the charts, indicate that they have fared worse since a tipping point in 2010. Let us move from symptoms that can no longer be swept under the carpet to deeper causes. How do children become autonomous - mature? Fixating on "How do we use digital media?" leads in the wrong direction. The question is: what do children need for a healthy upbringing, so that their senses develop, along with reflection and

Meeting friends, close friends, satisfaction with oneself



Source: compiled charts from
"The Anxious Generation"
by Jonathan Haidt

self-confidence? How does a child learn? How does the brain mature? Once these fundamental questions are answered, we can discuss the positive or negative role of digital media.

3.1 What is needed for a healthy upbringing?

To become autonomous, including in relation to media, the brain must be mature enough for self-control and reflection. The tower of media autonomy illustrates this. Children cannot help learning: they absorb everything like sponges. They need a stimulating environment so that all their senses and emotions can develop. Here are two examples. Autonomy - maturity - first requires sensorimotor integration: "senso" means senses, or the development of all senses, which is completed at age 16 at the earliest. Media education specialist Prof. Paula Bleckmann illustrates this with the tower of media autonomy.

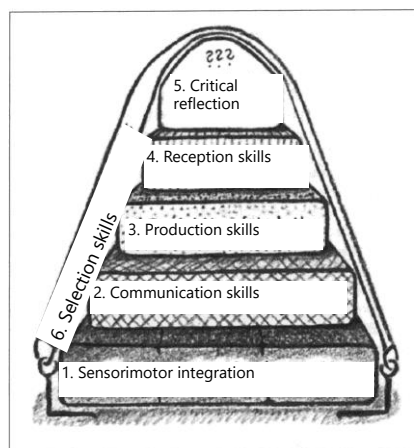


Fig. 2: stages of media autonomy (Bleckmann 2012)

Sensory experiences using chocolate as an example (after Leipner):

- Hearing (crack!)
 - Sight (chocolate-coloured)
 - Smell (Mmm! Cocoa!)
 - Taste (sweet, etc.)
 - Temperature (lukewarm, room temperature)
 - Touch (pressure on lips and palate)
 - Sense of force and position (jaw muscles/joint)
 - Fine motor skills (putting chocolate in the mouth)
- = 7 senses + fine and gross motor skills

1. Sensorimotor integration: development of all senses and motor skills
2. Communication and language abilities
3. Motor skills for crafts, needlework, etc.
4. Reception skills: recognising opinions
5. Critical reflection: being able to assess opinions
6. Selection skills: choosing a course of action from different options

When a child watches a video about eating chocolate, at most two senses (sight and hearing) are activated and trained. The YouTube child cannot develop a real concept of chocolate, only a substitute for reality. "Grasping" is missing. A child who has actually eaten chocolate has a comprehensive sensory understanding of what it is. Sensorimotor integration is therefore needed for the brain to mature (synaptogenesis). The same applies to sensory experiences of flowers, soil, animals and everything else. Put bluntly: the digital medium YouTube prevents important sensory experiences.

3.2 The smartphone and space-time memory: learning needs movement, breaks, leisure and boredom

Neurobiologist Prof. Gertraud Teuchert-Noodt and psychologist Angelika Supper wanted to discover how smartphone use affects the frontal brain and space-time processing abilities.¹⁵ The following illustration shows the results. The task: children were to write "Schneeballschlacht" ("snowball fight") in predefined boxes. Children who did not use smartphones succeeded; children who played on them a lot did not. Result: in children with heavy smartphone use, space-time processing is underdeveloped.

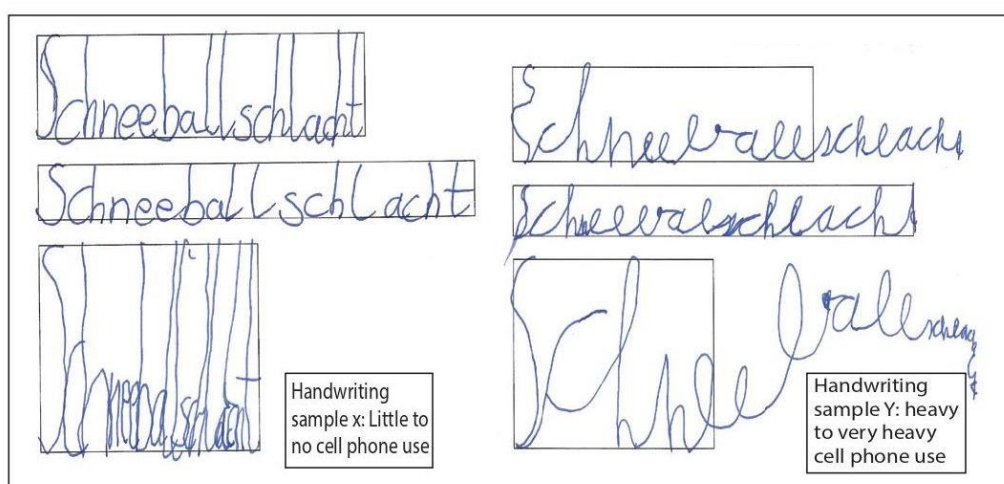


Figure. 1a. In this handwriting sample, both students try to fit the word "Schneeballschlacht" [snowball fight] into the assigned rectangle.

A major cause is lack of movement. If children sit in front of screens for hours and stay indoors, they lack movement through space. The accompanying sensory experience is replaced by the reduced action of swiping a tablet, now a dominant activity for many children. The brain thus lacks the building material to develop its thinking apparatus, and construction slows down. Concentration and thinking abilities remain irreversibly underdeveloped. Consider football as an example of movement's importance. The best footballers built on a childhood of street football: playing against a wall or on a local pitch, the fine motor skills of ball control trained their senses and space-time processing and became imprinted in their brains. We need space-time processing for climbing, cycling, crafts, driving - for all orientation, thinking and planning in context: in short, for intelligence.

3.3 "Man is only fully human when he plays" (Friedrich Schiller)

Sensory experiences are therefore three-dimensional, and only through them can spatial coordination develop optimally in the maturing modules of the cerebral cortex. Space and time are the tools through which neural networks and functional systems

communicate. If these neural processes, which connect sensorimotor and associative cortical areas and simultaneously allow the brain to mature, do not occur, they are difficult to make up for later. Jonathan Haidt arrives at two central propositions:

1. The cause of this global mental health crisis is the complete switch from a play-based to a phone-based childhood.
2. We overprotect our children in the real world. On the internet, we leave them alone.¹⁶

"Man only plays when he is human in the full sense of the word, and he is only fully human when he plays," wrote Friedrich Schiller, educated in Duke Karl Eugen's disciplinary institution at Solitude near Stuttgart. Haidt reminds us of the great importance of children playing together: "Free play is the work of childhood, and all young mammals have the same job: to wire up their brains by playing vigorously and as often as possible. Hundreds of studies of young rats, monkeys and humans show that young mammals want to play, need to play, and suffer socially, cognitively and emotionally if they cannot play" (p. 70). In virtual play, however, interactions are "disembodied: apart from swiping and typing, no muscles are involved" (p. 78). Turning away from communal play, the "loss of affective attunement" in computer gaming, prevents empathy from developing or causes it to wither, making people unable to cope with life: "To flourish, children need plenty of free play. This imperative can be demonstrated across all mammal species. The small challenges and setbacks that occur during play are like an inoculation preparing children to face much greater challenges later" (p. 18).



Photo: Kerry Eliason on Unsplash

Football: fine motor skills in ball control train the senses and space-time processing and become imprinted in the brain.

Haidt's insight agrees with neurobiology: the entire brain and space-time memory develop through play. Spatial brain development happens through crawling, climbing and communicating - in real life! What appears on a screen is a substitute for reality, rather than the thing itself. Physician Prof. Thomas Fuchs (Heidelberg University) writes: "Perception means sensorimotor interaction with the environment" (pp. 153-154). He warns: "A common feature of media and virtual worlds is a detachment from immediate bodily experience, a 'disembodiment'" (p. 132).¹⁷ If risky play, roaming the neighbourhood, adventures while hiking and climbing, and walking to school together are also absent because anxious helicopter parents tie their children to a digital umbilical cord, the result is an anxious generation. Jonathan Haidt sums it up:

"It is as if we gave our toddlers tablets with films about walking, but the films were so captivating that the children never took the time or made the effort to actually learn to walk" (p. 73).

The lonely, obese child swiping a tablet, trapped in the web, becomes a modern Kaspar Hauser.

Conclusion: just as all nature has an evolutionary blueprint, early childhood brain development follows a construction and developmental plan with consistent rules. The stages of brain maturation are set in the human genome. Slow development during childhood and adolescence leads to high intelligence; these stages generally cannot be changed or accelerated, even through digitalisation. Above all, a child's physical movements determine how the brain's first functional modules mature. The central insight is that movement and play, tactile and sensory experiences are crucial to brain development and thinking. Examples include crafts, modelling clay, games of skill, experiencing nature, building sandcastles, sport, drama, drawing, learning handwriting and making music, as well as repetition, practice, deeper engagement, concentration, perseverance and sufficient sleep. Learning synapses need working time and slow thinking.¹⁸ Recall the FAZ's observation: "Managing social media responsibly on their own overwhelms children and adolescents." Given their stage of brain development, children cannot yet do so. Consequently, media, technology companies and their influencers dominate them and condition them mainly for consumption. They have not yet developed the basic skills needed for reflective thinking: they are still children.

3.4 Developmental windows and the smartphone

Children's development contains windows that must not be skipped. The first 1,000 days set the course for the whole of life.¹⁹ The principle is: everything in its own time! "Healthy brain development depends on having the right experiences at the right age and in the right order" (Haidt, p. 83). For babies and toddlers this primarily means the home and attachment to parents and siblings. What they do provides a model for the little one and is inherently good; the child wants to do it too. Children

learn by imitation. Eye contact, facial expressions and parents talking with their child develop language; reading aloud stimulates imagination; playing together trains thinking and fine motor skills. Above all, movement during play allows the brain to mature. Naturally this continues in nursery and primary school. Children cannot help learning, and develop as they do so. Here are some of the developmental windows:

0-1 years: babies gradually become familiar with their bodies. They learn to grasp, sit and crawl, and discover their surroundings. They build attachments to their parents.

How the smartphone affects this: babies intuitively notice that the smartphone is as important to Mum and Dad as they are. Parents constantly look at it, almost more often than at the baby. An attachment disorder can develop; this pathological process is called "technoference".²⁰ At the same time, the desire to handle the smartphone is already awakened.



Photo: Катерина Кучеренко on Pixabay

1-2 years: children sharpen their senses and learn to speak, walk and grasp. This requires direct contact with the world.

How the smartphone affects this: fine motor development may suffer if, rather than walking, children are captivated by a tablet; if, rather than grasping objects and understanding them, their movement is reduced to one-dimensional swiping.

If parents and grandparents do not constantly play and talk with them, using facial expressions, gestures and atmosphere, and the tablet entertains them instead, language deficits and attachment to the smartphone begin.²¹

2-3 years: children make their first friendships and enjoy talking with peers.

How the smartphone affects this: its fascination may already make them lonely. Anxious, shy children retreat behind a screen. Language cannot develop through WhatsApp communication.



Photo: Oleksandr Pidvalnyi on Pixabay



Photo: Allan Mas on Pexels

4-6 years: children learn increasingly demanding movements: running, balancing, climbing, tying shoelaces and moving a pencil across paper when drawing. Language and emotions develop rapidly. Imagination and their own inner world develop, partly through picture books and parents reading aloud. Creative role play with peers is important. At this age, playing is learning!

How the smartphone affects

this: the chart shows the decline in social contacts. It also indicates withdrawal into one's own room - staying indoors. Smartphone use competes with exploring the world through all the senses. The child's own imaginative world, fostered early by parents reading aloud, is replaced by a predetermined flood of video images.

Daily Time with Friends, by Age Group

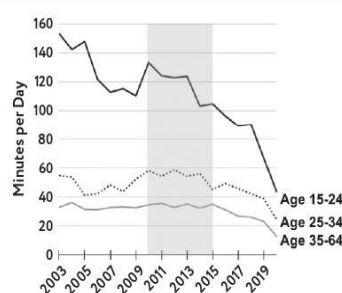


Figure 5.1. Daily average time spent with friends in minutes. Only the youngest age group shows a sharp drop before the 2020 data collection, which was performed after COVID restrictions had begun. (Source: American Time Use Study.)¹⁹

Source: Jonathan Haidt, *The Anxious Generation*, 2024

Smartphone use blocks all these developments and experiences. And the damage progresses. More and more children in Germany have access to smartphones or tablets. According to the new miniKIM Study 2023, one in five young children has their own tablet, 50% more than in 2020. Among preschoolers, the figure is already 28%. Now 23% of two- to five-year-olds use at least one internet-connected device daily, such as a smartphone, tablet, laptop or voice assistant.²² The digital indoor child is isolated in a sterile bubble.

Jonathan Haidt puts it this way:

"Trees exposed to strong winds early in life grow into trees that can withstand even stronger winds when fully grown. Conversely, trees raised in a sheltered greenhouse sometimes collapse under their own weight before they are fully grown" (pp. 95-96).

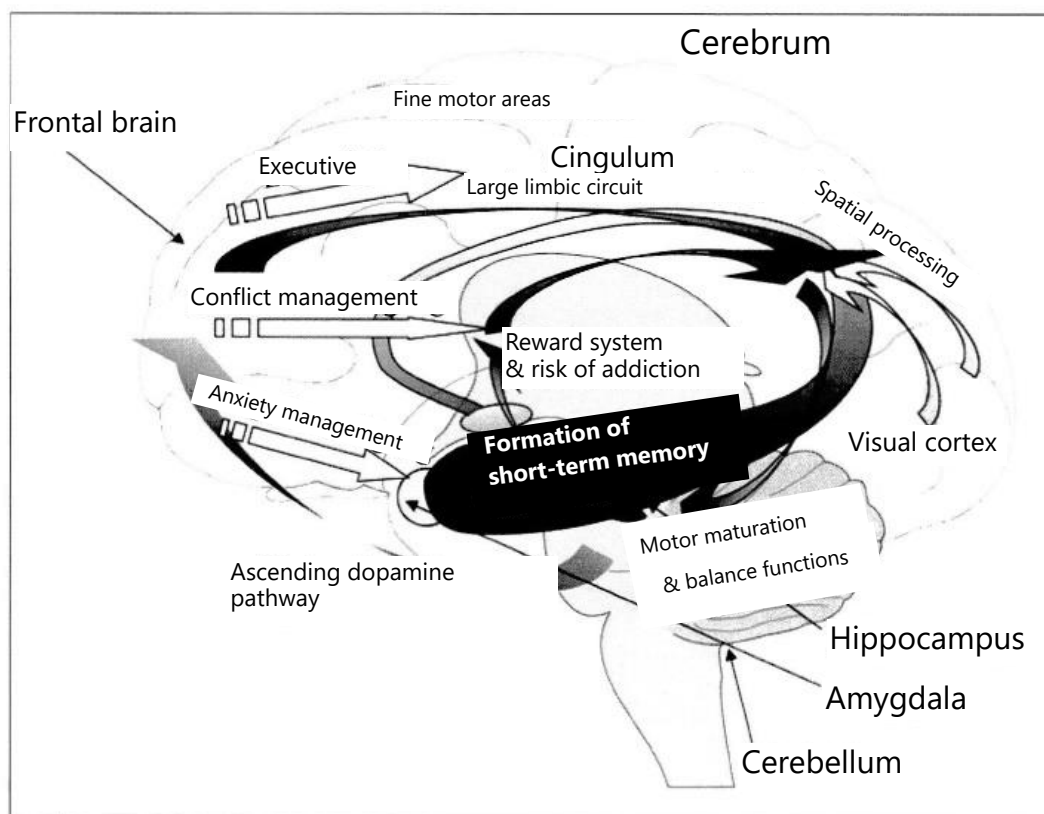
Does this not also bring to mind the obese child staring motionlessly at a smartphone, captivated by the web? This phone-based socialisation contradicts our evolution:

"But as mammals mature, their experience-seeking brains must wire themselves up through skills such as running, fighting and making friends. That is why young mammals are so motivated to leave their mothers to play, including risky play" (p. 119).

Without knowing the mechanisms of evolution and the blocking effects of digital screen media, and why they can cause irreversible damage, people will not be convinced that firm rules are needed.

3.5 The mechanism of addiction through overstimulation is known

Why are even toddlers captivated by smartphones? We have seen why movement, among other things, is important building material for brain development. Yet the smartphone supplies the wrong material, which can cause addiction, anxiety and lifelong impairment of learning and thinking. One wrong building material is overstimulation from videos, rapid animations and images on tablets: the constant flow of information. This is a continual acceleration of space and time that the child's brain can no longer process adequately, leaving no room for slow thinking and thorough processing. The fatal aspect: this incessant bombardment produces feelings of happiness. The brain demands more and more, and impulse control cannot develop or is overridden.



The human brain and the location of higher functions (see also Teuchert-Noodt 2003)

Acceleration produces a feeling of success, through likes or reaching the next level, for example. But this is a deceptive self-reward. The fascination with digital devices that even toddlers develop creates a pull that disables the will. The foundations of addiction are burned into the brain. This occurs dramatically. We see it everywhere, on the underground and in restaurants, and statistics prove it too.

The mechanism: overstimulation accelerates the supply of dopamine to the reward system, while undersupplying the frontal brain with dopamine. This blocks the dynamic phase of brain maturation (see Teuchert-Noodt's brain model).²³

Yet the frontal brain is the command centre for managing conflict and anxiety, logic, reason, planning and action. It is not fully mature until about age 20. Before age 16, the brain's cognitive and neural development is not yet equal to digital media's demands, because it cannot control overstimulation. Technology companies exploit this. Smartphones and software are designed precisely to make children dependent and awaken desires: this is their business model.

Some psychological tricks that bind users to smartphones: free gambling games for children in which they almost always win, until they are offered games for money. Likes, endless scrolling and time-limited content ensure that people constantly check the platforms. For example, with standard settings, Instagram Stories are online for only 24 hours, as is also the case on Snapchat.²⁴

Modern media, whether games or WhatsApp, encourage uncontrolled, rapid responses to stimuli, rather than the abilities so important for self-regulation, such as pausing and reflecting on available choices. Studies now visually demonstrate adverse changes in brain regions caused by intensive media consumption.²⁵

Understanding these effects on brain metabolism is the key to understanding the harmfulness of smartphone use.

3.6 Summary

The first mechanism of harm: the overstimulation children encounter when using digital media triggers the reward system and leads to addiction. The reward system running at full speed is fuelled by dopamine. The addiction loop takes on a life of its own, driven by new likes and levels in a behaviourist pattern. Sophisticated conditioning techniques exploit children's undeveloped impulse control, or disable impulse control, to make users dependent.

The second mechanism of harm: the frontal brain is our control system. The reward system's high dopamine consumption leaves the

frontal brain undersupplied with the dopamine it needs to mature. This blocks the dynamic phase of brain maturation.

The third mechanism of harm: overstimulation blocks synapse formation. Nobel laureate Eric Kandel, one of the foremost memory researchers, demonstrated that behavioural changes accompany quantitative changes in synaptic strength. Kandel writes “that the number of synapses in the brain is not fixed once and for all, but changes during learning. Moreover, long-term memory persists as long as the anatomical changes remain” (Kandel 2007, pp. 236, 283).²⁶ When learning experiences pass from short-term into long-term memory, new synapses form as storage sites. This consolidation takes several hours: it requires rest and breaks. A flood of information blocks it (p. 286). Kandel continues: “Practice makes perfect; repetition is necessary for long-term memory” (p. 289). Neurobiologist Gertraud Teuchert-Noodt confirmed this in her work, particularly for digital overstimulation and in relation to long-term potentiation and the Hebbian learning synapse.²⁷

The fourth mechanism of harm: smartphone use causes children to move less. Movement is a key to brain development, the maturation of space-time processing and all motor skills. Sensory experiences are largely reduced to swiping screens.

Unfortunately, none of this is merely theoretical. The current study by DAK and University Medical Centre Hamburg-Eppendorf found that 700,000 children in Germany are already addicted to media. The number doubled during the coronavirus pandemic. Addictive behaviour in social media rose from 3.2% in 2019 to 6.7% last year (2023), and in computer games from 2.7% to 6.3%. This means around two pupils in a class of 30 are addicted! Some 2.2 million children and adolescents use gaming, social media or streaming problematically, meaning they are at risk of addiction or already affected. Andreas Storm, CEO of DAK-Gesundheit, sounds the alarm because many young people's futures are threatened: “The current figures and developments during the pandemic are alarming. Unless action is taken quickly, more and more children and adolescents will slide into media addiction and the negative trend can no longer be stopped. Families would be destroyed and the futures of many young people threatened.”²⁸

Conclusion: children's smartphone use blocks brain development because it is programmed to produce addiction. It prevents self-control and reflection, reduces reading ability, language skills and social competence; in short, it impairs the development of intelligence.

4 The scientifically documented practical effects of digitalisation

The smartphone has been on the market for 17 years, and many children grow up with it and are now proficient users. "Children must learn this as early as possible!" is a sales argument: operating the devices is child's play. Even toddlers enjoy it so much that they can become addicted.

But has it made them intelligent, or can we already identify the adverse effects neurobiologists warned about early on? Reality gives a clear answer, and the educational catastrophe provides further evidence: smartphones and tablets make children less intelligent! A former secondary school teacher summed up the problem in a letter to the Stuttgarter Zeitung on 18 December 2013:

"After 34 years as a teacher, I can say: the PISA results and the collapse in academic performance are a catastrophe of our own making. Subjects crucial to intellectual development, such as German, sport, art and music, have been reduced. Schools as currently organised can no longer compensate for the markedly greater deficits pupils bring with them today. Renowned education researcher Prof. Klaus Zierer (Hattie study) concludes in his meta-study: 'The longer children and adolescents use their smartphones in their leisure time, and the more time they spend on social media, the lower their academic performance.'²⁹

Smartphone use brought inactivity and staying indoors; parents reading aloud and children reading themselves declined. For many, talking together is replaced by virtual Facebook, Instagram and WhatsApp communication. PISA 2023 shows the result. Forty experts call for a moratorium to stop digitalisation. The core of education is the motivating teacher-pupil relationship, rather than intensified algorithm-controlled lecturing: the screen-pupil relationship, from which only IT companies profit." (End of letter)

4.1 Speech and language disorders

"Have you spoken with your child today?" - such poster campaigns exist. A 2022 study by Hanover's Kaufmännische Krankenkasse (KKH) found that more children and adolescents struggle with speech and language disorders today than ten years ago. From 2011 to 2021, the number of 11- to 14-year-olds with inadequate language skills rose by about 107%, and among 15- to 18-year-olds by 151%.



An initiative of the Early Help Network, Hörter district.
www.fruehe-hilfen.kreis-hoexter.de



Source: Emsland district

One reason is digitalisation, remote learning and digitalisation in schools. Speech and language disorders hinder personal development, making education harder or preventing it, because speech is our primary form of communication and the basis for participation in the community. Bastian Resch, a KKH physician, therefore stated in the first study in 2020:

"Actively and continuously promote your child's language skills at every age. Smile at your child when they begin to babble or contact you through facial expressions and gestures. This encourages them to communicate with you. Read aloud frequently when your child is small. Have

conversations with your children about different subjects, thus providing sufficient language stimulation."

Watching alone does not teach speech.³⁰ Smartphone use plays a crucial role in these deficits, as parents talk less with their children. Children sit isolated on smartphones rather than playing with others outside, or communicate virtually, with reduced vocabulary and, above all, without facial expressions or gestures. This also adversely affects social competence and empathy.

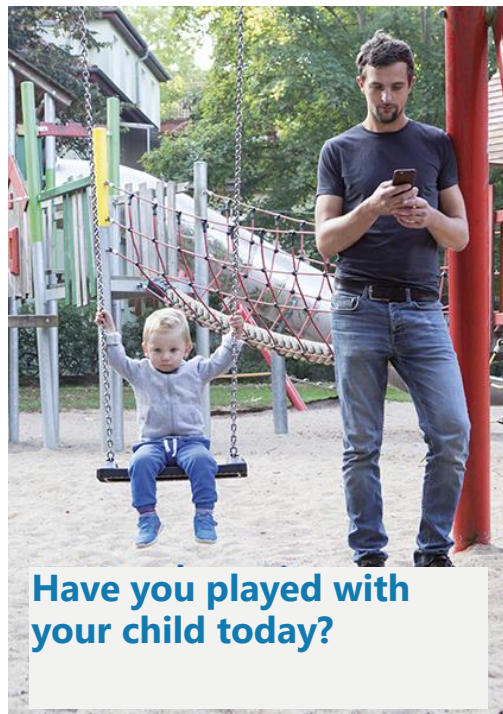
4.2 Reduced vocabulary

The current reading study by Germany's Institute for School Development Research (IFS, 2022) sums it up: "Frequent reading on digital devices is negatively associated with children's vocabulary. Vocabulary is smallest when children often read on digital devices and rarely or never read a book." JIM Study 2022 statistics show that only 32% of adolescents still read books, compared with 42% in 2012. So 68% do not read books! In the study, a quarter of fourth-graders reported reading on digital devices (almost) daily. Frequent reading on digital devices is negatively associated with children's vocabulary. Ulrich Ludewig explains: "Vocabulary is smallest when children often read on digital devices and rarely or never read a book." Yet vocabulary, reading ability, text comprehension and the associated language competence are fundamental to learning in all subjects.³¹

4.3 Loss of creativity

A second poster: "Have you played with your child today?" A study by researchers at Uppsala University and the Institute of Education at University College London found that children playing with tablets are less creative and imaginative than children playing with physical toys.³² This early separation of movement and perception may prove one of digitalisation's most serious effects, extending beyond brain development.³³ Above all, what is lost is the cognitive ability to construct knowledge independently, ask one's own questions and explore connections.

This also has great sociopolitical significance: the positive effects of personal experiences in nature can no longer be felt.



Source: Emsland district

How will future environmentalists develop if children grow up in an environment detached from nature and experience it only on screens in idealised documentaries?

4.4 Declining school performance

This is no longer a laughing matter, because the educational catastrophe is the result of this development. The IQB Education Trend 2021 on fourth-graders' skills found that barely 50% now meet the regular standards in listening, reading, arithmetic and writing.³⁴



Lotta Edholm Photo: Kristian Pohl

Swedish education minister Lotta Edholm explained the reversal of digitalisation in preschools as follows:

*"It is clear that screens have major disadvantages for young children. They hinder learning and language development. Too much screen time can cause difficulty concentrating and displace physical activity. We know human interaction is crucial for learning in the first years of life. Screens simply have no place in preschools."*³⁵

In his meta-study on schools and digitalisation, Prof. Klaus Zierer reaches the following conclusion:

"The longer children and adolescents use their smartphones in their leisure time, and the more time they spend on social media, the lower their academic performance. [...] More than ever, children and adolescents need time and space for play, sport and movement."

4.5 "We are losing our children!" - alarmism or reality?

Alongside cognitive effects on language and learning, the question arises of what all this does to children's emotional and mental lives. In her book "We Are Losing Our Children", headteacher Silke Müller vividly describes the widespread psychosocial damage smartphones cause children. In her experience, even fifth-graders already watch pornography, war crimes and animal cruelty on their phones. This is normality, she writes:

"I think we are losing our children, and above all their souls and mental wellbeing, in the depths of these networks because we are not looking." She holds a mirror up to policymakers: "Instead of consciously facing online dangers, acknowledging them and making them central to parenting and education, we ignore them through 'see nothing, hear nothing, say nothing', or by completely trivialising them."

5 What must nurseries and schools provide?

Thus more and more children arrive at school

(i) already conditioned to smartphones as toddlers through their parents' usage habits. This causes irreversible effects on brain development, as neurobiology has firmly established;

(ii) whose sensory experiences are largely reduced to swiping screens; and

(iii) who are consequently estranged from nature and conditioned early for consumption.

We face an educational catastrophe that naturally has several causes besides digitalisation: teacher shortages, excessively large classes, neglect of sport, music, art and drama, and the deplorable focus on competences. Education has increasingly moved towards mere factual knowledge.

The catastrophe's causes are already present before school. The interaction between time spent using digital media outside and inside school correlates with poorer learning performance. Here are a few facts. Smartphones consume time. Children constantly feel they are missing out (FOMO). Children and adolescents use digital media for an average of over 6-8 hours daily and receive up to 100

messages on WhatsApp, Instagram or TikTok. Increasingly, their smartphones are on 24 hours a day, constantly distracting them. A new meta-study shows that even a smartphone's mere presence is a distraction.³⁶ "Students who did not use their phones in lectures recorded 62% more information and recalled more detailed information from class" (guideline, p. 12).³⁷ The uninterrupted flow needed for intensive engagement never occurs. There are no longer pauses for creative reflection. Multitasking, for which humans are not designed, produces continual superficiality.

Given these effects, neurobiologist Korte considers digital media appropriate only from Year 7: "In my view, digital media should largely be avoided in nursery and primary school ... because it is important to create protected spaces" and "build compensatory alternative worlds".³⁸

5.1 The catastrophe of digital education

Yet we do the opposite: with "digital education", we open nurseries and schools to a potential drug! How did the inherently absurd idea that education must be transformed into "digital education" arise? No brain thinks digitally and nobody learns digitally. "Digital education" originates outside educational science: it is a neoliberal project pursued for decades by the OECD (Organisation for Economic Co-operation and Development) and industry through a dense lobbying network, as studies by Krautz (2014), Münch (2018) and Förschler (2018, see diagram on page 24) demonstrate in detail.³⁹ Educational institutions are to be transformed from places of education into an "education business sector".

"Digital education" is not about educating for media autonomy, something schools unquestionably need to provide today. On the contrary, it leads to domination by algorithms. Just as robots independently control production in Industry 4.0, computers and algorithms are to control education autonomously. "Digital education" rests on the behaviourist method of measuring, predicting and controlling behaviour, reducing human beings to a



Current study: three quarters of all first-graders are online

In Germany, 92% of children and adolescents use the internet at least occasionally. According to a representative survey by digital industry association Bitkom, almost three quarters (73%) of first-graders aged 6-7 are already online. This rises to 85% at ages 8-9 and 95% at ages 10-11. From age 12 virtually everyone is online (98%), and from age 14 the figure is 99%.

In May and June, 942 children and adolescents aged 6-18 took part online in the Bitkom Research survey. Children aged 6-10 participated with their parents. Source: dpa, 6 August 2024

dataset. B. F. Skinner, the father of behaviourism, would have delighted in it.⁴⁰ Very few teachers realise that this transformation is already under way.⁴¹

5.2 Nobody learns digitally!

There is no "digital education".⁴² Nobody learns or thinks digitally.⁴³ Neither learning processes nor education can be digitalised - at most, learning material can. The term "digital education" is revealing. What digital educational visions promote as individualised teaching is teacher-centred instruction with the human removed: the social counterpart is an algorithm-controlled talking screen. The socialising, community-building class disappears; the educational atmosphere created by the teacher gives way to isolation, technological coldness, calculability and conditioning.

Digital media can be useful teaching aids, but upbringing and education remain analogue because thinking and the senses are analogue. There is no digital education, because education is more than factual knowledge. Put casually, education is what remains when we have forgotten the facts. It means conveying values and attitudes, developing individual personality and, above all, social competences. Five hundred years of educational knowledge about learning and education, from Comenius, Pestalozzi, Humboldt, Kerschensteiner, Montessori and Piaget, must not be sacrificed to the IT industry's profit interests.

5.3 No media autonomy without basic skills

Today's pupils grow up in a digitalised environment. They need guidance. Schools need media studies across subjects, encompassing all media. Children should learn about digitalisation's benefits and risks in an age-appropriate way, with child protection and addiction prevention. No smartphone is needed: drug, alcohol and smoking prevention does not involve consuming the addictive substance either. The risks of poor nutrition are not taught by consuming junk food.

5.3.1 Approaches to educating for media autonomy

Media autonomy means controlling media as far as possible, rather than being controlled by them. It requires mental maturity.

Schools must educate for media autonomy. This requires approaches to guiding children in stages according to development. The concept of indirect and direct media education builds on this.⁴⁴ Healthy mental and physical development and future media autonomy first depend on education that trains basic perceptual and sensory skills, including with analogue media. Hübner (2017, see note 41) calls this preliminary phase "indirect media education". It includes promoting speech/communication, drawing/writing, music/singing/rhythm, theatre/role play/imagination, and sport/play/movement/fine motor skills. Hübner criticises digitally fixated media education for overlooking the bodily basis of brain and consciousness development. The image of an obese toddler sitting alone and motionless at a tablet, reduced to swiping skills, illustrates this warning.

Bleckmann and Mößle developed the tower (see p. 11) and the traffic light model of media autonomy (Bleckmann et al. 2023).⁴⁵

1. RED LIGHT: Protect young children! No screen media use! Simultaneous protection in all three problem dimensions (time, content, function), a protective educational approach. This corresponds to indirect media education.
2. YELLOW LIGHT: Older children (from school age). Accompany and support them. Use media in measured amounts with adults (reception-oriented approach); create media themselves (production-oriented approach). This begins direct media education.
3. GREEN LIGHT: Adolescents and adults. Gradually allow personal responsibility. Understand manipulation and risks, protect themselves and others as far as possible (critical-emancipatory approach), and expand practical skills. Schools need well-equipped computer rooms for classes aged 14 and above, where pupils can learn basic skills.

The first demand is therefore: education ministries and schools must develop a roadmap for media autonomy based on findings from science, medicine, developmental psychology and education, regulating age-appropriate use of analogue and digital media in stages.

Government phone bans in schools have positively affected school atmosphere and learning. From psychosocial and neurobiological perspectives, children should be introduced to digital media use at age 16 at the earliest. Only then can they reflect on themselves and gradually learn to withstand the flood of information and stimuli. Schools must teach digital media use across subjects and through measures such as smartphone proficiency certificates.⁴⁶

5.3.2 A tactical shift: “accompanying media education”

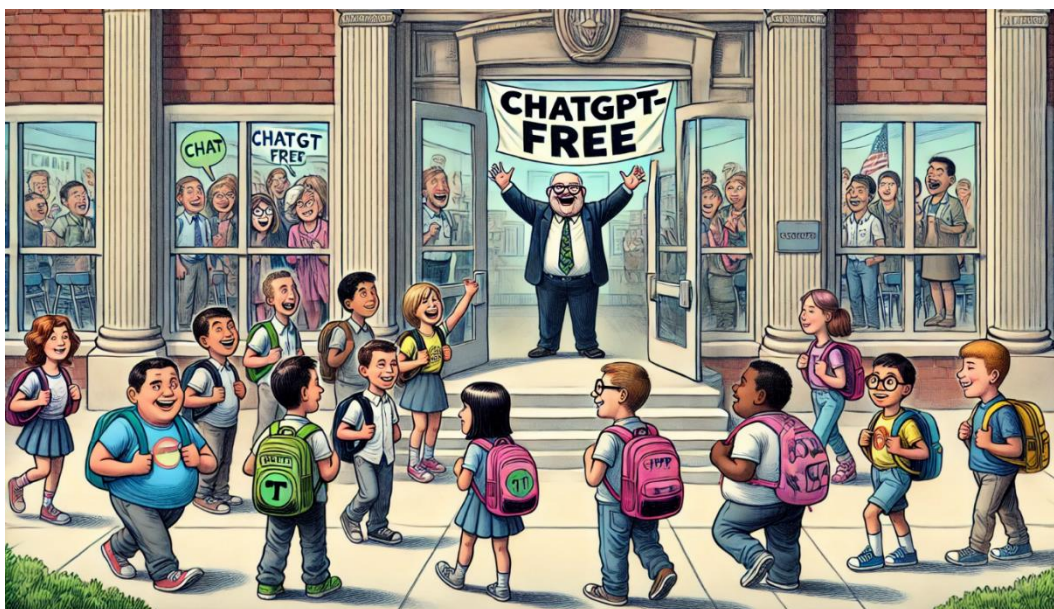
Faced with documented harm and the failure of media education subservient to it, industry is adapting its tactics to rescue the nursery and school business sector, again with obliging media educators' help. The new message: children should be immunised against risks by using smartphones as early as possible, to prevent harm. This sales strategy is called “accompanying media education”. Children are swiftly credited with impulse control and reflective abilities and redefined as young adults. The Bavarian government runs the “Startchance Kita-Digital” campaign. It writes: “Children are entitled to fulfilment of their rights to participation, protection and empowerment in the digital world. It is therefore the task of childcare institutions to support children early in creative, critical and safe use of digital media.”⁴⁷ Even the FAZ criticises this sales-promoting education policy: “Managing social media responsibly on their own overwhelms children and adolescents.”⁴⁸ Prof. Ralf Lankau puts it this way: “Anyone sitting in front of a display is fixed there ... All psychological and technological tricks are used to bind attention ... Today's digital screen media and online services are an addictive substance.”⁴⁹ “Accompanying media education” legitimises the creeping introduction of a drug to children. Some 700,000 children and adolescents are already considered internet-addicted, and 2.2 million problematic users.⁵⁰ In Germany in 2018, three million adults had an alcohol-related disorder (1.4 million alcohol abuse; 1.6 million alcohol dependence).⁵¹ To prevent this, health minister Karl Lauterbach proposed banning “accompanied drinking” in July 2024: “Adults' presence does not change alcohol's harmfulness for children. So-called accompanied drinking [by 14- to 16-year-olds, author's note] should therefore be prohibited” (FAZ, 11 July 2024). A ban on “accompanied smartphone use” in nurseries and schools is an obvious step. A drug remains a drug.

5.4 ChatGPT makes thinking unnecessary: “AI bots undermine young people’s general willingness to make an effort!”

The 2024/25 school year begins with a new, uninvited guest and secret prompter in pupils' bags. My friend and helper - ChatGPT! Yet this is a deceptive friendship! Schools are unprepared for this digital Trojan horse. But pupils are ready!

“A current study shows that no fewer than 72% of pupils no longer do their homework themselves, instead relying on ChatGPT and similar tools,” writes the Frankfurter

Rundschau.⁵² ChatGPT is not primarily a fantastic aid: it changes thinking and personalities because it makes thinking unnecessary.



Pupils can now let others think for them! It is tempting: why struggle with reading after school or painstakingly ponder homework? A pupil types the homework question into ChatGPT: "What is the relationship between Karl and Franz in Schiller's *The Robbers*?" The answer arrives in three seconds! It reads well, almost too well! The pupil asks ChatGPT: "Rewrite this in the style of a 15-year-old secondary school pupil." Three seconds later: "That fits now. I'll just risk handing it in," the pupil thinks.

In his article "Algorithm and Avatar in the Classroom",⁵³ Prof. Ralf Lankau describes the serious consequences:

"Generative AI starts phase II: machines no longer 'merely' teach and measure learning performance and calculate 'optimal learning paths', but create content themselves. These tools, some freely available online, can design lessons, complete homework and produce degree dissertations ...

Why, pupils and students quite rightly ask, make an effort when a cleverly worded prompt quickly and effortlessly produces results often better than independent research and writing? Especially when teachers already cannot identify AI-generated texts as such?

'Artificial intelligence breaks the backbone of school as it exists today. In the history of educational institutions, no invention has so insidiously challenged the learning system's entire motivational structure as this atomic-bomb AI - to state my position clearly. We are raising a generation of adolescents who can, for a while, still fool their teachers into believing that what ChatGPT or another program gave them is their own achievement, and who will soon no longer know why learning should be worthwhile at all.' (Böhme [12])

AI bots undermine young people's general willingness to make an effort and accustom them to trusting technological systems and their calculations as valid results. Convenience and laziness are familiar human traits, although they do not promote learning. Technically easy generation of text, images, presentations and more prevents independent engagement with language, text and images. This undermines the crucial creative act of finding ideas and developing concepts from one's own imagination. Bots prevent the free play of fantasy and imagination that begins with only a task or the proverbial blank sheet. Yet seeking individual solutions from within, finding and discarding ideas, sketching and eliminating, forms the basis of self-initiated learning. Technology that quickly supplies solutions deprives learners of autonomy and undermines open-ended exploration."

The debate has erupted, and the new school year presents all teachers with a major new problem. Two short books have appeared, addressing it from different, complementary perspectives.

Klaus Zierer: ChatGPT as a Saviour. On the Possibilities and Limits of AI in Education, Waxmann 2024, 55 pages, €9.90

Ingo Leipner: AI's Attack on Consciousness. Critique of Artificial Reason, INFO3 Verlag, 2024, 97 pages, €12.90

5.5 Parent-school cooperation: Ireland - "Everyone else is allowed to!"

Yet it is clear: the social pressure to use smartphones seems overwhelming. Children feel excluded from social networks without one. Ordinary tasks, from paying for orders and buying tickets to contacting authorities, are almost impossible without a smartphone. Parents are under pressure; children want a smartphone, and schools introducing it as a learning aid naturally legitimise it.

Parents need support. In Greystones, Ireland, schools and parents found an ingenious solution. They outwitted the "Everyone else is allowed to!" argument. Parents and eight primary schools agreed in a voluntary "no smartphone" code that children should have no smartphones privately or at school until secondary school. Greystones' initiative prompted Irish health minister Stephen Donnelly to recommend it nationwide:

*"Ireland can and must be a world leader in ensuring that children and young people are not targeted or harmed through their interactions with the digital world," he told the Irish Times. "We must make it easier for parents to restrict the content their children are exposed to."*⁵⁴

6 Alternatives matter: demands for education and municipal policy

Children must be inspired by “analogue skills for the future”, as the guideline also demands. We must offer alternatives that make smartphones boring: experiencing nature, climbing, hiking, acting, sport, learning an instrument, playing in an orchestra, singing in a choir, dancing and having real friends. All this is far more exciting than a small rectangular screen. Neglected subjects such as music, art, drama, literature and sport have a central role, conveying social interaction skills, self-efficacy, basic skills and education. Extracurricular municipal offerings from clubs, music schools and theatre groups must connect with schools. This gives pupils enthusiasm for hobbies.

Hence a clear demand for municipal policy: given the educational catastrophe and these findings, such projects must be supported, rather than harming children by spending millions on school tablets and Wi-Fi for the misguided path of digitalisation. Alternatives confine digital media to useful aids instead of making them life's central focus.

Alongside planned education for media autonomy, the urgent situation demands a contact point in every educational institution where children can process traumatic experiences of violence, pornography, bullying and cybergrooming on social media, as described by headteacher Silke Müller. Government measures must therefore relieve and strengthen parents. Prevention and child protection guidelines must be developed.

For parents, this means agreeing clear rules at home. Nurseries and schools must advise them. When do children receive a smartphone? It has no place at shared meals or during play, including parents' phones. If children play or learn on a computer, this should be a desktop with a large screen, also because small screens harm the eyes. Screen times should be agreed, and parental controls may be installed. An app records usage times.

Rather than squander billions on devices to benefit the IT industry, our first needs are more well-paid, well-trained teachers, more school social workers and psychologists, more residential school trips, smaller classes, time and funding for music and drama groups and project days, and renovated schools. School can then be a lively place to educate intelligent children. The attempt to digitalise school will fail. Prof. Klaus Zierer formulates digital education's fundamental misconception:

“As long as we humans are human, learning will remain learning. Digitalisation will not change that. Anyone claiming and promoting otherwise misunderstands human beings and turns people into machines. For some, replacing Homo sapiens with Homo digitalis, or at least ‘upgrading’ them, may indeed be a goal - under

the motto: artificial intelligence is the answer to human stupidity. But then we are no longer talking about education, but programming. What counts is no longer what I have made of my life, but what has been made of me" (FAZ, 4 October 2018).

"Unless action is taken quickly, more and more children and adolescents will slide into media addiction, and the negative trend can no longer be stopped. Families would be destroyed and the futures of many young people threatened." (DAK study, 2023)

7 Further information

Parents should consult educators at parent evenings and invite experts, for example from Echt-dabei: <https://www.echt-dabei.de/unser-angebot>

Educators can find many classroom examples for developing media autonomy at:

<https://www.analog-digidaktik.de>



For parent evenings, Eliant's short film "Growing up with digital media" can prompt discussion. Short link: <https://t1p.de/12qxi>

In 2023, an easily readable review of the effects of non-ionising radiation (mobile phone radiation) on children appeared for the first time. It was written under the leadership of Prof. Linda Birnbaum, former director of the US National Toxicology Program (NTP) and National Institute of Environmental Health Sciences (NIEHS).⁵⁵ Available in German translation as a diagnose:funk Focus report.

Article series on digital education on the diagnose:funk website:

www.diagnose-funk.org/ueberblick

For more detail on neurobiological connections, we recommend Teuchert-Noodt/Hensinger's article "Children, Adolescents and Digital Media. Without Considering Brain Research Findings, There Is No Way Out of the Smartphone Epidemic!" in *umwelt · medizin · gesellschaft*, 3/2024.

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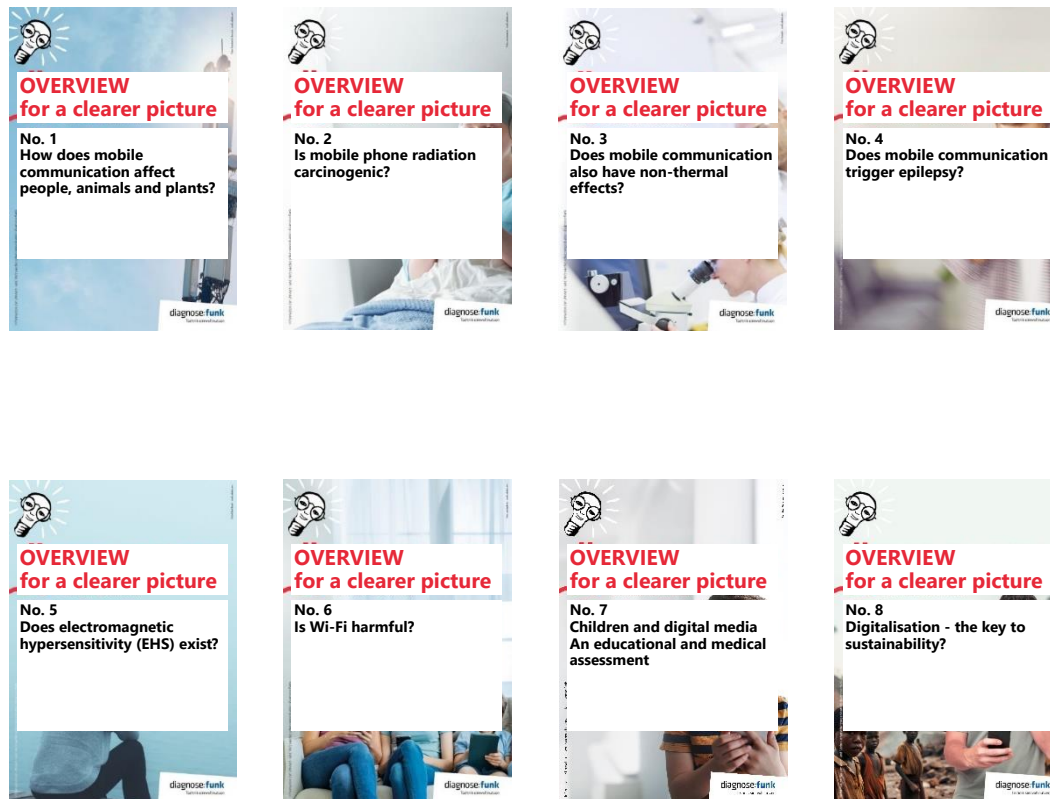
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