# Evidence of a potential

The political arguments for digitizing education 1983-2015

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## Abstract

Along with the popularization of digital technologies in education from the early 1980s, there has been a practice of evaluating the effects of educational technology on educational parameters. A high occurrence of systematic reviews and meta-analyses show that the evidence of the benefits remains elusive, and that there is little scientific evidence to prove the efficiency of new digitally supported learning models. Together these evaluations create insecurity about the contribution of ICT to the learning process. Yet, there is still a strong conviction in political institutions that education can be reformed for the better, by developing strategies that place digital technology at the center of their concerns. The dissertation works with the thesis that producing evidence for the benefits of educational technology is methodologically and philosophically unreasonable. The thesis is examined by analyzing a corpus of white papers and politically commissioned evaluation reports spanning four decades, in order to map arguments, epistemic sources and how arguments are used to recommend political interventions. The corpus consists of publications from influential global institutions like the UNESCO, the European Union, World Economic Forum and the Organization for Economic Co-operation and Development (OECD). Selection of the literature for the literature review and the analysis of the corpus is executed through a realist/anti-realist prism. This analytical prism seeks to map policy discourse onto a familiar tension between the realist sciences and schools of thought rooted in continental philosophy. The dissertation demonstrates that arguments for the value of ICT in education are dominated by evidence-based methods, but that interpretation of quantitative reports, to a large degree is based on an idealism that is inspired from continental pedagogical theory. This idealism, in turn, affects what is regarded as valid data - and gradually develops into historically new forms of evidential practice. Hence the title of the dissertation: "*Evidence of a potential*".

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# 1. Background and context for the dissertation

> *"There is something about the digital. Most people aren't quite sure what it is. Or what they feel about it. But something." - Alexander Galloway* (Galloway, 2015)

This dissertation asks the question: What are the reasons for digitizing education? Is there evidence for the beneficial effects of digitizing education?

Education, like many other dimensions of our society and lives, has been deeply affected by digital technologies. Networked digital devices and their services have become pervasive and the visions of ubiquitous computing[1] have become reality, at least in the country where I live (Denmark). How does this impact learning? Does it impact learning? Let me try and illustrate the influence of digital technology on learning-related issues, through some mundane examples:

### Transport:

On my way home in the bus, I notice that all passengers are looking at their smartphone, scrolling through Instagram and Facebook-feeds, listening to music, playing games or reading the news. In the bus, there is a screen that loops through commercials and news. The screen-device is updated by wireless Internet, which is also offered to the passengers by the bus company. This is a very different cognitive environment than the time preceding 2007 (when the first iPhone was brought to market). Does this access to vast knowledge-resources have an influence on how much we know, or the quality of what we know? I wonder what the ratio is between the time spent on learning-related content and entertainment in transport situations, by pupils and students. I feel uncomfortable peeking over the shoulder of younger passengers who might be students, in order to find out. I take out my travel card, and check out, before I get off. I have been told that the data that the travel card system generates will be used for optimizing the collective transport system. But I haven't experienced noticeable

[1] A term popularized by Mark Weizer, Chief Technologist of the Xerox Palo Alto Research Center (PARC), in 1988.

improvements in the collective transport system for many years. The digital signs telling us when the bus will be there are often off wrong or imprecise. What is the system learning?

### Professionally, as a teacher

The school where I teach - The Copenhagen School of Design and Technology - has a department dedicated to digital technologies, and the subject of digitization is considered important for all our students. They will certainly work with and through digital interfaces in many different forms for the foreseeable future - as they are doing on and off campus now. Some of them might be coding applications for smartphones; a majority of them will be registering tasks in task-management applications. Some may gain an edge in their professional life if they become tech savvy (or give the impression that they are), if they understand the logic common to the most commonly used interfaces, and if they feel comfortable exploring the technology behind the screens. In class it is normal to attend teaching with the laptop open. I wonder how much time is spent on so-called "off-task" activity. I can't know - it would require a mirror on the back wall, or invasive tracking software. I hope they are not negotiating difficult or boring subjects brought up in the lecture, by toggling their browser tab to sports news or some chat application. I would prefer that they told me instead, if they didn't understand something, or if they found the teaching boring or irrelevant.

### A metaphysical story

It has become a common narrative that the digital has pervaded everything. For many this story has become a metaphysical narrative: people, in the face of the abundance, complexity, and the scope of digital phenomena reach the conclusion that the digital is a force governing reality itself. The digital manifests itself in everything, its' troves of data can reveal anything about everything and its forces can be used to solve the thorniest problems. This often leads to the projection that we can expect the dramatic developments we have witnessed the last four decades to continue in the future. This also often leads to the conclusion that children and students should acquire digital competences for the future. In other words: there is something new, specific, and unique to learn. These digital elements are regarded as vital components of real or imagined digital professionalism, and of course vital to impart to our youngsters.

## 1. The scope of current research in digital phenomena

The amount of literature on digital phenomena is rich and varied. On the table in front of me, is a copy of "*The SAGE handbook of Digital Technology Research*" (Price, Jewitt, & Brown, 2013). It consists of 29 different chapters, and it covers many different topics and different perspectives on research in digital technologies. There are articles on ethnographic approaches to digital research, on tangible and material computing, on virtual reality environments, gaming, social media, on affective and experiential approaches - just to name a few. All of them could be read through the lens of their impact on, use in, or effects on education. On my bookshelf, the bright blue color of "Digital Studies" (Stiegler, 2014) often catches my gaze. Among others, it contains articles on the field of digital humanities, digital interfaces, and the state of attention in digital reading and writing environments. 30 centimeters to the left, separated by Carl Mitcham's "Thinking Through Technology" (Mitcham, 1994) and "Technology and the character of contemporary life" (Borgmann, 1987), stands a copy of "On the Existence of Digital Objects" by Yuk Hui (Hui, 2016) - an ambitious attempt to theorize web ontologies (XML e.g.) through Husserlian and Heideggerian phenomenology. On another bookshelf, on the other wall of the office, I look admiringly at "Culture Numérique" by Dominique Cardon (Cardon, 2019) that I finished recently, an exhaustive and dazzling sociological, history of the internet. The titles make me regret the project with this thesis - "the digital" as a research field (even isolated to educational issues) is too vast, there are too many perspectives, and I long back to an era where digital technologies could be understood through relatively simple and basic engineering, programming or cybernetic theories. Today the digital seems to be intertwined into everything, into every mundane activity, and has engaged all scholastic domains. This simpler past is also my own past. Before I started teaching, I worked for decades with video-compression, "moblogging" (software precursors to Instagram), video-logging (coined as "vlogging"), social platforms, web design and more. My partners and I sold consultancy-services in how to use RSS for media-scanning, edited videos on Final Cut Pro, sold websites, apps, social media strategies and wrote books on Flash MX, Weblogging and how to compress videos for the internet. At the time these were exciting new technologies, and it made *bricoleurs* of me and many of my peers. Digital tools were accessible, fostered creativity and with nothing else than interest and time, one could create interesting new technological and cultural products.

### How do we stay on top of digital technologies in education?

The passage above indicates that it is very difficult to reduce "the digital" to a skill, a specific knowledge-area, or a set of easily identifiable phenomena. One common strategy to try though, I would call "encyclopedic". It has attracted a variety of actors in the educational field and is akin to the work of trend-forecasters, or professionals in the fashion industry: it is based on the normative dictum to stay updated, to stay on top of the flurry of new products, neologisms and market developments in the digital space. It is a strategy that stresses actuality and of "first-moving". It also consists of the more or less explicit work of categorizing, sorting, and ordering the different phenomena according to criteria or schemas. This type of intellectual activity is supported by the digital industry itself: it publishes blog posts, forecasts, articles on "what to look out for in 2019", lectures and Ted Talks. These "think pieces" by industry "thought-leaders" are meant as help for educational professionals - to keep them updated, so they can be the first to pass on qualified knowledge about future technologies to their students. This has admittedly nothing to do with research, often it is arbitrary shopping in an intellectual bazaar, where the ideas you bring home will be made obsolete by next years conferences, overviews, white papers etc.

Another strategy, closer to what we traditionally associate to research, is to deploy well-developed theories from the humanities, sociology, mathematics, statistics, philosophy and so on to new digital phenomena - hence the advent, the last 20 years of "digital humanities", "digital sociology", yes even "digital philosophy", offered as courses, master degrees or Ph.D. programs in universities. But the boundaries are fuzzy: what is *new* about the disciplines themselves, and what is new about their empirical data? Does one need to be a "digital sociologist" to understand how societal groups form habits, values and identities on social media, e.g.? Does one need to understand information and communication technologies (ICT), to understand how children learn? Why the necessity to append the word "digital" to emerging research fields and paradigms? In the end, is "the digital" not a redundant term? Can't the phenomena in digital media, be explained by classic theories in psychology, sociology, political sciences or economics?

There is something about the digital for sure, but there is also something confusing, fast,

expansive, and categorically bewildering about "the digital".

### A critical turn

This dissertation is influenced by "a critical turn", i.e. a critical debate about the broader effects of digitization on society. These critical discussions manifest themselves in current debates about the legitimacy of Silicon Valley companies in general (or their philanthropic rhetoric), as witnessed in public outcries about surveillance, online radicalization, data-breaches, obscure, algorithmic business-models, addiction to social media, debates on the effect of intensive screen use on general health, and on the efficiency of automated systems (on productivity, employment, innovation). These debates have been raging in mainstream media, often fuelled by techno-critical literature that has caught the attention of the mainstream public (Foer, 2017), (Tenner, 2018), (Zuboff, 2019), (Morozov, 2014), (Bridle, 2018), (Pasquale, 2015), (Ford, 2015). It seems that the time is ripe for a critical evaluation of the hopes we have pinned to digital technologies, since they became mainstream in the early '80s. I mention this, because educational ICT, is a subset of a much more comprehensive digital trend. It is natural to direct many of the questions raised around the social, democratic, or societal benefits of new digital infrastructures and Silicon Valley dominance in a wide range of fields, towards education. But are the same mechanisms at play? Are the "disruptions" happening in the media landscape or the governance of cities through "Smart City"-solutions e.g., the same as those happening in education? This dissertation is an attempt to bring the same type of reflexivity to the educational sector.

Or in the words of Langdon Winner (Winner, 2009, p. 588):

"*What is known about the kinds of settings, human relationships, activities, and materials that foster genuine learning? What counts as reliable evidence that the efforts of teachers are succeeding? A persistent failure in contemporary discussions about computers and computer networks is an unwillingness to confront such questions squarely*."

In this thesis we will squarely confront the question of "evidence".

## Does it work?

### Context: a crisis of evidence

In current political rhetoric about how to shape our society, our future and hence our educational institutions, digitization has been become essential. It is common to describe our epoch as revolutionary, to compare the impact of current technologies with the impact of the printing press in the 15th century, steam power in the 19th century, and electricity and mass production in the 20th century. Sometimes this claim, appears under the banner of "The fourth industrial revolution" (Schwab, 2017) or "Industry 4.0" predicates. Each of these epochal, technological breakthroughs, it is purported, had a massive impact on productivity, the dissemination of ideas, innovation and general affluence, but also on power structures, the make up of institutions and ultimately the quality of life of common citizens. In this narrative, it is normal to establish a direct causal link between the invention of technologies (sometimes sparked by a genius-inventor, other times the result of what the spirit of technology "wants" (Kelly, 2010)) and subsequent financial growth, welfare, and overall quality of life. It is a consensus in governing bodies that digitization - if dealt with correctly - is, will, or can be a similar driver of growth, and has altered/will alter society, as we know it. Incumbents will be ousted, change will affect everybody mercilessly, and only the intelligent, the flexible and those who are open to change, will land on both their feet, on the other side. This narrative also permeates educational thinking, and saturates the domain with theories about how education should be understood, its predominant role in preparing societies for the future and consequently how we should design and form it.

### A fundamental problem: lack of measurable effects on student attainment

The business of politics is to a large extent the business of speculating, divining, imagining, and trying to anticipate the future. Politics, at all levels, is the space where, we the public and its elected officials, discuss what we want, which direction we should go, which common values we should make the foundation of reflection, debate and planning. It is no surprise that education so often becomes the centerpiece of speculative political activity. In

future-oriented thinking, the questions of how we train and form the youth becomes essential, as it is the adults of the future who will have to assume the responsibility of maintaining and developing our societies. Future thinking takes many forms, covering a spectrum from the science-fictional (as: in the future everyone will have a flying car and live forever), to future thinking rooted in "evidence", based on facts and research, i.e. a discipline of reflecting on possible consequences of observed and documented trends (as in: most professional processes have been affected by IT, ergo we should teach programming in school). Something bizarre happens, when investigating the epistemic basis for political systems' self-confidence in the digital future, and the consequences this should have for education. The most startling issue is, that it is debatable whether the use of educational ICT, has any significant, positive effects on students' learning attainment. There is also the problem that it hasn't (yet) been possible to develop a generic educational model that can *predict outcomes*. In a scientific context, the term "debatable" is shorthand for discussions between communities of researchers, not only about the effects of the ICT-interventions as a global solution (aka. across all imaginable contexts), but also on the methods to achieve results, on definitional praxis (what do we mean by "a computer", by "digitized" etc.), and finally on how to define the field of investigation - including taking account of local variations (can adults' learning attainment be measured the same way that we measure learning in preschoolers?), taking account of the importance of other variables than just the technological ones.

Do computers make education better? Do computers prepare children and students for the future? Are computers effective at supporting cognitive processes? It's around questions like these that this thesis evolves.

## Research Problem

> *"An astonishing $8.24 billion in investment flowed to learning technology firms in the first half of 2018," reports Sam S. Adkins, Metaari's Chief Researcher. "I have been tracking learning technology investment activity for twenty-two years and I have never seen such an incredible burst of global activity. A total of 437 companies were funded in the first half of 2018 including 105 companies in China."*[2]

The research problem in this dissertation is situated in the link between public investments in digital infrastructure and the quality of education. In market terms the educational ICT-sector has never done better, and from this perspective it might seem strange to allude to problems of any kind - impressive financial value is being generated. An illustration of the earning potentials in "Edtech" is the financial health of Pearson, the largest education company in the world, at the time of this writing. In 2017 it reported profits of £451m £, and in 2018 "*expecting to report adjusted operating profit of between £520m and £560m*"[3]. Pearson's product portfolio includes "*Revel*", an interactive learning environment, "*online homework, tutorial, and assessment products*", courseware and reading programs.

In Denmark, the market for digital courseware is dominated by three companies: Gyldendal, Clio Online (reporting revenues of 87 mill. dkk in 2017) and Meebook (reporting revenues of 6 mill. dkk in 2017). The companies offer "courseware", i.e. interactive learning materials and access to dynamic or interactive content on professional portals ("fagportaler"), accessible by schools, for a fee.

### OECD

If we zoom in on one global, influential actor in policy-shaping in the field of education, namely the OECD (Ball, 2012), (Korsgaard, Kristensen, & Jensen, 2017), (Bonderup, 2007), tensions quickly arise between the axiomatic and self-confident propositions about the digital

[2] https://markets.businessinsider.com/news/stocks/global-edtech-investments-shatter-records-in-the-first-half-of-2018-1027347829

[3] https://www.pearson.com/content/dam/one-dot-com/one-dot-com/global/Files/news/news-annoucements/2018/Pearson-2017-Full-Year-Results-Press-Release-February-2018-2.pdf

future, and evidence of the effects (in the past) of investments in digital technology, that had the intention to raise the quality of education.

In a Danish context, OECD-publications are widely cited sources. One example is a government report from 2011: "*A digital common school - national strategy for IT in the school*" (Regeringen, 2011) where "*Beyond textbooks - Digital learning resources as systemic innovation in the Nordic countries*" is referenced (OECD, 2009). Other examples are "Uddannelse og Innovation" (Education and Innovation, Produktivitetskommissionen, 2013), "Det Digitale Danmark omstilling til netværkssamfundet - bilagsrapport" (The Digital Denmark - conversion to the network society, 1999) which also links to OECD publications. But what is OECD's own analysis of the situation? In the preface to the 2015 report: "Students, Computers and Learning" (OECD, 2015), Andreas Schleicher writes: "*Still, the findings must not lead to despair. We need to get this right in order to provide educators with learning environments that support 21st-century pedagogies and provide children with the 21st-century skills they need to succeed in tomorrow's world*". The findings that must not lead to despair are the following:

- The rather vague problem that "...the reality in schools lags considerably behind the promise of technology." (p. 3)
- "...where computers are used in the classroom, their impact on student performance is mixed at best" (ibid.).
- Students who use computers frequently do a lot worse in learning outcomes.
- Countries that have invested in ICT for education show no appreciable improvements in student achievement in reading, mathematics or science.
- Technology is of little or no help in bridging the skills divide between advantaged and disadvantaged students.
- Children that spend more than six hours online a day (outside of school) are at risk of reporting that they feel lonely at school, and have a tendency to skip classes.

These are startling findings. In political circles OECD speaks with great authority (reflected in the number of institutions all over the world that endorse and use OECD-literature as justification for policy). Historically, the organization has put its entire weight behind the

project of digitizing education. The sheer amount of negative findings, in the report and the amount of data the report bases its conclusions on, one could be excused for thinking, ought perhaps lead to despair.

It is unsure which "promise of technology" Mr. Schleicher is talking about, but a qualified guess would be promises that OECD has communicated in earlier reports:

In 2003, in "Seizing the benefits of ICT in a digital Economy" (OECD, 2003), the perception is that "*ICT is bringing many changes and has the potential to bring many further benefits*". The report is about ICT in general, but includes educational ICT into its considerations.

In 2012 OECD made this statement:

"*Therefore, the promotion of IT education remains essential to achieving the long-term objectives of information societies*". (Competences & Economy, 2012)

In 2001, there is talk about ICT's potential for bolstering "Life Long Learning for all" (OECD, 2001).

The quotes above justify the claim, that OECD a) has had a sustained focus on the potential benefits of ICT over a long period b) has advised and has urged member states to invest in ICT in education, for a substantial period.

Another quote, from a videoconference organized by the Danish STIL[4] in October 2017, Mr. Schleicher said "*In a nutshell today technology does some more damage than it actually does good*"[5]. The formulations in "Students, computers and learning" imply that ICT in education (still) hasn't got it right, the latter quote (from the videoconference) is a direct and unequivocal statement: the effects of technology in education are negative.

Mr. Schleicher's point, as I hope is evident, challenges a long-standing, and general consensus

[4] Styrelsen for IT og Læring, aka. the board of IT and learning (my translation)
[5] https://media.videotool.dk/?vn=25_20171109190549178850984459 72

concerning the value of educational ICT. Later, I will document the perceived value of educational ICT systematically, but for now let me just provide three additional indicators of this consensus, substantiating that at least Danish practices agree with the decade-long call of OECD (and many other actors):

- A rise in expenses on educational ICT since at least 2011 (as witnessed by the two public digitization strategies (Undervisningsministeriet, 2018) and (Digitaliseringsstyrelsen, 2011)).
- The introduction of educational ICT both horizontally (the number of educational institutions adopting ICT), and vertically (from kindergarten to university level).
- A political discourse putting investments in educational ICT at the forefront of national concerns (the subject of this dissertation).

Taken at face value, Mr. Schleicher's statements seem to undermine the legitimacy of the scope, intensity and magnitude of the effort. If educational ICT does more damage than good, the warrant of investments, in the scale described above, seems considerably weakened: why bet on something that is directly damaging? Why not focus on more low-tech concerns, e.g. the number of pupils in a classroom, the climate indoors, access to schools and higher education in rural areas, the educational level of the teachers, the price of textbooks etc.?

Let's return to "Students, Computers and Learning".

Adherents of the PISA-reports (based on an impressively large dataset created from samples from 29 countries) would find the data credible and conclusive, and that the correlations are indicative of the problems Mr. Schleicher mentions in his foreword. Later, we will try and situate this method in a spectrum of the other research disciplines engaged in the question - which in turn will lead to a principled discussion of the validity of the data, the method used to collect it, and the conclusions Mr. Schleicher bases on them in 2015 & 2017. For the moment, the project is to make the case, on a solid empirical foundation, that there are problems that warrant the investigation this thesis wants to pursue.

Reading the above, one might mistakenly be led to believe that Mr. Schleicher's despair is a first occurrence in four decades, or the first time that problems with technology or

investments in them are detected or published. This is not the case.

In the process of reading policy papers, I have been surprised by the amount of reports that reach the same conclusion, or refer to a problem of lack of evidence, described below in a WEF-report as "the non-significance phenomenon". Below I will only list some of them (and urge you to consult appendix 2 for more quotes):

> *"There is, however, little scientific evidence of the concrete contribution of ICTs to the learning process. ICTs' impact remains difficult to measure, because of the lack of appropriate indicators, and therefore open to debate. Evidence is quite often derived from opinion-based studies interpreting perceived,9 not actual, impact. Some experts describe them as tools to support and improve existing learning processes rather than having any transformative potential. Studies tend to find small positive educational outcomes without ascertaining the causality of the link (i.e. it may be that more effective schools and teachers are more likely to use ICT and digital technologies effectively). Moreover, the cost advantage of digital learning is disputed" (Katsarova, 2014)*

> *"In the domain of technology policies in education, a very simple question is quite often posed: does technology- supported education make a difference? Or, more generally, does technology lead to better student results? When looking for a response in the existing knowledge base about the effects of technology in education, a striking fact seems to emerge: there is no conclusive evidence. This has been known for some years as the "non-significance phenomenon," leading to the overall conclusion that, in education, technology makes no difference because the investments made have not translated into improved educational productivity, thus reasserting Solow's productivity paradox in the education sector."* (World Economic Forum, 2012)

> *"Despite the fact that education systems have been heavily investing in technology since the early 1980s, international indicators on technology uptake and use in education are missing."*
>
> *(Scheuermann, Pedro, & OECD, 2010)*

Do the facts (or the interpretations) that there is little evidence, that impact is difficult to measure, that it can be problematized whether the use of technology makes any difference, or doubts about its cost effectiveness mean that there is a crisis? Does the fact that investments do not translate to intended educational productivity, by itself constitute a crisis? Again, if we look at the financial fitness of the purveyors of educational ICT-services and products (and interpret this as indicative of a healthy market), and the apparent excitement among

municipal- and school leaders, one would be inclined to dismiss such a notion. One could also point to levels of adoption of devices and software (read: sales), of the steadily growing number of political initiatives designed to harvest the potential of educational ICT, or to surveys that conclude that educational professionals feel there is indeed a potential (Bundsgaard, Pettersson, & Puck, 2014). A common conclusion in the reports is that if there is a crisis, it is not a crisis of the premise itself, but a methodological one. This often leads to recommendations of better data practices that can bridge a "data-gap", i.e. of dedicating more resources to the effective monitoring of the use and effects of educational ICT. This could also be interpreted as a very productive crisis for the commercial actors, aligned with their financial interests. As long as there is a crisis, it makes sense to keep experimenting with, researching into and spending more money on educational ICT.

One report that seems to contradict the above, (ICF Consulting Services Ltd, 2015), published by the Scottish government, states that

"*There is conclusive evidence that digital equipment, tools and resources can, where effectively used, raise the speed and depth of learning in science and mathematics for primary and secondary age learners.*"

The report bases its findings on an extensive literature review of more than 100 scientific reports. This seems to contradict the problems that I sketch above, until one reaches the "Key Findings"-paragraph. "*The effect sizes are generally similar to other educational interventions that are effective in raising attainment, though the use of digital learning has other benefits*." Another caveat is introduced, in the next sentence: "*The effects may be dampened by the level of capability of the teachers to use digital learning tools and resources effectively*." To rephrase: The conclusive evidence, is that digital technology (only where effectively used), generates effect sizes similar to other educational interventions - and only if teachers capability is good enough. A quick reading would give the impression that there is "conclusive evidence" for the value of digital technology in education, but after a closer inspection, it is very difficult not to conclude that digital technologies are a risky affair, and when they do succeed in raising attainment, they do not do better than other types of interventions.

### Research goals

The mentioned reports above, are just a few of many, and one risks being accused of cherry picking, just to make a controversial point (aren't there just as many reports "proving" that educational ICT is beneficial?). It calls for a methodic investigation, which sounds much simpler than it sounds, considering the many thorny questions embedded in the evidence-debate. Several questions immediately leap to mind: What is the political use of literature reviews published by entities that call themselves "Consulting Services" - and why are they commissioned for their services, instead of relying on studies from universities e.g.? Is the use of the phrase "conclusive evidence", in the report indicative of a positive, irrational, bias towards ICT? What are "the other benefits", mentioned in the quote from the Scottish government? How do we categorize digital artifacts, and is it at all possible to evaluate effects over longer time periods, if the digital artifacts change radically (in form and functionality), constantly and over short time spans? How is it possible to account for local contexts, differences in pupils' individual preconditions, socio-economic backgrounds etc.?

This is a complicated field to conduct studies in, it is like nailing jelly to a wall as the saying goes, and one is quickly pushed towards a junction of complicated choices: should one pursue a development of scientific methods to gauge the effective value of investments in ICT, or should one investigate the premise itself: why the interest in ICT for education? What are the underlying logics, belief-systems, and ambitions that motivate the selection of ICT as an important driver for reform? How appropriate is this interest in ICT, in the light of its complex nature? What is the appropriate time frame to experiment - at national levels - with the potential of educational ICT?

To make it manageable, it is necessary to make decisions, by breaking the problem down to smaller units. In the following I propose to support the research goals, by defining research purpose, research objectives, research questions and hypotheses.

At the onset, the research goal is to map the political arguments for digitizing education, from the earliest reasonable date, i.e. from the time computers became personal, affordable and accessible (in larger scale) for educational institutions. I situate this period to the early 1980's. We will end the investigation in 2015, the moment when this investigation started.

These arguments will be read from a point of view that seeks to enrich, illuminate or contribute to the understanding of *evidence* and *significance* in the political literature - partly on a methodological reading, partly on a justificatory reading.

Mapping, in this context, means something else than casting light on the totality of the terrain of educational policy & ICT, which would be close to impossible, given the volume of documents produced in the period. Instead, I will select central documents from influential institutions, across four decades. The purpose is to discern invariants, recurrent arguments, and common themes - I will develop this further in the methodological chapter. Besides the staggering quantity of publications on educational ICT, a host of themes is taken up in many reports - we will limit our focus to themes that relate to notions of evidence and justification. The purpose is to find out a) what political institutions believe that educational ICT can do, b) what the knowledge basis is of claims that there is a potential associated to educational ICT (if any) c) how the potential is assessed, or what the plans are to assess it (if present).

### Objectives

Before we can engage with the core of the analysis, i.e. the nexus between theories of education and governance, preliminary steps are necessary. It is the ambition to ground our problem empirically, but this requires some work, to give legitimacy to the project. This will happen in the following series of steps

1) Identify actors who argument for the use of educational ICT, internationally and in Denmark
2) Select a representative report
3) Analyze arguments and justifications, with a focus on the use of evidence
4) Contextualize the arguments epistemologically

## Research questions

The objectives above, are designed to answer the following research questions:

1) Which are the most influential institutional actors, that have put educational ICT on the agenda (internationally and in Denmark)?
2) Which of their publications are the most important, representative and/or influential?
3) What are the arguments for educational ICT? What is the warrant of the arguments?
4) What is the political epistemology in the educational domain?

## Hypothesis

*Technology cannot be proven to enhance learning.*

This is a very different hypothesis, than the hypothesis underpinning much political report-production. As we will see, many institutional actors acknowledge the evidence-problem, and attempts at explaining the evidence crisis are offered, with a tradition of rationalizing them in external factors (often called "barriers" in the literature). Very few studies draw the consequence of the negative or the neutral findings, by concluding that digitization is a wrong driver of reform, by recommending that investments need not be done at the scale that is the case, that learning is not a problem that technology can solve, that ICT in the educational context is a red herring, or what have you. We will work with the hypothesis, that the project of "proving" increased learning attainment, by technological means, is methodologically and philosophically impossible. To some, this may be a provocative thesis, but I will try to make the point that it's a hypothesis that can both be empirically and theoretically warranted. Even though it at first glance might read like it, it is not a *binary* hypothesis that can be answered with at "yes" or a "no". Working with the hypothesis requires documenting how political arguments appear, are maintained and legitimized; it requires a rigorous and trustworthy

analytical framework to gauge their validity, and the right analytical framework to understand them. But it also needs to take into account that digital artifacts and digital theories have invaded the "life-world" - a critical view from the outside misses important points, if it does not take into account how beliefs, thoughts, and intentions affect the physical world and how the cognitive environment shapes or pushes forward the question itself.

But, for simplicity's sake, the hypothesis takes propositions like this seriously:

"*The findings may suggest that technological aided instruction is not superior to traditional instruction.*" (Bulman & Fairlie, 2016)

A focused analysis of political epistemic practice will hopefully provide an empirical platform for interpreting the lack-of-evidence-problem, on which future evaluations of educational ICT can build. Or perhaps even suggest an alternative course, altogether. For some people the hypothesis will create associations to Hubert L. Dreyfus (1980) and his fundamental critique of artificial intelligence in his book "What computers can't do". This study however is more empirical and focuses on educational technology. There are some shared concerns, but for foundational, phenomenological discussions on whether machine can become human-like (being teachers for example), I encourage the reader to consult Dreyfus' work

In the methodology chapter, I will argument for the value of document analysis and a qualitative, hermeneutic variant of the systematic review (we could call it "qualitative synthesis"), compared to other methods commonly used to evaluate on reasons for, and the effects of, educational ICT. The methodology chapter argues for the best method to investigate what is at stake in the crux between technology and learning (and how it is measured), and argues for the value of using document analysis as the primary method for the empirical part of the thesis and b) philosophical, qualitative synthesis as the most salient interpretative framework to analyze the empirical material. In the post-script I describe broader methodological considerations, and the many detours that were necessary to take before settling on the focus of this dissertation. They are placed at the end of the dissertation, in order to avoid too heavy a front-loading of methodological and theoretical considerations, i.e. to get to the heart of the matter faster.

### Significance:

Some work has been done to analyze the history of institutional, educational ICT, notably Larry Cuban (Cuban, 2001), Neil Selwyn (Selwyn & Facer, 2013) and Thomas Russell (Russell, 1999) but my claim is that the work with this thesis, as it picks up on, and extends their work, contributes to scholarship in two ways: empirically, and methodologically (as outlined above). Empirically, the aim is to analyze the material across several decades, but reading the reports from a very distinct perspective: through the lens of justificatory political strategies - and its relation to the significance/evidence of educational ICT. Hopefully the study will identify an important gap in political thinking. The significance might well be, to develop an original method, that synthetizes document analysis with policy recommendations. The study will benefit two parties: policy-makers who want to make more informed decisions about educational ICT, and teachers or pedagogues who want to be better at decoding the intentions of the digital artifacts and strategies they to an increasing degree are forced to use in their professions. The study is a contribution to the field of digital literacy.

### A note on digital literacy:

There are different discussions on what digital literacy could or should be. In the post-script I describe my own (small) contribution to a Danish variant of digital literacy. Besides the Danish model, the EU-commission's in-house research center has published "Digcomp 2.0" (Vuorikari, Punie, Carretero, & Van Den Brande, 2016). It proposes a five-point model for digital literacy (for citizens, but it applies to education as well):

1. **Information and data literacy**: To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content.
2. **Communication and collaboration**: To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation.
3. **Digital content creation**: To create and edit digital content To improve and integrate information and content into an existing body of knowledge while understanding how

copyright and licenses are to be applied. To know how to give understandable instructions for a computer system.

4. **Safety**: To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.
5. **Problem solving**: To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up-to-date with the digital evolution.

I will return to this model in the chapter: "Implications."

Further benefits of the study are to create a more comprehensive understanding of the problems associated with attempts to increase learning attainments technologically, and pitfalls in various methods trying to make evidential claims for such attainments.

## Overview

The thesis is divided in five major sections:

1. A theoretical background section. In this section we will present the dominant schools of thought that are engaged in the problem area. The aim of the background chapter is to develop an analytical vocabulary from background theories, with which we can analyze the empirical material. This chapter is longer and more thorough than the reader might anticipate (and longer than what one might expect of ph.d. dissertations). This is essentially the result of the terrain determining the tactics. In order to properly understand the phenomenon of educational ICT and its relationship to evidence, both the concept of evidence and the concept of pedagogy need to be unpacked in detail.

2. The core, dedicated to the empirical analysis. It is the review of eight selected political reports, spanning four decades.

3. The synthesis, dedicated to relating the corpus analysis to the research goals. In this section I will discuss findings in light of the background theories.

4. The conclusion. In the concluding section, I will suggest what the analysis should imply for future policy-making, and suggest how other approaches might illuminate the problem area.

5. Appendixes. There are three appendixes.

    a) The first is the bibliography of the extended corpus (which I am not quoting, the result of preliminary desk-research).

b) The second comprises quotes from evaluation studies that cannot produce evidence.

c) The third is the bibliography of the second report being analyzed in the core section, namely "Education and Computers: Vision and Reality (Daley, Loop, & Carnoy, 1987). It did not fit into the table of epistemic sources and deserves to be included in the dissertation. It is also is an interesting snapshot of sources considered relevant at the start of the period.

## Definitions and terms

The analytical objects for the research fields that investigate digitally supported learning (or teaching) goes under surprisingly many different names. On the industry-side, the umbrella-term "EdTech" (abbreviation for "educational technology") is often used for covering various phenomena and concepts such as learning management systems, connected classrooms, smart boards, blended learning, flipped learning, virtual reality, etc.

In academia, the analytical field is often expressed in acronyms: CAI (computer assisted instruction), CAL (computer assisted learning), TEL (technology enhanced learning), e-learning, MOOCS (multiple open online courses), CBT (computer based training), CSCL (computer support for collaborative learning) etc., but also in terms like adaptive learning, blended learning, flipped learning, gamification, and many others. It's a tall order to track the emergence, the development and the variety of different terms used for the products, pedagogies, didactics and different ways of using digital technologies for learning, and a process I will skip entirely, at the risk of insulting professionals in the field who read crucial categorical differences into the different terms. Instead I choose to coin the subject of the thesis "educational ICT". By "educational ICT" I mean the range of information and communication technologies that a variety of actors claim can execute important functions in the educational space - either as a support for a human teacher, as an alternative to a human teacher or for assisting the professionals whose job it is to secure the best learning conditions in the institutions where they are employed. It is used to denote the composite nature of the field, drawing on educational history, and the field of information and communication technologies. This choice reflects an ambition to connect our investigation to longer, scholarly traditions in a way that covers more ground than just cataloguing the terms in vogue at the moment, in order to "consider a number of issues and factors that can only be revealed with 'the benefit of hindsight' (Cassidy 1998)" (quoted in Selwyn, 2017: 46).

## 1.1 Historical context

In this chapter we will establish the historical context of educational ICT more broadly, followed by a similar account of the evidence phenomenon.

### The history of educational technology.

In the following, I will draw mainly (but not exclusively) on a body of research by Neil Selwyn (professor in the Faculty of Education, Monash University) to situate the combination of ICT and education, conceptually, politically and in a historical context. In other words: it will be an attempt to create a panorama-view of our analytical field and to describe it's emergence as a singular (but composite) subject considered more and more worthy of focused academic scrutiny (as opposed to investigation in ICT *per se*, or education/pedagogy *per se*). Three publications will serve as our starting point. *Education and Technology - Key Issues and debates* (Selwyn, 2017), *The politics of education and technology* (Selwyn & Face, 2013), and *Distrusting educational technology* (Selwyn, 2014). The publications share many of my thematic issues: what are the political stakes in educational ICT? When did educational ICT emerge as a political concern?

#### 2700 BC

As Selwyn notes in his book about key issues and debates, technologies have been linked to educational thinking for a long time. He reminds us of the length of this particular history, by pointing to the Mesopotamian Abacus in 2700 BCE, the introduction of the textbook in the 16th century, and the chalkboard in the 1800s. As technological development accelerated in the twentieth century, so did the attempts to reform education through technology, by the means of radio, film and TV. Selwyn describes the "fickle romance" (Selwyn, 2017, p. 50) between educational reformers and technology, and how new technologies have nurtured feverish hopes of revolutionizing education. In the 1920s Thomas Edison predicted that the motion picture "*is destined to revolutionize our educational system*" (to a degree, that film would supplant the use of textbooks). In the US, the project to weaponize education with film was taken seriously by the government, in 1922, by establishing the Committee on Visual Education, under the National Education Association (Orgeron, Orgeron, & Streible,

2012:152), dedicated to studying the potentials and effects of film in education.

The medium of radio was also adopted with great enthusiasm in the same period and was linked to possibilities for reforming education. Selwyn describes the "School of the Air" programme that ran from the 1930s until the 1970s, and deemed important enough by the US government that the Office of education established a "Radio Section". Radios were purchased by school systems (two-thirds of Californian schools owning one or more sets, cited as an example of adoption, Cuban (1986)).

The third and final educational technology (prior to educational ICT), that Selwyn discusses, is TV. In the 1950s programs were set in motion to offer TV channels for educational purposes and promoting the development of public and community TV-stations, and the establishment of university tv-stations. Enthusiastic claims about the potential of TV surpassed claims directed towards film and radio before it. TV "television could well prove to be the power tool of education" (p. 57), and television could "provide the closest thing to real experiences for many children" (p.57).

### Shared arguments

The shared arguments - across the three media portrayed - are benefits related to:

- Scalability: educational resources can be multiplied at marginal costs.
- Accessibility: the idea that educational technologies can reach areas outside the physical educational institutions, also at marginal costs - with benefits for social mobility especially.
- Observations that pupils are "engaged" by the use of media that are also used for media consumption outside the educational institution.

The reason for taking this short - non-digital - historical detour, is the observation - at least in Selwyn's account - that the evidence problem accompanies the history of technologically supported education, long before computers enter the educational scene, and in many ways foreshadow the evidence crisis described in the introduction.

Regarding film:

"*Concerns over the lack of tangible effect were followed by subsequent decline in the use of motion pictures [...] As the 1950s progressed, it became apparent that films were not having a major impact on how schools, colleges and universities went about education students, despite their booming popularity as an entertainment medium*." (p. 52)

Regarding radio:

"*However, by the end of the 1940s it had become clear that the educational potential of the radio was not being realised fully across the US school system. While many schools may have owned radio sets, studies suggested that most teachers made sporadic use of them."* (p. 55)

Regarding television:

*"...by the 1980s educational television was generally deemed to have failed to impact school, college and university education, especially compared to the very high levels of domestic television viewing."* (p. 57)

In general:

*"As Cuban and many others have observed, most of the technological developments of the twentieth century - from the x-ray machine to the aeroplane - were heralded for their educational potential, with most failing subsequently to challenge the established "chalk and talk" model of classroom teaching and learning."* (p.56)

Before we go on to the history of educational ICT, let us pause for a moment to characterize the evidence-problem, as it emerges from the preceding historical account. The "effectiveness" of the different technologies are gauged against different factors:

- Levels of adoption (related to levels of hype and hyperbolic statements), i.e. an observation that despite political investments and grand claims, the adoption and lifespan of technologies is less and smaller than prophesized.

- The functionality of the technologies, i.e. persistent problems associated to the technical use of the various technologies.
- Individual teachers' lack of use of said technologies.

These could all be contributing factors to the tenacity of "chalk and talk" practices and the modest impact (on learning attainment) of technologies in formal education that seems to be the case. To sum them, they are problems related to adoption, functionality, technical problems, life span and teachers' reluctance to use technology. We must keep these problems in mind, when asking of educational ICT whether it is better equipped for tackling these hurdles (and if they are acknowledged by the political forces promoting it), or whether non-significance or lack of evidence is an invariant, or somehow a *feature* of technologically assisted education.

We must also keep two things in mind regarding the account we have been referencing:

- There are few references to studies of increase/decrease in learning attainment, as the result of the introduction of technology. One could theoretically imagine a situation where general levels of adoption are low, technologies plagued by technical problems, and used to a lesser degree by teachers than intended, but still producing better results than traditional methods.
- The account is based primarily on American sources - we must be open to the hypothesis that things could be different elsewhere.

### The history of educational ICT

Neil Selwyn historically situates the introduction of computers to education, with the use of mainframe computers for research and education in universities from the early 1960s - for numeric purposes especially, i.e. engineering, math and programming. But there is empirical evidence, that soon after, psychologist Patrick Suppes "heralded the emergence of the 'computer tutor' as an apparent savior school and university education, capable of providing education to any child or adult on a flexible and individualized basis." (p. 59), and speculation on how computers might revolutionize and improve education flourished, as did the amount of digital educational devices (like the Texas Instruments "speak and spell" machine). As did

the private donations from IT firms such as Apple, Tandy and IBM.

By the end of the 1960s, Selwyn describes how, educational computing in the US had evolved into a number of different forms: coaching instruction, drill-and-practice instruction, problem solving, dialogue systems, simulations, database information retrieval and educational games. By 1983, "computers were being used for instructional purposes in more than 40 per cent of all US elementary schools, and more than 75 per cent of all US secondary schools." (p. 60)

As with film, radio and TV, a discrepancy arises between grand, sweeping claims, and the realities in the schools and classrooms. Often they consist of lack of "take-up": "nationally representative studies suggested that the educational use of computers was sporadic and inconsistent" (p. 61). "The apparent failure of the micro-computer to transform education was linked with several factors. Issues of teacher expertise and confidence with computers were often highlighted by research studies, issues that were usually reported as being exacerbated by a lack of training". In 1983, David Hawkridge's (Hawkridge, 1983) overview of computer use in the UK, identified a number of factors associated to the low take-up of the technology, .

- Restricted quantity, quality and variety of software and courseware;
- Concerns over the over-dependence on mediated learning;
- Teachers' role changes associated with computer use;
- Concerns over the weakening of public educational systems;
- Concerns over commercial bias;
- The over-emphasis on IT in government policy to maintain national prestige;
- Teachers ambivalence towards technological innovation;
- Concerns over the "communications effects" gap (e.g. the inequalities introduced by computer 'haves' and computer 'have nots'.
- Concerns over the social and political bias introduced with information technology.

This superficial contextualization establishes a century long pattern of technological hype, governmental funding and persisting problems, especially in the form of lack of uptake, lack of technical training in school staff, and resistance from teachers. This diagnosis - of failed expectations and lack of uptake - could be problematized however. It is difficult to make the

point today, that there is a lack of uptake, recent studies point to the opposite: WHO recommends reducing screen[6] time and the budgets spent on ICT have grown steadily over the last decades. There *has* been a revolution, education has changed dramatically, but the question, of course, is: has it *improved* education? The gap that Selwyn's research is addressing is the "*relatively limited analysis of the politics, the economics, the cultures and the ethics of digital technology in education*" (Selwyn & Facer, 2013). Selwyn characterizes the academic studies of educational technology, as dominated by socio-psychological perspectives on education, the researchers "*proudly aligning themselves with the 'learning sciences*'" (do.), as opposed to the social sciences. The research, in Selwyn's characteristic, relates to individual behaviors, individual development and classroom practice. Its restricted view of technology affords enthusiasms for social-constructivist and sociocultural theories of learning, offering a "localized" concept of social contexts in which technology is used. Elsewhere, Neil Selwyn is harsh in his criticism of the (dominant) academic studies of educational technology: it is a field that "*remains stubbornly stuck in its ways*", dominated by an "*optimistic desire to understand how to make an immediate difference*", and (in its worst cases), "*in thrall to technicist concepts of 'effectiveness'*" (Selwyn, 2012, p. 25).

In the literature review for this study, examples of these localized, social-constructivist studies are apparent, and I will use the opportunity here to illustrate what Selwyn means. One of the most ambitious studies in Denmark recently, is the "Demonstration-school experiments" (Demonstrationsskoleforsøgene, Danmarks Evalueringsinstitut, 2016), in cooperation with the then ministry of children, teaching and equality, led by the Danish Institute of Evaluation (Danmarks Evalueringsinstitut). The report's preface states that it is - at the time - the largest research-based activity ever in Denmark, with the ambition of gathering knowledge on practice-based learning on how IT can support pupils' learning. The report is presented as a catalogue for inspiration, based on findings in the five different areas of experimenting that were launched: IT-support of learning goals, differentiation of teaching, 21st century competences, pupil engagement, and professional IT-didactics. I won't go into the reports' details and conclusions, but confirm Selwyn's portrayal of the dominance of constructivist theories in the area. The experiments

[6] https://www.who.int/news-room/detail/24-04-2019-to-grow-up-healthy-children-need-to-sit-less-and-play-more

are localized, they seek to document "immediate differences" (how students become more self-confident by using presentation software, is one example in the report), and embrace "technicist" concepts of effectiveness: the report concludes that many of the technologies applied in the experiments were effective for the pedagogical tasks at hand, and that the experiments themselves increased efficiency by releasing resources for the teacher, so that her time could be used more effectively. What the report does *not* treat, again confirming Selwyn's analysis, are the political and the economic dimensions of the experiments: who gains economically from the use of technology? Is the new role of the teacher (in the technological age) part of an unspoken redistribution of power?; are there ethical issues at stake? Another example: In "The Global Information Technology Report" - which we will treat in depth later - (Kirkman, Cornelius, Sachs, & Schwab, 2002), Mitch Resnick tells the story of how Computer Clubhouses helped "*young people learn to express themselves and gain confidence in themselves as learners.*". He illustrates this through the example of Mike, who begins to "*feel a new sense of responsibility*" in the clubhouse, Mike becomes more creative and independent through his work with the computer. Mitch Resnick's tale indeed relates to individual behaviors, individual development and classroom practice - and again, the political and economic implications of the new pedagogies Resnick recommends, are ignored.

I have invoked these two examples, to illustrate what Neil Selwyn means by studies dominated by constructivist theories of learning.

## 1.2. Pedagogics and ICT

In Education and Technology (Selwyn, 2017) reviews four key learning theories developed over the last century, and their contribution to the use of technologies for learning. Additionally I spend some more time communicating the concept of "connectivism" than Neil Selwyn does in "Education and Technology"- based on my perception of this particular pedagogical strain's influence on current thinking. Before we look at them, let us look more broadly at the concept and history of the term "pedagogy".

### What is pedagogy?

The art of teaching, as a specialized area of human knowledge, goes back to ancient Greece, etymologically rooted in the term "paideia" (the art of bringing up boys). This period marks the first structured reflexions and theories on raising, educating and forming young people - and the purpose of doing so. Pedagogics as a field has a long history, and the aims of educating children and youngsters have, of course, undergone a long range of transformations and epochal shifts. In the Danish history of pedagogics "Pædagogikkens Idehistorie" (Korsgaard et al., 2017), the authors propose seven different pedagogical epochs, ranging from the reformation (the period starting in 1536) to the epoch of globalization and life-long learning (1989-). Each epoch is characterized by different anthropologies, i.e. views of what the child essentially *is* and what the purpose of education ideally should be, including seminal thinkers, exemplary technologies and the forms of government that define the normative purpose of pedagogics. See page 25 for a useful schema (my translation) of the different -isms in pedagogy, and most importantly the legitimacy of pedagogy in relation to the political system. In the current epoch, the authors describe the current legitimacy of pedagogy to serve "globalization, economy, education, comparison and competitiveness", and compare the epoch to the Middle Ages, where it was the Catholic Church that delivered the universal discourses that determined the aim of education. The distinctive difference today, is that the discourse is legitimized in *economy*, instead of religion.

### Pedagogic development since the 1500s

Below I have translated Korsgaard et al.'s overview of the development of pedagogy from 1536 to today. It is used to describe the developments in Denmark, and may seem irrelevant to Anglo-saxon readers (some of the phenomena, like the "Højskole" e.g. are strictly Danish phenomena). I have included it because it can help us describe our epoch (1983-2015), but can also help us visualize how the current situation is a continuation of a development going more than five hundred years back.

| Epoch | Reformation and Christian enlightenment | Enlightenment and useful knowledge | New humanism and formation |
|---|---|---|---|
| Year | **1536-1750** | **1750-1820** | **1776-1850** |
| Form of government | Absolutism/autocracy | Enlightened absolutism | From absolutism to constitutional monarchy |
| Form of state | Territorial state | The composite state | From the composite state to the nation state |
| Anthropology | Created Being | By nature undecided rational being | Spiritually self-guided being |
| Perception of the child | Born sinful | Tabula Rasa | "Bildsamkeit" (moldability) |
| Ism's | Protestantism<br>Pietism | Rationalism<br>Empirism<br>Sensualism | Humanism<br>Romanticism<br>Expressivism |
| International lighthouses | M. Luther<br>P. Melanchton<br>A.H. Francke | J-J. Rousseau<br>J.H. Campe<br>I. Kant | J-J. Rousseau<br>A.v. Humboldt<br>F. Schiller, J.F. Herbart |
| Danish lighthouses | P. Palladius<br>E. Pontoppidan | J.B. Basedow<br>J.L. Reventlow | Frederik Christian 2. J.N. Madvig |
| Definition of learning | Authoritative<br>Dogmatic | Knowledge and experience through sensory perception | Formation through acquisition of latin and greek language and culture |
| Legitimacy of pedagogics | God and King | Reason and nature | Humanity and education of the individual |
| Institutions | Church<br>Catechist schools | The school for citizens<br>The common school | The Humboldtian university<br>The gymnasium (high-school) |
| Exemplaric things and media | The small catechism | The encyclopedia<br>The reading book | Latin grammatic<br>Evening and morning songs |

| Epoch | The people and national education | Naturalism and reform pedagogics | Progressivism and democratic education | Globalisation and lifelong learning |
|---|---|---|---|---|
| Year | **1830-1940** | **1870-1945** | **1940-1989** | **1989-** |
| Form of government | Development towards democracy | Liberal democracy and parliamentarism | Liberal and social democracies | Liberal and social democracies in interaction with the EU |
| Form of state | The nation state | The nation state | National welfare state | National state and EU-membership |
| Anthropology | Historical-poetic being | Natural and biological being | Independent being | Value-generating resource being |
| Perception of the child | Culturally determined | Natural organism | Self-expression through social interaction | The competent child |
| Ism's | Nationalism<br>Liberalism | Naturalism<br>Positivism<br>Darwinism | Critical theory<br>Pragmatism | Social-constructivism<br>Post-modernism |
| International lighthouses | J.G.v Herder<br>J.G. Fichte | H. Spencer<br>E. Key<br>M. Montessori | J. Dewey<br>J. Habermas<br>P. Freire | G. Becker<br>J. Heckman<br>OECD |
| Danish lighthouses | N.F.S. Grundtvig<br>C. Kold<br>N. Zahle | H. Trier<br>O. Hansen<br>S. Rifbjerg | H. Koch<br>K. Illeris<br>C.C. Kragh-Müller | |
| Definition of learning | Formatin through acquisition of national culture and language | Learning through development and experience of natural sciences | Learning by doing<br>Constructivism | Social learning theories<br>Learning as the development of competences |
| Legitimacy of pedagogics | The people and the nation | The people and the nation | Democracy and democratic life form. | Globalisation, economy, education, comparison with other states |
| Institutions | "Folkeskolen" (primary school)<br>"Højskolen" | The Kindergarten<br>The folk-university | The public school | The entrepreneurial university |
| Exemplaric things and media | History of literature<br>"Folkeskolens" songbook | Illustrated boards<br>Crafting rooms | Group work & project work | Digital learning games, the internet, Google and Facebook |

### 1.3. Neil Selwyn and pedagogy

The four learning theories that Neil Selwyn describes are behaviorism, cognitivist theories of learning, constructivist and constructionist theories of learning and sociocultural theories of learning. In the following I will summarize them (and expand the quartet with "connectivism"):

#### Behaviorism - the learner as a passive recipient of the learning experience.

In Selwyn's account, behaviorist theories of learning describe the mind as a "black box", i.e. as an entity whose processes are too complex to understand. This shifts the attention to effects of learning rather than processes of learning. These processes are understood in stimuli-response schemas: desirable behaviors can be attained, by punishing or rewarding behaviors, "learning can be seen as the formation of a connection between the stimulus and the response" (Selwyn, 2017, p. 74). The early - rather crude - behaviorist theories of learning, based on punishment are gradually superseded by B.F. Skinner's model of learning through "operant conditioning", based on rewarding correct responses in feedback and reinforcement loops, in chains of incremental learning steps. Selwyn characterizes the behaviorist view on learning as a teaching theory, rather than a learning theory - as the learner is largely "a passive recipient of the learning experience" (p. 75). The learning subject's cognitive contribution to learning is minimal - the subject is regarded as a generic entity, its' learning "mechanisms" are hardwired into the nervous system, and positive effects happen independently of deliberate action from the individual - apart from meeting up and participating. Selwyn proceeds to describe how this evolves into a system of "programmed learning" that can be supported by devices. The curriculum is broken down into small units, "observable and measurable learning products", where positive reinforcement is supplied by (mechanical or electrical) devices. This solves an efficiency problem: feedback can be given instantaneously (in contrast to feedback models dependent on the teacher's review of test-responses, a significantly slower process) - the teacher can unload responsibility for feedback to machines, and focus on supervising the technical setup. This affords multiple-choice test type learning, where the machine gives immediate responses to whether the student has answered correctly or not. According to Selwyn, Skinner speculates that these types of instruction can double the amount of learning (in the same time), compared to practices in the

standard classroom. Behaviorist learning has not been relegated to a curiosity from the past, but is widely adopted to this day, especially in "drill-and-practice" programs, commonly used to reinforce basic skills and specific competencies, such as spelling, learning to type or increasing the learner's vocabulary. Others link behaviorism to another popular variant of learning today - going under the name "gamification". Gamification is a vision for education, that uses principles from computer games - "*there are countless examples of positive reinforcement contingencies implemented in gamified applications. For example, the rewarding of points, badges, leveling up, and access to new features as a consequence of appropriate behavior*..." (Steffen, Linehan, Kirman, & Roche, 2015). One example of this: The Danish think tank DEA recommends gamified apps as an interesting "building block" for education (DEA, 2015).

### Cognitivism - learning as internal process of mental action

Where behaviorism has evolved from the field of animal training, cognitivism, in Selwyn's account, draws much of its theory from computer science. Cognitivism is interested in the mental processes behind learning, with a strong focus on how the mind stores and retrieves information. Cognitivism relies heavily on a metaphor of the brain as a computer, and the development of (complex) models of the mind, based on how the computer works, "*involving three main stages of information processing where 'input' first enters a sensory register, then is processed in the mind's short-term memory, and is then sometimes transferred to long-term memory for storage and retrieval*." (p. 78) The result of cognitivist learning principles are "intelligent tutoring systems" and "cognitive tutors" responding to a model of what the learner ideally should be doing. The learner's actions - in the constructivist learning environment - are compared to what ideally should be learnt, and answers with troubleshooting, "intelligent feedback", and diagnostic models of common learner errors. Selwyn sees the cognitivist learning theories in adult and vocational training and in simulation-based "free-play" systems that provide comprehensive feedback, optimally used as a cue to reflect on the actions and decisions taken in the learning process. In newer software, this feedback comes from avatars or "conversational companions", which represent variants of "coached problem solving". This feedback, does not necessarily directly instruct the learner what to do, but may provide hints to stimulate individual thought processes, and is in some instances intelligent enough to discern that the learner masters the subject matter, to let them progress through the easy tasks, to the more challenging ones.

In the cognitivist model of learning, there is a strong element of "learning by doing" (followed by "intelligent" feedback), it requires more activity and involvement from the learner, than in behaviorist models, and there is often an enhanced notion of learner control at play.

### Constructivism and Constructionism

Constructivism, appears quite often in policy papers in our extended corpus. In "Harnessing the Potential of ICTs for Literacy and Learning" (UNESCO, 2014) UNESCO promotes constructivist theories of learning. Their description of constructivism, aligns nicely with Selwyn's description:

> *From the constructivist perspective of the Interactive System, the learner's knowledge construction should be based on understanding or, in other words, the establishment of meaningful relationships between the new information and the one he or she already possesses. In regard to information that lacks any meaningful relation to the learner because of the specificity of the subject matter, strategies of didactic intervention must be established. (UNESCO, 2014)*

The constructivist theory of learning was originally launched by the Swiss pedagogue Jean Piaget - launching a theory of learning that is critical of representational, or information-transmitting theories of learning. For Piaget, learning is more effective when it happens in didactic environments that assume that knowledge is constructed by the subject, i.e. departs from what they already know, by introducing problem-based tasks, and relying on the subject's eagerness to be curious, inquisitive and explorative by themselves, in order to construct the knowledge necessary to solve the task at hand. This is often an iterative process (imagine the child trying to make a tower out of wooden blocks, through play, as opposed to a scenario where an adult transmits knowledge to the child about how towers are built). For Piaget, the learning mind is in an ongoing process of maturation, seeking equilibrium between what is known and what is experienced. These concepts afford models of learning that are more open, looser, and more activity based. Problems can be solved by the individual learner in a multitude of ways, and the role of the teacher is to support exploration, rather than provide instruction. According to Selwyn, technology becomes a key means of facilitating exploration. Technology can create rich learning environments for the unique subject, that encourage simulation in complex environments, the construction of knowledge from the subject's own starting-point, encourage reflection on experience etc. The most famous exponent of this digital version of constructivism, coined as constructionism, is Seymour Papert. In his account, the computer becomes a fascinating toy, which engages the learner, and encourages playful interaction, on the subject's own terms. We will return to the political

excited adoption of Papert, in our analyses later.

To gain an understanding of the "active learner" that has become such a hot commodity in policy thinking, I will shortly introduce to Jean Piaget, a influential theorist of active learning.

*"To know an object is to act on it"* (Piaget, 1964, p. 176)

In "Cognitive Development in Children" (1964), Jean Piaget opposes "development" and "learning". For Piaget, development of knowledge is an embryonic, biological process, that ends in adulthood, whereas "learning" is a limited process, provoked by a teacher eg. in a situation, to reach a specific (atomized), didactic goal. For Piaget, development is not a sum of learning experiences, but an essential process, where all learning happens as part of "total development". Piaget criticizes the cognitivism and representationalism of his era, i.e. the understanding of knowledge as a copy of (some reality). Knowing, for Piaget, happens when the learner is engaged in modifying, transforming an object of knowledge *and* when the learner at a meta-level understands this process of knowledge-transformation that results from the operation of construction that the learning activity is. The phenomenon of operation is never isolated; it is always linked to other operational structures. These considerations lead Piaget to formulate an ambitious scientific program: "...to understand the formation, elaboration, organization, and functioning of these structures." (p. 176) Jean Piaget proceeds to partition these operational structures in different phases, starting with identifying a purely sensory-motor, pre-verbal stage, to the final hypothetic-deductive operations.

What does this entail for learning? in the second part of his lecture, Piaget claims that the concept of learning, classically has been based on a "stimulus-response schema". The stimulus-response schema is in Paget's perception *associative* instead of being a relation of *assimilation*. Piaget does not exemplify this, but if I were to illustrate the differences, it would be one of a history teacher, teaching about the Roman Empire, planning his education so that the pupils *associate* the Roman empire to a set of facts: historical dates, populated with certain names, and predicates that the teacher deems instrumental to "know" about the period. Piaget's view on learning carries a strong normative element. The aim should instead be to let the pupil *assimilate* knowledge, by actively engaging with the matter, by e.g. learning some simpler version of the complex structure. The example that Piaget does use is the case of

teaching "transivity" in the logical-mathematical domain. He explains how a Swedish researcher, by statistical means, tried to ascertain the ideal method of transmitting knowledge about the "conservation of weight". Piaget's approach - in contrast to that method - was embodied, active, and took its departure point in the developmental phase of the child, by letting it "play" with glass jars and beads. In the conclusion this experiment demonstrates the value of the "transformation"-response over a "copy-response".

Piaget does not conclude that learning cannot be attained through the "associative" approach, but questions whether the knowledge obtained is 1) remembered 2) if it is generalizable 3) whether there is a transformation in the level of one could call "operational attainment", i.e. whether the acquired knowledge has helped the pupil operationalize the knowledge.

### Sociocultural theories - learning as social action

All three mentioned theories mentioned until now, disregard the social nature of learning, according to Selwyn, they are individual-centered. The sociocultural theories, emphasize the effects of social contexts in cognitive development, the role of language in meaningful social interactions with "knowledgeable others". The role of the others in sociocultural theories, is to guide to "zones of proximal development" (a concept introduced by Lev Vygotsky), or scaffolding as it is also known. It is a teacher-dependent theory of learning, as the teacher plays an important role in pointing to knowledge-resources, but it is also a view on learning that regards technological/digital tools as instrumental in promoting social experiences, e.g. in collaboration on social networks (providing access to knowledgeable others in communities of practice), and digital resources as providers of proximal zones of development. It is easy to see how this philosophical pedagogy has ushered in an excitement for the social dimensions (and platforms) of the Internet, collaborative tools, communication channels (in smartphones and on social media) and the social activity in online multiplayer environments. Selwyn quotes Scott Grabinger (Grabinger & Dunlap, 1996), who sees a potential in these virtual communities as "rich environments for active learning". It is also easy to see how affirmative this theory is of any arbitrary social environment - learning happens where social formation of identity happens, and where peers can be found.

We could add some, more recent pedagogical trends, that are less software/interface-centred, but that claim to apply especially well to our digital age: *connectivism* (centred on network-competences) and *material* pedagogies e.g. Both can be said to subscribe to the view that new theories need to be developed to explain learning in new contexts, and former theories regarded as only partially relevant.

### Connectivism:

Neil Selwyn, in the glossary section of "Education and Technology" (2017), defines connectivism as: "The idea that learning now relates to primarily to the ability to access and use distributed information on a 'just-in-time' basis. Rather than knowing and retaining information on a long-term basis, connectivism describes how individuals develop personal, meaningful networks of learning." (p. 192).

The term connectivism is attributed to Stephen Downes (2005), who proposes "connective knowledge" as a supplementary, third category to the foundational forms of knowledge historically described as (and excluded to) 'qualitative' and 'quantitative'. Connective knowledge is characterized by its distribution - and more importantly the relational interaction between knowledge between entities. "Connective knowledge is knowledge *of* the interaction" (Downes, 2005, p. 78), and meaning is the emergence of meaning as it arises between connected, knowledge-sharing entities. "The wisdom of the crowds" is often invoked when talking of connectivism. It is the idea that large groups of people are collectively smarter than individual experts when it comes to problem-solving, decision making, innovating and predicting. Thus the pedagogical aim becomes to empower the learner to create these meaningful connections (that are codified by the internet and various platforms), to engage meaningfully with them, to build them, or simply to become aware of their uniform resource locators (URLs). But also to understand how knowledge is the fruit of pooling individuals' resources, to design settings where this distribution of knowledge may be stimulated. These techniques can be bound to programming languages (how to build or to connect to networks through webpages or mobile applications), to techniques for 'harvesting' the intelligence generated by networks through linking, or aggregating resources that may be recirculated into the network so that one becomes an interesting node, or even hub that attracts the attention of other nodes/hubs in the network. For Goldie (Goldie, 2016) - citing Downes (2006, 2012) - the characteristics of a good network are:

- Diversity - the widest possible spectrum of points of view
- Autonomy of participants
- Openness – mechanisms that allow perspectives to be entered into the system

• Connectivity – connections between its nodes

It is easy to translate this to a pedagogical mission: to teach learners these criteria, to use them normatively in their own network-building, by connecting to autonomous individuals that have divergent points of view from the learner, to create as many openings into ones node as possible (the amount of "sharing" and "connecting" buttons on many personal webpages, CVs and profile-pages are an illustrative example of this) and finally to engage in a practice of linking all ones profiles together for maximal network effect.

The underlying science of much connectivism is network theory, with its mathematical models of power laws, but also scientific theories of mind. Mathematically, advantages of the network are expressed as mathematical axioms: power distribution, the pareto law, "degrees of separation", the "kevin bacon"-law etc. - that can be translated to "network-actions" that can quantify the value of ones work with establishing links. For Goldie (2016), network theory is parallel to theory of mind:

"*Connectivism is an emergent theory of the mind. Patterns of input phenomenon cause or create patterns of connections which are distributed in neural networks in the brain. These connections are formed naturally during interaction and are associative i.e. they form when two neurons are active at the same time and weaken when they are inactive or active at different times*. " (Goldie, 2016, p. 5).

The connectivist model has been formalised in the concepts of MOOCS, which integrate aspects of connectivism into their interface:

"*Educators had the role of facilitator or were totally absent from the learning process. All course content was available through RSS feeds, and learners could participate with their choice of tools: threaded discussions in Moodle, blog posts, Second Life and synchronous online meetings. Learners use digital platforms such as blogs, wikis, and social media platforms to make connections with content, learning communities and other learners to create and construct knowledge. They are encouraged to contribute actively, using these digital platforms. Participants' contributions in form of blog posts, tweets etc. are aggregated by course organizers*

*and shared with all participants via daily email or newsletter*." (do, p. 6)

One can see the appeal of connectivist theories of learning - the idea that a wealth of knowledge is accessible at the tip of your fingers, the idea that the tedious work of incorporating knowledge - by reading, memorizing, or practicing tasks - can be replaced by the far easier and more convenient activity of connecting or reaching out to the network, and the individuals in it, to access the knowledge that you need. The question is whether there is any fundamental difference between connectivism, and constructivism, situated learning etc. that all emphasize the situational, social and relational aspects of knowledge and learning - be it analogously or virtually.

### 1.4. Sub conclusion - pedagogical theories

This introductory account has served the purpose of creating a backdrop to the evidential crisis sketched out in the introduction. It offers confirmation of the fact that the evidence crisis is not unique to our times, nor that is has been "solved" in the meantime. There is something about computers - or technologically mediated education - that clashes with expectations *or* the way we assess the quality of education.

A second important insight that the account has offered, is the fact that it makes little sense to speak of educational ICT in general terms. They operate with different pedagogies, and hence: different theories of cognition, and ultimately with different notions of relevant outputs. This has bearings on how to assess whether a technological intervention was successful. The history of technologically mediated education can be traced back to 2300 A.D., but gained traction in the 20th century with film, radio and TV. There have been many instances of various interventions that have been welcomed, supported and financed by political institutions (instead of leaving it to the individual teacher, e.g.), and they have often been backed up by visions of a more engaging (as in fun or inspiring) and efficient educational system. There have been waves of hope and disillusionment, and throughout, classical methods of teaching ("talk and chalk") have shown remarkable tenacity. What is novel about educational ICT, is the amount of terms used to describe it (both as a general concept but also to describe the proliferation of distinct technologies) - and its coupling to a discourse of a paradigmatic shift that affects larger processes in modern society.

In the next chapter, we will examine "evidence", historically and culturally.

## 1.5. Introduction to evidence-related terminology and issues

> *"Until much more research is undertaken and its results available and assessed, decisions about bringing computers into the schools to prepare youth for an uncertain future will be made for many of the wrong reasons."*
>
> (Daley, Loop, & Carnoy, 1987, p.6)

> *"We need to invest in capacity development and change-management skills, develop sound evidence and feed this evidence back to institutions, and back all that up with sustainable financing".* (OECD, 2015, p.4)

> "*...there might be other educational effects of having a computer that are not captured in measurable academic outcomes.*" (Bulman & Fairlie, 2016, p. 47)

Is there *evidence* for ICT's positive effect on education?

This is perhaps one of the most difficult questions in the sciences to answer, maybe apart from the P vs NP, the Birch & Swinnerton-Dyer Conjecture, the Riemann hypothesis or other Millenium Prize problems in mathematics[7]. Appendix 2 documents various attempts to answer the question, with little luck. In order to properly understand the question, we have to make an additional step back, at the risk of frustrating the expectation of the reader. We cannot understand the real challenges that are packed into the seemingly simple question above, without properly unpacking the notion of evidence. It is has become a commonsensical term, but it needs to be opened up. Understanding its recent history, use, and the scientific norms embedded in the term are necessary to answer the question.

### The meaning of the term evidence

By "evident knowledge" or "evidence" we mean something to the effect of "certain knowledge" or "something that needs no further justification". There are of course a number

[7] https://en.wikipedia.org/wiki/Millennium_Prize_Problems#Unsolved_problems

of competing definitions of "evidence" and the adjective "evident". The Cambridge Dictionary proposes synonyms like "obvious" or "manifest" to the word "evident" (“Evident,” 2019a). The Merriam-Webster dictionary defines "evident" as "clear to the vision or understanding" (“Evident,” 2019b). It seems counter-intuitive to spend energy on understanding evidence-based practice, evidence and the adjective evident - as it should be clear for all. This is unhappily not the case. One symptom of this, is the fact that the impetus to justify educational ICT seems as strong today as when the concept of educational ICT was a new phenomenon, if not more. If there were certain, stable and commonly accepted knowledge that ICT had beneficial effects on education, one would expect that there would be no need to justify it, at least not in the scale that has been the case since the early 1980s.

## Governance and measurement

Our focus is on how pedagogical, digital, interventions are assessed. The phenomenon of assessment is of course not a new phenomenon either. All pedagogies expect an outcome, be they the ability to memorize a religious text, to co-operate with peers, to demonstrate certain manual skills and so on - expressed summatively in grades or in formative feedback. What seems newer however, is the emergence of economy and statistics as the dominant tools to determine the justification of pedagogical choices and the coupling of education to national economic welfare. These assessments invariably lead to political initiatives to improve education. Where pedagogy, as a research field, to a large extent is focused on processes in the individual, the assessment regime is preoccupied with *outcome*, often measured numerically in relation to "key indicators". These assessments are not simply external to the educational system, but are fed back into education, and contribute to define the frame of pedagogical choices available to the professional. To understand how assessment influences pedagogics, it is my claim that we must understand how these are carried out, their background assumptions and their normative elements - whether they are formulated explicitly or are implied, whether their claim is objective or ultimately based on values.

### Technical explanations

It is necessary to define the cluster of concepts and terms often used when trying to answer evidence-related questions. They are the terms such as "evidence-based", "research-based", "significance", "positive effect", "null-effect", "validity" etc. These can be defined and

understood in a purely technical sense, but they can also be used rhetorically in the justification of decisions or in recommendations. There is of course a risk that the interpretation of studies claiming evidence, significance or synonyms thereof, is based on misunderstandings, that it is generalized to other areas that a cited study says nothing about, or that evidence for something very specific, is understood as evidence for something else, unwarranted by the study at the basis of the claims. In other words: the concept of evidence does not by itself ensure that it isn't misinterpreted, and it plays the role of more than just reflecting an objective reality: it has performative power. The valorization of evidence, and the funding of evidence-based practices, can also serve the function to stress values that have cultural, socio-technical or political implications. In order to further break the evidence-question down, we will point to some of the theoretical background questions buried in the question. In the introduction, I tried to make the case that there is an evidence crisis in educational governance. This crisis manifests itself in recurrent observations that intended (or hoped for) effects do not manifest themselves, that in some cases negative effects are observed, and finally in the frequent rationalizations that these effects will manifest themselves if support-factor problems are fixed - if teachers overcome their insecurity, if the infrastructure becomes 100% seamless, if the public is persuaded of the benefits through awareness campaigns or the like.

### Basic terms

In the introduction, I quoted findings from different political reports. Although they hint at the same, i.e. the difficulty of providing evidence for superior learning outcomes attributable to educational ICT - different words are being used. We need to settle on clear definitions of them. I will start with the most basic terms, as described in literature about evidence, and then define some of the terms that have emerged from the extensive literature review. Understood technically (in the statistical domain), evidence can be claimed, when a range of criteria is met:

On the basis of a *hypothesis*, an effect is observed: *something* has been registered in the data that can be attributed to something else than pure chance. This means that the intervention had an *impact* on certain indicators (improved ability to memorize, the ability to solve math questions e.g.). When the experiment is reproduced, the same effect is observed, in a

predetermined *confidence interval* - guaranteeing the *significance* of the observation. Data across several studies can show *mixed performance,* i.e. that in some cases the results are positive and in other cases negative. Studies can also show *no appreciable improvements, sometimes* leading to the verdict that there is no "*conclusive evidence*", meaning that further studies *could* (under other circumstances) show different results. When a result is *significant*, it doesn't necessarily say anything about the size of the impact (it could be anything that crosses the threshold of an effect that can't be attributed to chance, up to 100%), but that it is trusted that - if replicated - the experiment would turn out the same data/values. Another important term is the "null-effect" or the "null-hypothesis: this is the baseline any experiment is measured against. It is a general statement or default position that there is no relationship between two measured phenomena, Testing the null hypothesis—and concluding that there are or no grounds for believing that there is a relationship between two phenomena (e.g. that a treatment has a measurable effect)—is a central task in the modern practice of science; to create evidence is to reject the null-effect. Finally there is the term "*correlation*" - the term for the observation that there is an observed association between an intervention and the data that it produces. This *can* lead to the conclusion that the effect is causal - but the data, as mentioned earlier, doesn't by itself say anything about causes - this requires interpretation from the researcher, in the frame of a theory - and of course: repeated experiments. This is why it has become popular to say, "correlation is not causation". There is a risk that the more data there is available, the bigger the risk of observing so-called spurious correlations. I just mentioned the concept of "theory" - the view that correlations only make sense within a theoretical frame or model (which also guides precisely what the researcher is looking for in the data). The notion of theory that I adhere to is the simple one that theory an abstract, proposed model of the world, or some part of it. These models can be hypothetical; they can speak to causal relationships, or to more ontological issues (what there is in the world, and how the entities in them relate). A theory, in our context, could be that the current generation is ontogenetically hardwired (through their upbringing) to prefer screen-based media. The theory can be tested by asking pupils whether they prefer books or iPads, or by testing the same educational material on different media, in order to assess whether the theory is true or not.

The simple view of the importance of theory has been contested, though. An influential article

(in the general public, but much less in scientific circles, I suspect) published by Chris Anderson in Wired Magazine - "The End of theory" , claims that the technological development, in the form of big data, has done away with the need for theoretical models. As Chris Anderson states it:

"*There is now a better way. Petabytes allow us to say: Correlation is enough. We can stop looking for models. We can analyze the data without hypotheses about what it might show. We can throw the numbers into the biggest computing clusters the world has ever seen and let statistical algorithms find patterns where science cannot.*" (Anderson, 2008)

The idea is that raw algorithmic power can detect patterns, anomalies or deviations in the data, and find correlations, by itself so to speak. I won't discuss Andersons' article at length here, but just note that beneath the controversy, there is a familiar figure: a theory. A theory that machine intelligence can find meaning in data without human intervention or with minimal human intervention. Whether it is a sound theory (supported by strong empirical data) is another question altogether. Work by Antonio Casilli (Casilli, 2018) seems to suggest that what we understand by artificial intelligence is much more dependent on human labor, than the industry would like us to think.

For many scholars, the notion that educational policy, and policy in general, should be based on (or informed by) research and evidence, has become influential in many countries. Evidence-based educational policymaking has become a global phenomenon and "...evidence-based decision-making has become a staple of educational reform and funding requirements worldwide". (Wiseman, 2010). Theoretically, research based policy is about "how predicting policy outcomes is really betting that policy can play the right causal role" (Cartwright & Hardie, 2012). How this plays out in educational policy and our understanding of the role educational ICT plays in notions of evidence and research based policy - call for a historical contextualization, in which we will try to describe the emergence of a new political terminology to assess and predict success in political interventions.

For Martyn Hammersley (Hammersley, 2013), the idea that evidence should inform political practice can be traced back at least as far as Machiavelli, "who believed that wisdom distilled from practical experience and comparative historical analysis could greatly improve the decisions made by 'princes'" (p, 1). More recently, Hammersley adds, substantial

funds were directed towards evaluation of social programs in the United States in the '60s - sometimes labeled as "the experimenting society", also described by (Rossi & Wright, 1984) as the "Golden Age of the large-scale field experiments". The basis for these evaluation programs, were underpinned by the hope that strict experimental methods could test the scientific value of new policies and practices, later allowing for quasi-experimental and other forms of quantitative studies. Many of these evaluations were criticized for "failing to measure key variables accurately", and as Rossi & Wright describe, the golden age was cut short by the Reagan administrations abrupt defunding of experimental, social research.
The '90s saw a new rise of the evidence-based practice movement that could inform policy making directly, starting in medicine. The key argument for evidence-based medicine movement was that "much clinical practice is unknown", that in some cases some treatments proved to be ineffective or damaging, and this led to demands that practitioners make themselves familiar with the latest research, and only employ treatments whose effectiveness had been demonstrated. This demonstration took the form of systematic reviews and statistical meta-analysis of all the relevant RCT-studies in a given area. Archie Cochrane often surfaces as an influential figure in this rebirth of the evidence-based movement, and its advocacy for systematically reviewing RCT-studies. In 1993, the "Cochrane Collaboration" was founded, it publishes the "Cochrane Library", and a key component of the library is the "Cochrane Database on Systematic Reviews". Today, the Cochrane institute is considered as one of the most influential networks for informing health-based policy. It is also online host to the "Cochrane Library".

Hammersley notes that several assumptions are built into the Cochrane-model:

- That RCT's are considered the gold standard of scientific knowledge ("trumping all other sources of information, and especially that from practical experience", p.3).
- That evidence garnered from the systematic review of RCT demand implementation - the reviews produce information about "what works".
- Outcomes will be significantly improved (i.e. made more efficient economically) if policy-making bases itself on this type of evidence.

The final point, for Hammersley, reflects "a predominantly technical or instrumental

orientation on the part of the advocates of evidence-based practice" (p. 3).

The important aspect for us, is how the evidence-based movement has spread to other fields like social welfare, justice and...education. Hammersley situates the arrival of evidence-based practice in education (in the UK), to a lecture by David Hargreaves in 1996, in which he criticizes educational research for failing to provide the evidence needed for good practice. This prompted the department of education and employment to publish two reports inquiring into educational research, concluding that much educational research is "on this analysis, at best no more than an irrelevance and a distraction (Tooley ,1998, quoted by Hammersley)", and in the press release for the report that "considerable sums of money are being pumped into research of dubious quality and little value".

### A hierarchy of evidence

For a long time, the demand for evidence has dominated the evaluation of social interventions (H. R. Hansen & Henningsen, 2019). Results of a study or an intervention are expected to be obvious - and this often presupposes that they are *evidence-based.* This in turn means that effects are measured in special norms and matrixes that can be ranked in hierarchies of evidence. Different methods are ranked, the RCT most highly, and qualitative studies (case studies, interviews) are placed lower on the hierarchy. According to Rieper (H. F. Hansen & Rieper, 2007) the evidence-"movement" is preoccupied with aggregating knowledge from several individual studies and evaluations - aiming to produce and communicate the best possible knowledge about the result of a given intervention. Over the past decades the service of offering systematic reviews, has been delegated to various public entities and private actors and/or networks (the Cochrane network in the medical field e.g.). They have become key actors in supplying knowledge to politicians - and thus play an influential role in defining what counts as valid knowledge. In education, in 2006, Denmark established a "clearing house" (with the OECD as the inspiration, it has since closed), for the systematic production of evidence of the effect of educational interventions.

According to the same authors, it has become common to rank studies in a hierarchy of evidence:

1. RCT-experiments
2. Controlled experiments without lottery
3: Register analyses based on time-series
4. Cross-sectional studies
5: Qualitative case studies
6: Documentation of professional opinions
7: Documentation of user-experience

The hierarchy appears in a majority of organizational handbooks that Rieper and Hansen have sampled (p. 9).

### RCT & internal validity

The reason behind RCT's prominent position on the hierarchy, is attributed to internal validity, minimal bias, and rigor. But first, let us describe RCT as a method.

The randomized, controlled trial, attributes random individuals (or members of a population) to a group that is submitted to an intervention, and to a group that is not submitted to the intervention (or offered placebo). The groups are blinded - i.e. they do now know whether they belong to the experimental group or the control group. Furthermore, effects on the groups - before and after the intervention - is documented. The measured net effect is an isolation of the factors caused by the intervention, as long as all other factors are maintained constant (across both groups). The RCT-test is regarded as stricter, as it much more often shows *no effects* (compared to other types of studies), and consequently is perceived as less biased and better at pointing to causal principles. It is often referred to as the "gold standard" in research. It is a research design that has *internal* validity, to the extent that a piece of evidence supports a claim about cause and effect, *within* the context of a particular study. A criteria for evidence produced in an (ideal) RCT-study is reproducible, i.e. the results repeat themselves, when the experiment is carried out again - in the same setting, with the same population, and influenced in the same manner.  The strength of RCT is attributed to the fact that randomization of the experimental- and the control group accounts for the presence of unknown factors, that can have an effect on the result (so called confounders). All factors are

controlled for, not only those known to the researchers.

The limitations of the RCT-test, is that it only says something about a measured effect, but nothing about *why* some interventions work and others don't - nor does it say anything about how members of the experimental group (that has been intervened upon), have experienced the intervention - and in that regard is considered as a narrow type of research. Other common critiques are of a more technical nature:

Blinding (to keep it a secret from the experimental group that they are the ones intervened upon). In many cases, it is hard to maintain the blindness of the experimental group. This introduces "performance bias", i.e. the effect that subjects react to being tested (perform otherwise than they normally would). This is also described as the "Hawthorne effect", the phenomenon that individuals modify an aspect of their behavior in response to their awareness of being observed. In a strict RCT-sense, experiments with innovation in education (especially ones that are promoted publicly), would not qualify as an "experiment" in a strict RCT-sense - as the experimental group knows they are part of an experiment and thus adapt their behavior. Maybe it has been marketed as a prestigious experiment to a degree that participants don't want to spoil the party by displaying behavior that contradicts the thesis...

Individual preferences: Individual preferences may affect the constitution of the experiment- and control groups. This simply means that people attracted in participating in an experiment are overrepresented compared to a general population, and thus risk skewing the result. Maybe they are excited by computers, and choose to join the experiment whereas those who do not care about them abstain from participating. One acknowledgement of this effect can be found in the Danish consultancy firm "Rambøll"'s evaluation of the effectiveness of the use of digital teaching-aids ("Anvendelse af Digitale Læremidler" - Rambøll & BCG, 2014). The authors state that the data should be interpreted with some caution: the population, consisting of professionals who were asked to participate in the survey, may be affected by selection-bias: there is a risk that either those with a strong aversion to educational ICT or those with a passion for educational ICT were more likely to respond.

Over-focus on efficiency: An RCT-study focuses exclusively on effect, and not on *cost*

*effectiveness*. In many instances, low cost-effectiveness can invalidate even the best evidence - if it is not financially feasible to scale the experiment across larger populations due to costs, the knowledge it produces, has little practical relevance. This, of course, also is relevant in the educational domain: despite myths of rapidly falling costs, budgets to implement or maintain a digital infrastructure that is considered adequate should not be underestimated. In Denmark there is no publicly available information on the total costs of educational ICT, say in the primary school system. The two numbers that I have managed to get hold of are from KL (the association of municipalities) who communicated to me, that the approximate costs between 2012 and 2015 were 2.5 billion Danish kroner. This was to cover expenses for establishing Internet in schools, of developing digital materials, training teachers and the purchase of hardware. These numbers do not say anything about to what extent the hardware works, how much it is used and whether the training had the intended effect.

A final note on this issue, concerns the economic notion of negative or positive "externalities", i.e. the cost or the benefit that affects a party who did not choose to incur that cost or benefit (Buchanan & Stubblebine, 1962). Externalities related to educational ICT, could be the non-budgeted, hidden, undocumented costs related to deciding whether a system should be purchased or not. This is an expense that is held by the staff (by participating in meetings), or it could be time spent to acquaint oneself with a system (time taken from core tasks, reducing the efficiency of their teaching in the process). Ideally these externalities should be transparent, to increase sound evaluations of cost-effectiveness.

The literature on potential sources of biases, fallacies and irrationalities (in social research) when carrying out RCTs is extensive...and overwhelming. Besides the ones just mentioned, one could mention the "instrument"-bias - the phenomenon that the choice of instrument to measure with, can distort a result; demand characteristics - the effect that subjects in a study feel that they have to live up to some (imagined) demand from the researcher or the setup; evaluation apprehension - to distort data so as to live up to the researchers (imagined or perceived norms), for example by underreporting the number of cigarettes one smokes; the Rosenthal-effect - where the authority of the researcher can prime the experimental subjects, by giving the impression, or priming the subjects, (consciously or unconsciously) that the intervention carried out carries great promise, or is doubtful. Handbooks in quantitative

methods in psychology or the social sciences abound with these possible methodological fallacies in the design of RCT studies. One starts to understand the meticulous research-design required before proceeding, the caution and the reservations with which conclusions can be drawn, and the risks associated with scaling out "solutions" across contexts (differing from the original study). Pursuing this literature carries the risk of leading to a nihilist impasse, or to confusion on a very high level. In many ways it is parallel to the conclusion one reaches after having consulted literature on behavioral economics, which generates an endless stream of RCTs proving irrational elements of the human psyche, when asked to make this or that choice, under this or that influence. This is not meant as a critique of the validity of the studies in experimental settings, but more a critique of the usability of the knowledge in real-life situations. To make a rational purchase of a commodity in a supermarket e.g., presupposes that the agent is aware of the hundreds of (purported) identified cognitive biases[8], and remembers to apply them self-reflexively. The same counts for the scientists carrying out experiments.

### RCT and external validity

The biggest critique of RCTs - or perhaps more precisely, their potential use outside the context in which knowledge was obtained, is the issue of *context* and lack of standardization - relating to external validity. The main argument, is that causal relationships first of all, are complex and dynamic, and secondly that they are contextually bound. Very few experimental situations are identical, the different people carrying out the experiments can vary (as can their effect on the subjects being studied). So, of course, can the differences in the subjects that compose a population. It has become evident (pun intended), that the use of RCT's in psychological and social domains is in a crisis. This is also known and debated as "the replication crisis" or "the reproducibility" crisis - ignited by different studies that systematically have attempted to repeat experiments that have had influential theoretical impacts but that can't be reproduced under rigorous retests (like the “ego depletion” theory of willpower (Vadillo, Gold, & Osman, 2018), or the “marshmallow test” (Watts, Duncan, & Quan, 2018)).

[8] https://ritholtz.com/wp-content/uploads/2016/09/1-71TzKnr7bzXU_l_pU6DCNA.jpeg

### Synthetic meta-analyses, second order meta-analyses & systematic reviews

Since the introduction of educational ICT, and the growing popularity in policy circles with statistical meta-analyses (of RCT's) and/or systematic reviews, a number of studies have been published that have had the ambition to uncover "what works" in the constellation of education & digital technologies, by synthesizing the findings of a large pool of individual studies. While appearing to be the most objective type of studies (given the perceived neutrality of the statistical method and the large mass of data it is applied on), it is also obvious that there is a strong element of *interpretation* at play in these studies. The data does *not* speak for itself, and is *always* accompanied (in the shape of a preface or an introduction) with comments signed by a named individual - who highlights or downplays findings, infers consequences for policy, or hypostasizes the data - often reducing the hermeneutic potential of the data to advice that is so generic, that the reader has no other choice than to agree - albeit devoid of guidance in *how* to follow the advice in the real world of education. These type of studies will often end up in the same place: with no significant effects detected, or concluding that the reports "produce mixed evidence with a pattern of null results" (Bulman & Fairlie, 2016), or "that benefits of technology on education remains elusive" (Pastor & Quirós, 2015) or some times wrap the findings in "suspect auxiliaries like 'ought' or 'can' and dubious constructions like the hypothetical" (Austin, 1962). In other words, they presuppose a range of support-factors that only exist in *ideal* situations (that exist somewhere *outside* the studies that have been aggregated). Finally, the number of methodological reservations will in some cases undermine the relevance of the findings. This echoes the critique of RCT-studies above: that they disregard costs and externalities.

Let me give a few examples[9]:

[9] More than 60 meta-analyses have appeared in the literature since 1980, each focusing on a specific question addressing different aspects such as subject matter, grade level, and type of technology (Tamim et al., 2011)

### Case 1: Technology and education: computers, software, and the internet.

(Bulman & Fairlie, 2016)

For the national bureau of economic research, George Bulman and Robert W. Fairlie, published "Technology and Education: computers, software and the Internet" in 2016. The article is a review of the theoretical and empirical literature on the impacts of technology on educational outcomes. In the first sentence of the article, the focus is on the substantial amount of money spent by schools, with the hope of improving educational outcomes. This is put in perspective by summoning the ghost of mixed evidence and null results (aka. the non-significance phenomenon).

"*However, much of the evidence in the schooling literature is based on interventions that provide supplemental funding for technology or additional class time, and thus favor finding positive effects. Nonetheless, studies of ICT and CAI in schools produce mixed evidence with a pattern of null results. Notable exceptions to this pattern occur in studies of developing countries and CAI interventions that target math rather than language*." (p.1).

It is interesting that the authors point to an inherent bias in much of the schooling literature (positive effects are favored, as they provide supplemental funding) - implying that even when this biased is included, results are mixed. Their discussion focuses primarily on the impacts of computers, the Internet and software on educational outcomes (instead of computer skills, related to an "environmental" argument which we will describe later).

The result of their review is that the net effects of investments in ICT are "ambiguous", and "that we should not expect large positive (or negative) impacts from ICT investments in schools or computers at home." The authors continue: "Schools should not expect major improvements in grades, test scores and other measures of academic outcomes from investments in ICT or adopting CAI in classrooms, though there might be exceptions such as some CAI interventions in developing countries." (p. 46) and "Existing and proposed interventions to bridge the digital divide in the United States and other countries, such as large-scale voucher programs, tax breaks for educational purchases of computers, and one-to-one laptop programs with check-out privileges are unlikely to substantially reduce the

achievement gap on their own." (p. 46)

The authors are tethering on letting these results speak for themselves, but introduce the caveat that the educational effects of having a computer are not measurable in academic outcomes. Future research is recommended, to provide a better understanding of potential benefits.

**Case 2: What Forty Years of Research Says About the Impact of Technology on Learning** (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011)

Tamin et al. are in the same ballpark as ours:

*"...computers and associated technologies have been touted for their potentially transformative properties. No one doubts their growing impact in most aspects of human endeavor, and yet strong evidence of their direct impact on the goals of schooling has been illusory and subject to considerable debate*."

The purpose of the study "*is to synthesize findings from meta-analyses addressing the effectiveness of computer technology use in educational contexts to answer the big question of technology's impact on student achievement, when the comparison condition contains no technology use*." (p.5). It does so by a second-order meta-analysis, "*defined as an approach for quantitatively synthesizing findings from a number of meta-analyses addressing a similar research question*".

I will not go into the authors' methodological considerations, but jump straight to the result of their second-order meta-analysis:

"The average effect size in both the second-order meta-analysis and the validation study ranged between 0.30 and 0.35 for both the fixed effects and the random effects models, which is low to moderate in magnitude" (p. 17). The author's note that these results must be interpreted cautiously:

"...it is arguable that it is aspects of the goals of instruction, pedagogy, teacher effectiveness, subject matter, age level, fidelity of technology implementation, and possibly other factors that may represent more powerful influences on effect sizes than the nature of the technology intervention." (p. 17)

Again, this can be interpreted in many ways, one of which could be that 40-years focus on educational ICT yields nothing interesting, and should be abandoned in favor of focus on other factors. The authors, reach a different conclusion however: "It is incumbent on future researchers and primary meta-analyses to help sort out these nuances, so that computers will be used as effectively as possible to support the aims of instruction". (p. 17)
Non-use is not proposed as a viable alternative.

### Case 3: Literature Review on the Impact of Digital Technology on Learning and Teaching (SG 2015)

In 2015 the Scottish government commissioned the report "Literature Review on the Impact of Digital Technology on Learning and Teaching" - in the following abbreviated SG2015 (Scottish Government 2015). It is based on a literature search of nearly 1000 items, "to help inform the development of a strategy for digital learning and teaching". It focuses on five areas: raising attainment, tackling inequalities and promoting inclusion, improving transitions into employment, enhancing parental engagement and improving the efficiency of the education system." (p.1.).

This particular report is exceptional (it was mentioned in the introduction), as it is one of the only ones registered, that in its key findings section, affirms that "it is possible to state there is conclusive evidence" (p.1).

In the first area of focus, raising attainment, the conclusion is that digital equipment *can*, *where effectively used*, raise the speed and depth of learning in science and mathematics for primary and secondary age learners. This is a double-hypothetical sentence, i.e. digital equipment "can" (not "does"), raise attainment, but only if effectively used. Furthermore, even supposing that attainment *can* happen, under the right circumstances, the impact is generally similar to other changes to pedagogies which are effective in raising attainment. Regarding

"reducing inequalities" there is *indicative* evidence that digital tools *can* help to reduce gaps - *if* they are effectively implemented. Regarding "transition into employment", there is *promising* evidence that digital tools *can, where effectively used,* build skills in interactivity and collaboration, critical thinking and leadership for secondary age learners. Regarding parental engagement, there is *promising* evidence that digital tools *can* improve learners' and parents' cooperation with requests from teachers about "attendance, behaviour and support for learning". (p.3). As for the last focus area - improving the efficiency of the education system - there is *promising* evidence that teachers' efficiency *can* be increased by using digital equipment and resources to prepare for teaching.

This leads to the overall conclusions that succesful utilisation of digital technology depends on sufficient access to equipment, the availability of training, and knowledge networks for teachers. Another - equally valid - interpretation could be a simpler one: "it is too uncertain to say - substantial investments are risky", or the like. Above, we quoted the report for saying that potential impact, matches those of other pedagogical interventions. I would argue that it is also a matter of interpretation to include ROI-concerns - given that digital equipment is an expense that has to be *added* to the expense of teacher-salaries.

These formulations, I would argue, are *interpretations* that are neither warranted by the government's commission (to provide evidence *tout court*) nor directly obvious from the data. It is not clear how much the introduction of differentiated forms of evidence - "indicative" and "promising" - dilute what is understood by "evidence" (and why this concept does not suffice), and by which factor. Is "indicative evidence" half of "promising evidence"? The Cambridge dictionary defines "evidence" as "*one or more reasons for believing that something is or is not true*[10]". It is a very far stretch, from the above reports, described in terms of varying degrees of evidence, that an intervention *can* have some effect, *if* certain conditions are in place, to accept that "it is true that computers raise learning attainment". The OECD report of 2015 is mentioned in this report, and I would also argue that it is a subjective choice to omit OECD's *unequivocal* evidence - based on correlations of their data - that computers have caused negative effects.

[10] https://dictionary.cambridge.org/dictionary/english/evidence

## Cartwright and Hardie on evidence

The experience that it is difficult to establish *absolute evidence* should not itself be an argument for not conducting evidence-based studies, or for not advocating raising the bar when carrying them out.

In "Evidence-based policy" (Cartwright & Hardie, 2012), Nancy Cartwright and Jeremy Hardie, make the point that political interventions can be (proved to be) beneficial. They cite the case of the Tamil Nadu Integrated Nutrition Project - a nutritional intervention (funded by the World Bank) to tackle problems related to stunted growth, caused by malnutrition. One central element of the intervention was the education of pregnant mothers on how to better nourish their children and themselves, to improve the health of their babies. The World Bank concluded that the project was a success - studies showed that malnutrition fell at a significant rate. In Bangladesh a similar project was launched, modeled on the Tamil Nadu experiences. But the project had little success - an assessment concluded that the prevalence of malnutrition was the same after six years with the program. Cartwright and Hardie cite another case, the California Class-size Reduction Program. A RCT evaluation of an intervention in Tennessee concluded that students in smaller classes performed better at all K-3 grade levels than students in larger classes. "*It also concluded that minority and inner-city children gained two or three times as much from reduced class sizes as did their white and nonurban peers*." (p.4). The policy of small class size was adopted on large scale in California. But the hoped-for results did not occur. "*Exhaustive evaluations...could find no conclusive link in California between class-size reduction and student achievement*." (p.4).

In their book, Cartwright and Hardie, aim to address issues like the above: why do some programs succeed in some contexts, and fail in others? Through the book they develop a framework to "*provide you with the kinds of questions you need to answer to make better predictions about whether a proposed program will work if you implement it, and if you implement it how and when you should actually do so*." (p.5). There are several reasons for bringing up Cartwright and Hardie's work. The first is to make the simple point that political interventions *can* work, and that there are many good reasons to try and repeat positive experiences, in other settings, other locations, at larger scales. Cartwright and Hardie are representatives of researchers that a) have faith in evidence-based methods b) use scientific realist methods to assess data, to form evidence (RCT) and c) that demonstrate that

effectiveness can and should be strived for. Effectiveness, in this particular context means "a positive difference in the desired outcome".

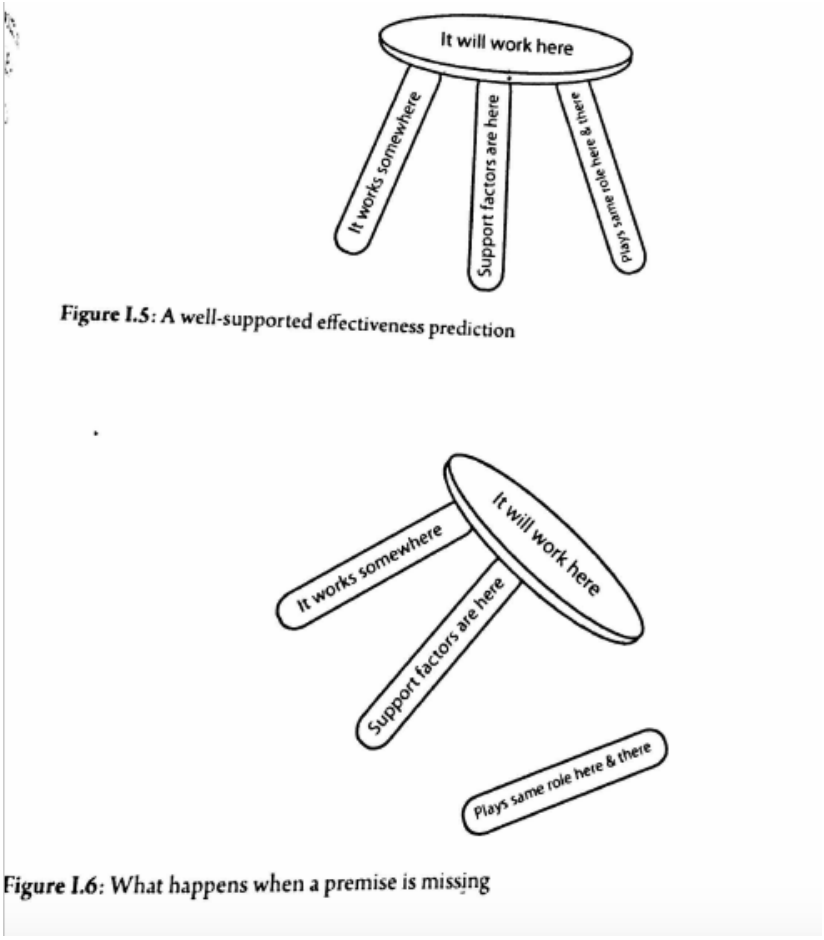



Figure 1 - Hardie's and Cartwright's evidence stool

The most important reason to include their work, for us, is their conceptualization of "context". Their book's main point is warning against faulty logics such as "because it worked there, it should work here". The "there" is usually some particular setting, in some particular population, at some particular time. But they also try to formalize some of the complexities described above. They use two (among others) illustrations to "*provide a daunting picture of everything that generally needs to go into determining a policy decision*" (p. 12). In the center is "Evidence", that should be supported by considerations of seven other dimensions that influence on it: effectiveness, political expediency, side effects, choice of goals, values and policy context, and resources (quoting Davies (2005)). Cartwright and Hardies book is about "efficiency", the considerations needed to analyze whether something that works there, will work here. The authors illustrate a well-supported effectiveness prediction through a three-legged stool (figure 1).

### How well suited are RCT-studies and systematic reviews for the educational domain?

Whether RCTs can generate useful knowledge in the educational domain depends on which aspects of education are being studied. There are many physical, biological or inorganic aspects in schools and educational systems that are well suited for RCT-studies, and that

indirectly can impact learning attainment: the temperature in the buildings, the quality of the indoor climate, the amount of money spent on wages etc. There are also strong arguments for teaching RCT-methods, and how to conduct experiments in technical or mechanical problem-areas, in order to learn to solve problems in domains that rely heavily on the RCT-method. When it comes to the evidence of pedagogics, didactic interventions, and learning attainment - with the biases and fallacies described above - it seems pretty clear that it is a) difficult to generate evidence that is significant b) to standardize data across contexts c) to do it in a cost-effective way across larger populations. There are other problems: first of all, it is difficult - ethically - to work with "control-groups" in schools, i.e. to deprive parts of a population of an intervention that is perceived as beneficial - or to blind students (i.e. submit them to an intervention they, or their parents are not made aware of). Secondly, the number of subjects in a classroom, the diversity of the subjects (socio-economic background, moods, interpersonal dynamics etc.), and the variance in attendance (due to absences, illness etc.) together represent a large variability that multiplies the complexity to a degree that make it extremely hard - not to find correlations - but to establish causality. Thirdly, the effect of the teacher (or the learning environment) in potentially priming students is very difficult to control, - e.g. when introducing them to a test (by generating excitement, boredom or antagonism that affects the performance). This often has the effect that studies revert to surveys of *perceptions* - but it is equally difficult to ascertain causality between how a student feels about something (e.g. how engaging a pedagogy was experienced, how nice the teacher was etc), and the value of the teaching, or the value of the learning - at least not over time. I am not aware of any studies, providing ironclad evidence that a strict, demanding teacher is detrimental to learning - nor the opposite. The same goes for didactic setups: it is not possible to provide evidence for the superior effects (cross-contextually) of group work, lectures, blended learning or the like. This of course means, that RCT-generated knowledge become very difficult to transport to the political domain - whose attention is directed towards generic, and general knowledge about "what works", that can be rolled out nationally. Policy seeks to justify the *general* benefits of legislation. This is the crisis: not that there is no evidence of positive outcomes when using ICT in education (plenty of studies document beneficial effects in specific settings), but that these are worthless if they do not translate to national indicators - the most valuable metric at the state level, again, if they can not be replicated in different contexts.

I will, end this chapter on RCT in education, with a laconic statement about educational research, expressed by Benny Karpatschof (Karpatschof, 2010, my translation):

"*One of the domains, where we often meet the Hawthorne-effect, are in pedagogical experiments, that try out new ways of teaching. Here, it is often said, that pedagogic experiments always work the first time. This special version of the Hawthorne-effect is so widespread, that it to some degree has undermined the confidence in pedagogical experiments. A methodological antidote, is to repeat the experiment, until it loses its news-value*." (p. 70).

### 1.6. Concluding the background chapter

The aim of this first background chapter (based on Neil Selwyn and an account of evidence-related issues), has been to present the reader with dominant theories of pedagogy, and how they have influenced digital theories of learning. Dominant schools of thought within pedagogy have been described: Behaviorism, cognitivism, constructivism, socio-cultural theories of learning and connectivism. Each of them encapsulates a distinct perception of the subject's role in learning (often described in levels of activity). The behaviorist subject is passive, in the sense that it is practically reduced to a cybernetic-like response-system, which learns facts through punishment and reward-systems. The subject does not contribute actively with anything else than her nervous system, her memory and her capacity to gradually learn from mistakes. Resources like personal reflection, engagement, social background, feelings etc. are not contributive factors in behaviorist theory of learning. But we also saw that there is a degree of acceptance that it is a theory of learning that is perhaps suitable for the acquisition of certain types of basic knowledge acquisition. Often it is a didactic practice that assigns a crucial role for learning on the technical infrastructure around the subject, in the shape of interfaces and feedback systems. We exemplified current behaviorist systems in the gamification trend.

Cognitivism puts more faith in the active subject and his ability to *reflect* on experience: the subject is released into a (often simulated) world, can contribute to the learning experience by experimenting, choosing to make mistakes (deliberately crashing an airplane in a flight-simulation program e.g.) following impulses, and learns by inputs from an intelligent tutor, that compares learning activity with desired activity or knowledge. In this

philosophy of knowledge, the subject is more active in the sense that it requires engagement - it is in the subject's reflection on invested time used to gather experience, coupled with evaluation from the more-knowing tutor, that learning happens. We exemplified current cognitivist systems with simulators and adaptive learning systems.

In constructivism, learning departs from, and in many instances is restricted to the subject. There is very little knowledge *out there* that some instance, authority or system has the responsibility to convey. The role of the infrastructure outside the subject is paradoxical - it has to offer stimulating environments - but get out of the way as soon as possible. The subject is highly active, and the subject is a richer entity than in behaviorist and cognitivist anthropologies. Apart from the brain, the subject consists of a will to learn, a recent history of personal experiences, an inherent will to create equilibrium, to explore, to play - often in environments where bodily activities with multimodal learning artifacts (the computer) become valuable learning resources. The learning lab was used as the most illustrative example of current materializations of constructivist theory.

In socio-cultural theory, the subject is also very active - or is required to be - when it comes to engagement with the multitude of social dynamics that she is embedded in. In socio-cultural theory, the subject is constantly active in negotiating social identity in social networks (analogue or virtual), and is an active contributor to the same social networks. "The social" includes the teacher or the educational institution, and in contrast to the most radical constructivist theories, the teacher plays an important role in pointing to resources, and planning proximal zones of learning. The active use of social networks, the encouragement of integrating the pupils or students' social media profiles and a respect for media-habits' impact on identity formation becomes a concern.

Finally, connectivism operates with an ideal of a highly active subject, whose potential for learning is defined by his ability and willingness to connect to, build, and understand networks and their dynamics - because it is in the network that knowledge resides. The phrase "learning to learn" is used as shorthand for learning to find knowledge resources, and orientate the subject towards nodes in the network where knowledge is being created - and tends to imply that the incorporation of "substance" or "content" is irrelevant. It is partly made obsolete by databases (like Wikipedia) on the network, but also by the constant new configurations of facts and knowledge.

### The relationship between evidence and pedagogy

In the introduction to the notion of "evidence", we presented technical issues relating to the production of evidence, often through statistical analysis of data collection. It served the goal of equipping us conceptually to the empirical analysis later. We also described the political case made for research-based evidence, and the imagined benefits that it creates: A perception of a more objective knowledge foundation (than the one that individual teachers or administrators possess), better justifications for political remedies, transparency, creating structures that support freedom of choice and means of aligning professional groups towards political goals. We have also seen, that there is a substantial risk of reaching the wrong conclusions due to bad research design, or not accounting for context and potential bias in the data. It is also important however to understand that - applied rigorously - RCTs tend to produce "non-significance", or null-effects, much more often than other methods. Maybe we should not be surprised by the amount of studies that cannot deliver the evidence. Most importantly however, finally, is to understand - in the light of cost-effectiveness - that significance or evidence often are used to describe *small effects.* This is where political judgment should be exercised: what are the effect-sizes we are looking for, at what price? If it - in average - only produces a 7% increase in correct answers in a math-test e.g., is it worth the investment? Could the same evidence be produced by other means?

The presence of a variety of different pedagogies embedded in learning software complicates the evidence debate considerably. The synthetic meta-studies described earlier, do not seem to take this reality into account, and it undermines their findings if they aggregate studies that on one categorical level deals with "computers and education" but on another level in fact are aggregating constructivist and behaviorist pedagogies at the same time. They are incommensurable. They focus on different aspects of learning and produce different outputs.

As one might have expected, evidence is not just evidence (i.e. something that requires little explanation, doesn't need justification, clear for all to see). It is a concept that is embedded in history, originates in specific scientific domains, operates with a set of background assumptions that are not always divulged, has different implications in different situations, and is used strategically (highlighting some aspects of evidence, while downplaying others) for varying political purposes - that often translate scientific "facts" into actionable policy in

ways that are not at all evident. Thus, "significant effects" are used as a form of "evidence" that provide the justification for policies (that are generally accepted), can involve rationalizations, may rely on tacit assumptions, and depend on a range of ideals, or support-factors that can not be taken for granted - which might explain the prevalence of the non-significance phenomenon.

## 2. Literature review

We will now shift our focus from fundamental contextual reflections, to a review of the literature that deals with education and ICT. Any account of scholarly research and background theories that have educational ICT as its analytical object is bound to be incomplete: the field is vast and productive, and it would require several lifetimes to read the entirety of the literature. This poses a serious challenge, as does considerations of how one should categorize the different domains that produce knowledge about the effects of educational ICT. It is literally impossible to get the full overview of the different instances of educational ICT (be it devices, platforms, software) that are being observed, measured or evaluated; the amount of academic disciplines engaged in the field (sociology, economics, humanities, political science or "digital subsets" of those disciplines: techno-anthropology, digital humanities, digital sociology, digital pedagogy, artificial intelligence, neuro-linguistics ad nauseam) is an equally intimidating task. Finally the different foci of their investigations (learning attainment, well-being, creativity, employability, coding skills, digital literacy, co-operative skills), and the different methods used, encourages the researcher to abandon the project altogether. The purpose of the following background section is to identify scholarly and scientific theories, discoveries and debates relevant to our topic. As will become apparent, educational ICT has been the object of scrutiny by many different fields that in turn have produced many valuable studies. It is impossible to cover them all. To narrow the field, while hopefully maintaining relevance, I have established three criteria to select and present them with.

*Actuality*: I only present theories or scholarly domains that are thematically engaged with educational ICT. This rules out background philosophy, theories and scientific paradigms that could go all the way back to Greek antiquity, and whose theoretical frameworks contribute a lot to the phenomenon. This means that the presented theories are of newer date - coinciding with the emergence of the phenomenon of using computers in education itself. I will of course mention intellectual background figures and traditions whenever possible.

*Angle:* Theories and research are read and described from the perspective of their affinity or relevance to evaluation. Some of them are directly engaged in the evaluation of the effects of

educational ICT; others are included to the extent that they qualify perspectives on evaluation.

### Two scientific domains:

The two criteria are helpful in creating a manageable body of relevant contributions, but it is necessary to introduce a third criteria, to determine the order in which I will describe them. To that effect, I have chosen to divide the relevant research by their affiliation to two different, well-known paradigms. They echo a well-known divide between the empirical sciences (physics, medicine, biology e.g.) and the human sciences (arts, humanities, the interpretive sciences). This is a divide sometimes described as a dichotomy between "two cultures" (Snow & Collini, 2012), and is the frequent locus of intense debates (illustrated by the science wars (Guillory, 2005), or by the debate between Searle and Derrida (Raffel, 2011)) and many other tectonic tensions underpinning various disputes in academia. On the methodological level, it often goes under the distinction between qualitative and quantitative methods. In the educational sphere, this is obvious in actual discussions about the role of humanities in the new digital age, the perceived, increased need for more programmers, or opinions that schools should prioritize STEM (science, technology, engineering and mathematics) over creative subjects, etc. For our work, I choose the categories "realist" and "anti-realist traditions" (or positions), also described as the methodological gulfs between analytic philosophy and continental anti-realism, respectively. This distinction may appear crude and simplifying - but it spans a number of important categories that relate to various scientific positions, and ultimately to foundationally different approaches towards learning and computers. I suggest that we spend some time bringing those forth, in the hope of loading our analytical apparatus with crucial differences and focal qualities.

## A dichotomy

Above I suggested that many scientific and philosophical debates could be understood in the light of camps in an antagonistic relationship with each other. This is the result of a development of western philosophy and science, according to "A thing of this world" by Lee Braver (2007), and can be described as the bifurcation into branches of analytic philosophy and continental philosophy. For much of the twentieth century, "the level of engagement between analytic and continental thinkers has rarely risen above mutual disinterest, uniformed dismissal, or plain insult" (p.4). This bifurcation mirrors the split into rationalism and empiricism in the 16th century. It started with Descartes' commitment to discern reason's ability to determine facts about reality *a priori,* and Leibniz's deductive reasoning about how God must have set up the universe. On the other side, out of Hume and Locke grew the idea that there is no rationality, "*our beliefs are determined by an arational reflex, a process that has roughly the epistemological status of digestion.*" (p. 3).

In this account, Immanuel Kant became the figure that - at the time - reconciles these two positions, "*weaving a seamless system out of ideas taken from both sides*" (p.3). Kant's Copernican Revolution was the epoch-making claim that the mind actively processes or organizes knowledge, rather than reflecting an independent reality. The mind "*is more like a factory than a mirror or soft wax*" (p. 36). This proposition alone has fundamental bearings on what it means to learn, and what knowledge is, technologically mediated or not. The introduction to Kant is for Braver, the starting point of his project to translate (the value of) continental philosophy to analytic readers, and he does so through essays on Kant, Hegel, Nietzsche, Heidegger and Foucault. It is not my project to repeat Braver's project - i.e. to reconcile different factions in the sciences that study learning and technological support of it - but to adopt his realism and anti-realism matrices, i.e. foundational categories to make concerns in both camps relatable. Braver divides this history of antagonistic philosophies into six different categories of dualities, that relate to independence and mind-independence, correspondence and rejection of correspondence (of language's relation to the world), uniqueness and ontological pluralism, bivalence and rejection of bivalence, passive and active knowing, realism and the subject & the plural subject. The reason for introducing the matrix is its relevance for understanding different scientific positions on the subject, knowledge and learning (without which it is not possible to discuss our topic), but also to make the claim that

education, today, has become a battlefield for disputes on the meaning of the subject, knowledge and learning. *Grosso modo*, one can say that in the post-war period until the early '80's, education (in Scandinavia and Denmark at least), lived a relatively harmonic existence, dominated by certain (Kantian and German) pedagogical schools of thought, and where the realist, scientific paradigm was encapsulated in subjects taught, but not discussed as *the* mode of organizing education. This changed with the arrival of computers. Computers and digital technologies have disrupted the situation, to the extent that educational thinking is increasingly imagined as "analytic" technical systems. This situation is afforded by the potential of new technologies to collect and analyze data.

In simpler terms, the cluster of sciences that evaluate, speculate or are engaged in educational ICT from the realist position are united by a set of axioms (or assumptions) that scientific studies can say something (stable) about both technology and human psychology. These sciences can be hierarchized on a taxonomy of complexity, ranging from the more or less simple act of counting the number of physical devices in the world (how many schools have access to the internet?) to more sophisticated theories of how the brain works - and how technology can support or enhance mental processes.

It is not the intention to remain loyal to this divide, but it serves as a useful starting point. As will be clear later, it constitutes a necessary first step to interpret the perceived value of the computer, the Internet and digital devices in education. Their success, is my intuition at this time, to a large degree contingent on the industry's ability to dissolve, obfuscate, confuse (or bridge) this otherwise classical divide between the predictive sciences on one hand, and humanistic traditions on the other. The computer - on the surface - presents itself (or is often described as) as a historically new type of artifact that is not burdened by the dichotomy and the history of its conflicts. To which extent this is true, or whether the computer can be analyzed as an instrument in the service of agents (in conflict) on one side of the divide or the other, will hopefully become clearer for us at the end of this chapter.

The first part of the literature review, is an overview of the realist, i.e. positivist, rationalistic and scientific studies of computers in education - including economical and statistical studies. The second part creates an overview of the sociological, interpretative and phenomenological studies of the value of computers in education - including pedagogy, pedagogical philosophy and more recent research collectives like STS, new materialism and post-phenomenology.

Both perspectives and traditions have a longer and richer history than one might anticipate - the reader will be asked to trust that state of the art theories, key discussions and dominant frameworks will be communicated diligently, and based on thorough orientation in the literature. Each perspective implies, affords or subscribes to different theories of learning (or pedagogies), assigns different roles to the learning subject, which ultimately impacts on how learning attainment is assessed (if it should be at all). Whenever possible, we will link these foundational, philosophical and scientific issues to current learning technologies. This is to make the point that these ideas are not abstract, theoretical issues restricted to academia, but ideas that are technologically embodied in artifacts, that thrive on the educational marketplace and in the classrooms of today.

## 2.1 Realist Studies

By realist studies, I understand studies that have emerged from the field of philosophy and the sciences that can be described as adhering to empirical, positivist, analytical, and/or rationalist traditions. These are scientific traditions that are often described as "scientific realism", often contrasted to "continental", antirealist schools of thought. These in turn can be represented by variants of phenomenology, hermeneutic philosophy and existentialism, just to name a few (see next chapter for a more in-depth description of antirealist schools of thought). Scientific realism is "*typified by an epistemically positive attitude toward the outputs of scientific investigation, regarding both observable and unobservable aspects of the world*" (Chakravartty, 2011). In other words, it is a position that claims that there are some things we can know about the world. What we can know is mind-independent (i.e. exists independently of an observer), it can be described in bivalent values (either it is true or not) and is founded on the view that there is a correspondence between language (thought-signs) and the external world. Scientific realism has been the foundation for scientific progress in many areas, fields like physics, mathematics, chemistry, medicine, biology, etc.. They have all achieved remarkable insights into the inner workings and mechanics of physical phenomena by facilitating "*empirical predictions, retrodictions, and explanations of the subject matters of scientific investigation, often marked by astounding accuracy and intricate causal manipulations of the relevant phenomena*." (do.), in other words: *evidence*.

It is a school of thought that has expanded its' interest into areas formerly dominated by anti-realist positions: psychology (in the form of psychiatry and behavioral economics), pedagogy (in the form of neurology and learning sciences), sociology (represented by big data analytics) - domains that could be described as being *cultural* rather than *physical* and for many critics of the scientization of the social domain - not directly understandable through realist methods.

This is of course a gross simplification of several centuries of scientific history and progress, but is introduced to reflect on the use of the concept of evidence in education. At the core of scientific realism are concepts of prediction, replicability, and causal explanations. Scientific experiments that can produce knowledge to predict future events are of interest to instrumentalist, political concerns: the knowledge that interventions - based on sound scientific principles - can guarantee certain outcomes that are instrumental to a political project. The question that interests us, is how scientific realist methods can produce evidence in education, and how this relates to policy-practice: how is learning (or teaching) identified as something that exists, as a physical entity that can be analyzed and experimented with, that can be augmented, guaranteed, replicated - perhaps even with "astounding accuracy"? How are eventual causal effects of ICT on the improvement of learning processes studied?

## Critical RCT-studies

In the chapter on evidence, there was ample opportunity to look at realist studies. In the following I will describe OECD's PISA (highly affirmative of both the evidence-regime and digitization), followed by an introduction to RCT-based research that is critical of ICT in education.

## PISA

The most well-known and probably the most ambitious example of attempting to provide objective, realist evidence of learning at a global level, is undertaken by OECD's programme for international student assessment (PISA). It has been successful in setting the agenda on how learning should be measured, and policy developed - attracting scrutiny from many different sources. The PISA undertaking is "a well-funded multinational techno-scientific machine - undoubtedly the world's largest empirical study of schools and education..." and "....the results have become a global gold standard for educational quality" writes Svein Sjøberg (Sjøberg, 2016, p. 103), who also describes how it has become common sense that "high scores on PISA reading, mathematics, and science are predictors for the country's future economic competitiveness" (p. 102).

The concrete test-format is described by the OECD as "International large-scale assessments" (ILA). To properly understand PISA, it is necessary to describe the institutional framework from which it springs, namely the OECD. In it's own words, OECDs "goal is to shape policies that foster prosperity, equality, opportunity and well-being for all."[11] This is done by "establishing international norms and finding evidence-based solutions to a range of social, economic and environmental challenges" (do.) and it considers itself a "unique forum and knowledge hub for data and analysis, exchange of experiences, best-practice sharing, and advice on public policies and global standard-setting." Despite its considerable influence on policy, the OECD doesn't describe itself as a political institution, but as a "knowledge hub", offering advice and providing data on international standards. OECD is committed to a global,

[11] http://www.oecd.org/about/

competitive free-market economy, with an emphasis on reducing barriers for trade, to the stimulation of competition, and to a range of transnational concerns. OECD has, according to (Korsgaard et al., 2017) been an influential institution in transnational educational policy. It has, in a series of reports and whitepapers introduced and advocated for key terms like "competence" and "lifelong learning", to describe new and increased demands to the workforce of the future. According to the same authors, it has been a key player in a focus shift from *input* (what is important to learn) to *output* (how we measure learning), and a shift of focus *away* from national history and traditions (i.e. pedagogy formulated within the frame of national traditions) to *globalist* concerns.

Aligned with those goals, "PISA is a large scale attempt to give guidance to all "stakeholders" in education", by assessing students' "knowledge and skills for life", and for providing knowledge on "Learning for tomorrow's world" (the title of the Pisa 2003 report). The PISA-test itself consists of testing 15-year-old students from all over the world in reading, mathematics and science, every three years. "The tests are designed to gauge how well the students master key subjects in order to be prepared for real-life situations in the adult world."[12] The tests themselves are not made public, but samples can be accessed on their website. They are a combination of multiple-choice questions and "questions requiring students to construct their own responses." Tests take 2-hours, are deployed via computer, and include a background questionnaire, seeking information about the students themselves. Furthermore, school principals, in the 2015 test, completed a questionnaire that covered the school system and the learning environment[13].

To maximize use of the allotted time, the assessment materials are bundled into several 30 minute 'clusters' within each domain, and individual students are randomly allocated four of these in the form of two pencil and paper test booklets. Besides its status as a leader in attempts to quantify and compare learning internationally, PISA interests us for two reasons: the deployment itself (which has now become a computer-test), and how data from the background questionnaire in 2015 (that included questions on computer use) resulted in the

[12] http://www.oecd.org/pisa/

[13] https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

report "Students, computers and learning" - which will be treated extensively in the empirical section of this dissertation. For a critical discussion of PISA, its methods and the effect of the PISA-test on the practice of educational policy making see "Knowledge and skills for PISA - assessing the assessment"(Bonderup, 2007), "Is the foundation under PISA solid? A critical look at the scaling model underlying international comparisons of student attainment."(Kreiner, 2011), "Policy effects of PISA"(Baird et al., 2011).

### Critical RCT-studies, cases

One might get the impression that RCT-studies in principle are *affirmative* of the project of digitizing education (and that phenomenological, humanistic, anti-realist schools of thought in principle are *critical* of the project of digitizing education). This is neither a correct, nor a fair assumption. There are numerous studies - on the basis of RCT studies - that conclude that different devices used in the field of educational ICT - mobile phones, apparatuses, apps, software products or social media platforms - produce *negative* learning results, or have detrimental effects on psychological well-being in students and young people (that indirectly could affect their learning negatively).

From the public debates about the intrusion of the mobile phone and social media into schools and the classroom, emerges a body of research that has become a cause for alarm for many actors in and around education. In the following I will draw forth three instances of reports that aim to synthetize or create an overview of the different studies that show negative results.

### Case 1: Learning and Technology Options

The first is a report commissioned by the European Parliament in 2015 (Pastor & Quirós, 2015), "Learning and Technology Options", published by the European Parliament Research Service. On page 14 of the report, negative reports are summarized (quoting the neurologist Manfred Spitzer):

*"Some of the concerns raised by researchers and academia are as follows (Spitzer, 2012):*

*· Reduction of concentration capacities and ability to think deeply (generate wisdom)*

*· Diminution of memory*

*· Decline of the quality of personal relationships (generation of superficial relationships)*

*· Generates risks associated with cyber mobbing and bullying*

*· Risks of technology overuse: addiction*

- *Sleep disorders*
- *Anxiety/depression*
- *Increase of sedentary habits (health related problems)*
- *May increase aggressive behaviours*

*In the cited neuroplasticity studies, researchers argue that the negative effects of ICT particularly influence the cognitive development of infants and young children. The cerebral deterioration caused in the long-term by the intense or excessive use of digital technologies and the Internet is known as "Digital Dementia". The term was coined in Korea in the 1990s and popularised by Dr. Spitzer in 2012; it describes how digital technologies are atrophying our brains because they are limiting the way we use them (Spitzer, 2012)."*

This excerpt references Manfred Spitzer's book "Digital Dementia". Manfred Spitzer is a psychiatrist, psychologist and neuroscientist. He is Medical Director of the Psychiatric University Hospital in Ulm, Germany, and founder (2004) of the Transfer Center for Neurosciences and Learning (ZNL). In the book, he expounds on the many different issues cited above - often based on neuroscientific studies, i.e. studies where the source of data comes from brain scannings, medical studies and other types of RCT-studies. Spitzer's main claim is that the aggregate effect of the observed effects in the different studies is to *accelerate dementia* in the population - that intense screen use takes time from activities that strengthen brain-functions (i.e. activities that ward off dementia until old age).

### Case 2: ICT in Education: Fundamental problems and practical recommendations

The other report is from business professor Tom Butler (Butler, 2015), a critical exploration of "the intended and unintended consequences of ICT in education". Butler's approach is, like Spitzer's, neurocentric: "*Recent research on ICT in education indicates no broad improvements in learning outcomes despite decades of investment and advances in EdTech. The nub of the issue is that the affordances of ICT are not aligned with the way in which the human brain functions.*" (p.1). The paper considers studies from cognitive psychology, neuroscience and the educational sciences, and Butler highlights observed problems like sleep deprivation (causing negative impacts on learning capacity, and associated to obesity), disruption in the classroom (due to distractions from social media and mobile phones), the inferiority of screens compared to paper in relation to reading competences, how taking notes on paper leads to superior learning outcomes, internet addiction and more.

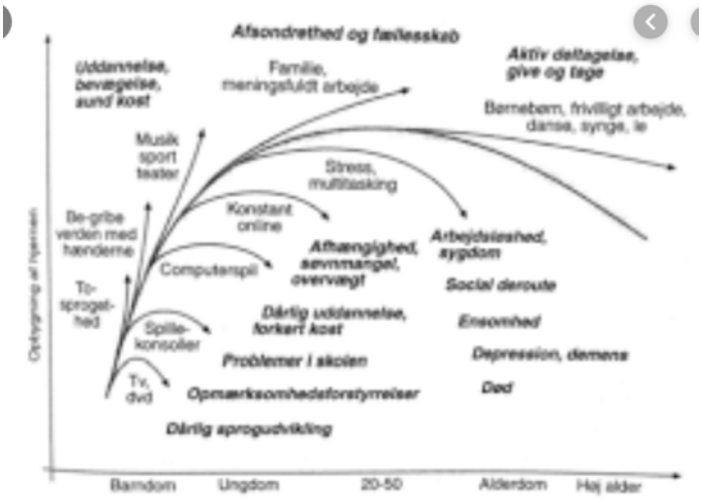



Fig. 14.1 Opbygningen af hjernen gennem hele livet. Opadgående og nedadgående kurve (fremhævet i grå), positive og negative faktorer.

**Figure 2 - Manfred Spitzer's illustration of his theory of digital dementia**

Butler and Spitzer's reviews are not systematic reviews, in the sense that they systematically assign a commensurable value to each scientific article, in order to rank them in order of effect-size, but are *syntheses* of their literature review, on the basis of professional judgment.

For some it is a great source of confusion that the modernist, scientific project towards enlightenment through technology, and the critique of the modernist project tend to get associated to distinct scientific and academic domains. This confusion obfuscates valuable analytical distinctions for researchers and for educational practitioners alike. The interesting

thing however, is how political institutions interpret, absorb or implement the result of evidence-based critique (or problematic results) into policies. When is the critique - based on a given study - regarded as a fruitful addition to the advance of societies through technology, and when is it regarded as *adverse* to the project of advancing society through technology? In this respect, the realist-antirealist distinction cannot be used as a predictor: many antirealist, social-constructivist studies e.g. adhere to, or are appropriated and communicated as affirmative of the project of digitizing education (ever more), and on the other side the results of studies from realist traditions (e.g. neuroscience), can just as well be interpreted as a threat to the project. The neuro-scientific domain has produced an abundance of studies on the effect of excessive screen-time on infants, children and adolescents, effects that often lead to the conclusion that they threaten commonly accepted goals of education: to read (Wolf, 2019) and write, to think critically, incorporate knowledge, to achieve physical fitness etc. These studies have started debates that often prompt politicians to regulate children's screen use, in and outside schools - but play only a minimal role in our extensive corpus.

## 2.2. Anti-realist studies

The second side of our matrix contains qualitative studies, or research fields that have emerged from a continental tradition. In Bravers' matrix the continental tradition is explained by the categories on mind-dependence, rejection of correspondence, ontological pluralism, rejection of bivalence, active knower and plural subject.

### Discourse analysis/Network analysis

The first type of analysis I want to invoke, is the discourse analysis and/or the institutional network analysis. I bring these two methods together deliberately, as their methodological considerations overlap in important areas. This analytical perspective has a lineage with the anti-realist tradition to the extent that it focuses on how truth is produced discursively, and how institutions create and maintain legitimacy through language. The network analysis is focused on just that - how networks are "held together by subscription to a discursive ensemble, which circulates within and is legitimated by these network relations". (Ball, 2012, p.10). The "*what works*" angle, in these type of analyses, is not concerned with learning attainment, but with the effectiveness of discourses to manage how education should be designed and planned *through* educational ICT (and perhaps even how a focus on "learning attainment" support this goal). In this optic, educational ICT can be understood as the proxy, the means or the Trojan horse for a political project that is not immediately transparent (or formulated explicitly) in the advocacy of it. The possibilities and potentials of educational ICT are used instrumentally to further specific actors' (sometimes vested) interests - and the language used around educational ICT should be understood in the light of distribution of power or power struggles. The discourse analysis analyses language as a social practice determined by social structures - and how these are "ideologically shaped by power relations in social institutions and in society as a whole" (Fairclough, 2015). On a philosophical level there is, of course, profound epistemological issues at play in this school of thought, in a manner that flies in the face of perceptions of the objective value of data, e.g. collected through digital devices - as it is often promoted by team realist. From a discourse-analytical point of view, PISA and national tests for example are promoted as projects to create more knowledge about effectiveness in education, but should be understood as a tool to take control over what counts as valid knowledge - and how one obtains that knowledge. Which of

course has consequences on who is delegated the task of managing education, who is excluded from it, and so on. Or in other words: Just like the history of educational ICT, the "history of the West cannot be disassociated from the way in which "truth" is produced and inscribes it's effects". (Braver, 342) The philosophical source of discourse analysis, and investigations into how language produces truth (instead of merely *reflecting* it), is Michel Foucault. A discourse, in his explanation is "the set of discursive or non-discursive practices that makes something enter into the play of the true and false, and constitutes it as an object for thought" (whether under the form of moral reflection, scientific knowledge, political analysis, etc.)(Michel Foucault, interview with Francis Ewald, 'The concern for truth', Le Magazine Litteraire, May 1984, pp. 456-57). I will assume the work of Foucault is known to the majority of the readers - I will not spend any time communicating his philosophy, but jump straight ahead to discourse studies of educational ICT.

### From a hierarchical state to network governance.

> *"The hierarchical model of government is in decline, pushed by governments' appetites to solve ever more complicated problems and pulled by new tools that allow innovators to fashion creative responses. This push and pull is gradually producing a new government model, in which executives' core responsibilities no longer center on managing people and programs but on organising resources - often belonging to others - to produce public value. We call this trend 'governing by network'". (Eggers, 2008, quoted in Ball(2012))*

As the quote above indicates, the concept of "network governance" is understood as a shift away from a previously dominant state-government model, hierarchical in nature, focused on managing people, to neo-liberal governance and its' advocacy and dissemination of 'private' an social enterprise solutions to the 'problems' of state education. Stephen Ball suggests that policies - in contrary to policies emanating from the modes of governance in the nation-state - "move through, and are adapted by, networks of social relations or assemblages (see below), involving diverse participants (see below), with a variety of interests, commitments, purposes and influence, which are held together by subscription to a discursive ensemble, which circulates within and is legitimated by these network relations." Solutions are fuelled by a neo-liberal imaginary sustained in "intellectual, policy, and practitioner networks that under-pin the global expansion of neo-liberal ideas, and their subsequent manifestation

in government policies and programmes" (Larner, 2003, quoted on page 4). These networks need to be traced, as does the mobile and fluid nature of their configurations. For Stephen J. Ball, this affords the use of a method that "is set within a broad set of epistemological and ontological shifts across political science, sociology and social geography which involve a lessening of interest in social structures, and an increasing emphasis on flows and mobilities (of people, capital and ideas e.g. 'policies in motion') (Ball, 15). The characteristics of this emerging form of policy, can, again, be described in neo-liberal terms, characterized as "a specific form of rule that governs at a distance through norms of efficiency, agency and accountability" (Ball & Junemann, 2012, p. 4), and "the governing of populations through the production of 'willing', 'self-governing', entrepreneurial selves" (Ball, 2013, p.3)
So: network governance is a new form of exertion of political power, best graspable through a analytical method that is geared towards grasping the heterogeneity of private and public actors, in assemblages that are fluid in nature. If we want to understand how educational ICT is advocated - and the effects of this advocacy - it is not enough to study classic and well-known institutional structures embedded in the state apparatus (ministries of education etc.) - but to map the ensemble of discursive actors, their relations, and of course their concrete, discursive products: reports, white papers etc.

In Stephen J. Ball's case, this leads to network mappings that are richly complex and that divulge an overwhelming number of actors, representing a variety of interests, related in a myriad of ways. What these models tell us is that the *site* of policy production has indeed shifted from the national parliament (or the ministry, or the government offices), and that the neo-liberal project of including private actors has been hugely successful. In Ball's and Junemann's view, this spells the end of state-managed education. There is a new dispositif in place, that can be described in four sorts of related changes:

1) The change in systems and governments (its systems and structures) (p.141)
2) The form and the type of the participants in processes of governance (do.)
3) In the prevailing discourses that flow within and articulate governance (do.)
4) In the governing and production of new kinds of 'willing' subjects. (do.)

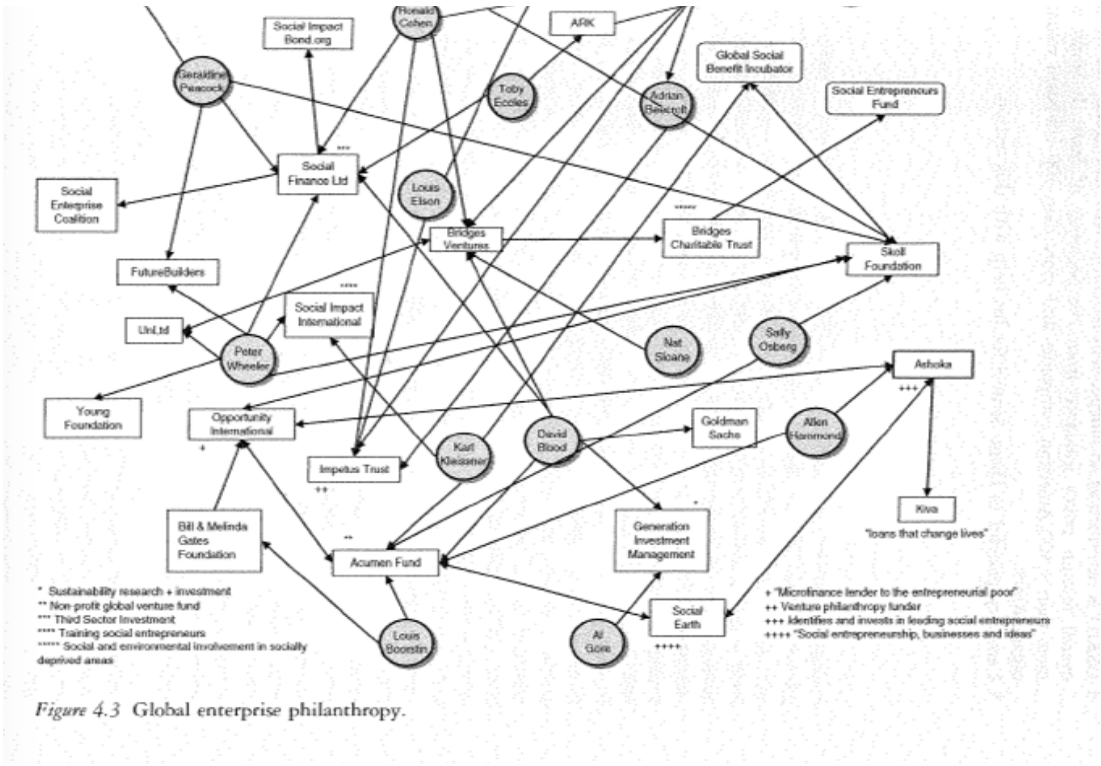



*Figure 4.3* Global enterprise philanthropy.

**Figure 3 - network mapping of global enterprise philanthropy (Ball, 2013)**

### Big Data and Education

In "Big Data and Education", Ben Williamson (Williamson, 2017), undertakes an analysis of the concept of Big Data and Education, its semantic and rhetorical uses and its manifestations, that produces interpretations echoing some features of Ball's analysis, though the focus is narrower. For Williamson, Big Data - besides a functional concept - represents a turn in governance - and the central point of his investigation is how "a set of powerful animating visions or imaginaries of education" underpin these developments. For Ben Williamson, education policymaking processes "have been transformed by the collection, analysis and use of data"(Williamson, 2017, p.66). Data-collection technologies have been the catalyst for ambitions around data-driven educational policy and "how data-based software platforms, infrastructures and projects are increasingly being stitched on to the kinds of policy work that governs education systems" (do.). Technological imaginaries have been woven into political objectives and projects. Williamson quotes an independent review of Scottish education, carried out by the OECD: "*We must move from a culture of judgement to a system of judgement*". This system, in the review, contains a routemap of 12 steps, among them 1) to escalate standardized assessment 2) to gather data about academic progress 3) to produce key performance indicators on employability 4) greater performance metrics and measurement of schools 8) the use of visual dashboards. These steps, of course, afford the use of digital technologies and techniques of data collections. For Williamson, this is not only a series of new technical interventions, but also a "governance turn", a redistribution of authority, from the teacher and government agencies, to a wider array of private sector and civil society organizations: think tanks, entrepreneurs, consultants, policy innovation labs and independent experts. The use of analytics for governance is not a new phenomenon, known from census recordings of health (going back to the 19th century), health and crime monitoring, and other instances where "numbers are used to define the problems that government might seek to to solve and inform the projects devised to do so." (p.70) Statistical systems are a major technique of understanding reality and acting on it. The important difference however - is my reading - is the radical "forward-turn" in policy development that has been happening in the last decades, fuelled by speculation. Big Data suggests an increased belief in evidence, and a vision for rich, new sources for data that can serve evidence claims. But the success of the movement is based more on perceived benefits down the road, than valuable knowledge obtained in the (recent) past or startling success observed with new

data-practices as the result of increased access to data today. He quotes the US Center for Data Innovation: "*U.S. Schools are largely failing to use data to transform and improve education, even though better use of data has the potential to significantly improve how educators teach children and how administrators mange schools*" (p. 10). The think tank argues that a data driven education should achieve four main goals: personalization, evidence-based learning, school efficiency and continuous innovation. A backward-looking stance reveals, that until now, big data, digitization and trends in evidence-based education, have not succeeded in bridging educational gaps and raising general learning attainments, instead we can observe worrying divides between the highly educated and the less-educated: Brexit, the election of Trump in 2016 and the "post-truth" era, phenomena fuelled by Big Data and social media, that play an influential role in shaping public opinions, have rather led to a general "mis-education". This is a new problem space that education and research should engage in, rather than speculation, potential and imagined benefits, or what he calls "utopias of unrealism".

*"Education has long reinforced these utopias of unrealism. Contradictory policy demands over the last two decades have pointed simultaneously towards an education for the future of high-skills, globalized knowledge-economy and an education of the past which emphasizes traditional values, national legacy, social order and authority (Ball 2008). Social media algorithms and architectures have further enabled these utopias of unrealism to embed themselves across US and Europe. The mis-education of democratic society by the public pedagogies of big data and social media is being enabled by algorithmic techniques that are designed to optimize and personalise people's everyday experiences in digital environments. But in the name of personalization and optimization, the same techniques are leading to post-truth forms of political mis-education and democratic polarization." (p. 203)*

I have allowed myself to quote Williamson at length here, because he performs an important change of perspective, a zooming-out, so to speak, and points to the importance of analyzing the relationship between, not only education and society, but the possible relationship between societal developments and certain algorithmic and big data techniques, that are also put intensively to use in education.

This creates a need for new agendas for critical educational research: digital sociology, critical data studies and software studies, and a more sustained focus on 1) the political economy of schools and technology 2) the management and governance of schools through accountability and performativity mechanisms associated with digital data 3) the digital labor of schools and schooling 4) the digital surveillance of schools and schooling (p.

203-204). As is apparent, Williamson and Ball analyze educational ICT from an anti-realist perspective - i.e. their approach operates with notions of active knowers, mind-dependent subjects, and it rejects bivalence. Their analysis, however, is not directed at the learning subject within the confines of the educational institution, but the political subject that shape the educational institutions, how its' language forms reality (instead of mirroring it), and finally that the analysis is not finite - the permutations, reconfigurations, and the unexpected results of policy need to be followed in a continuous process.

### Rationalism?

Above we looked at methods that describe the network framework within which governance formulates its educational theories. Many of these are underpinned by economic theories and political theories that operate with assumptions of the subject as motivated by self-interest, and thus governable through incentives and sanctions, and through designs directed from outside the subject (the government, the school, the algorithm, nudges). This led to the explanation that the dominant paradigms of neo-liberalism of today have embraced digital technology in a positivistic effort to quantify human behavior - in order to be able to understand and predict the human at more and more fine-grained levels - through a corollary and increased expansion of data-collection methods. This culminated in current theories, models and deployment of predictive analytics, and through the works of Ben Williamson and Stephen J. Ball, we witnessed how rationalistic conceptions of the learning subject, are foundational for data-scientific practices that manifest themselves through concrete products marketed to the educational sector: IBMs cognitive learning systems, the IT-systems supporting the Danish system of goal-orientated pedagogy, learning management systems, Pearson's AIed program etc. One of Selwyn's four pedagogical theories - behaviorism - fits hand in glove with this rationalist paradigm. Williamson also made us aware that modern behaviorism takes on more subtle forms than Skinner's "teaching machine", i.e. behaviorist logics are not bound to an apparatus within the confines of a school or educational institution, but can be embedded in legislation and systems (grades, best-practice policies, comparative indexes) *around* the individual, and the physical school.

### Ethnography

In 2017 Christo published "Disruptive Fixation" (Sims, 2017), a landmark ethnographic study of The New School in New York. It is a remarkable account on "how a technologically cutting-edge philanthropic intervention - in this case, the attempt to redesign the American school for the twenty-first century - ended up mostly remaking the status quo, as well as its problems." (p. xiii). Sims' work is not about "evidence" but gives an in-depth account of the mechanisms that cause a disruptive project to fail, by gradually reverting to status quo - which, I will propose as an anti-realist parallel to the "non-significance phenomenon". In his book Sims tries to ask questions that may transcend the field that he is studying, to more general questions: "How is it that this idealism, while temporarily tarnished by recurring shortcomings and failures, does not take long to renew? Why does techno-philanthropism seem immune to the lessons of history?" These questions are the same questions driving this dissertation: how does political techno-idealism persist despite recurrent observations that evidence of its positive effect can't be convincingly produced? By using the ethnographic method, Sims wants go "to the heart of the most hotly debated questions about technological innovation, social change, and hence, the social and political ordering of modern life" (p.5). Sims' method has roots in ethnographic notions of "communities of practice", a notion that "draw attention to how culture and structure make and remake each other through people's ongoing participation in the situated practices that sustain and change different figured worlds" (p.9). In the book, Sims attributes explanatory power to figured worlds, future imaginaries and reform fictions. These are only capable of existing as long as they are constantly remade, maintained, and repaired in order to survive. If we transport this observation to our domain, the intense production of policy papers becomes a cultural phenomenon. It is practice of sustaining ideal visions for the future, that would fall apart if not continuously produced and maintained.

### Post-phenomenology and new materialism

A final, anti-realist approach to technology in educational settings, are the post-phenomenological and material schools of thought. These studies are grounded in phenomenological theory and ethnographic observation. Contrary to the realist studies, they focus on the *how* and the perceived meanings of educational technology, from the subjective perspective - both the researchers' and that of the subjects being studied. There is often an

acute attention to material agency in these studies. Post-phenomenologists often employ micro-scale case studies to examine how technologies influence our choices, decisions, and the way subjects perceive the world. I could be criticized for inferring evaluative principles or normative pedagogical ideals from these schools of thought that don't directly formulate them, and whose empirical data is mostly ethnographic observation in very specific contexts (not designed for standardization). But its theoretical implications in many respects, speak very directly to fundamental assumptions in dominant pedagogical theories related to the use of ICT. They have contributed greatly to the field of educational ICT through studies of concrete practices in educational settings. Often these are appropriated by political evaluations, and political discourse about how technology should be used.

Where the systematic review, or the RCT abstracts the result from a context (often into a number), phenomenology attempts to describe human experience "before it is abstracted, reduced and explained" (Aagaard, 2017) to explore the lived experience and the invariant aspects of psychological phenomena. This is attempted by obtaining concrete and detailed descriptions from people who experience situations in which the phenomenon takes place. The *psychological* aspect of an observation emerges, not through testing an hypothesis, but on the contrary, by refraining from importing pre-conceived notions into the field. Neutrality and objectivity are strived for, by *bracketing* researcher subjectivity. This requires self-reflexivity, and a degree of transparency about the perspective one is disposed at looking from - in order to suspend it.

The material perspective tries to describe how beings that are intentionally directed toward the world - through a technology - transforms perceptions in accordance with the characteristics of that particular artifact. This also means that technologies are invariably non-neutral and that "technologies invite or solicit certain actions while inhibiting others" (Aagaard, do.) Post-phenomenological and material schools of thought operate with weaker concepts of subjects and objects than other subject/object dichotomies - it is rather in the interplay between the subject and the (technological) environment that causalities can be observed. Subjects are not the theoretical rational humans presupposed in neo-classical economy (under the guise of Homo Economicus), but neither are they the *victims* of being scientifically proven irrational agents, as some neuro-scientific or behavioural economy positions tend to conclude.

The critique, from the realist sciences, is of course that phenomenological and material studies can't standardize their findings - making it impossible to integrate them in systematic reviews, or to place them on indexes that guide practicians towards "what works".
What they can do, however, is to provide clues as to *causes* behind the numbers.

### Examples:

Jesper Aagard, that I have been referring to, is the author of two interesting studies on the distracting effects of devices like laptops and tablets in a classroom setting. The first is "Drawn to Distraction" (Aagaard, 2015). As he says, they are introduced on the assumption that the technologies will increase motivation and learning, but pupils (also) use them for off-task activity and multitasking. Aagaard does not say it himself, but for the detective chasing reasons for why superior learning effects don't materialize in studies, the observation that students use the devices for all kinds of other things than learning, may provide important clues. Those behaviors are only observable *in situ* and cannot be inferred from test-results. Aagaard cites numerous studies that "show that students frequently use educational technologies for off-task activity and multitasking, which in turn leads to significant decrements in educational performance" (Bowman, Levine, Waite, & Gendron, 2010;Fried, 2008;Gaudreau, Miranda, & Gareau, 2014); Hembrooke & Gay, 2003;Junco & Cotten, 2012; Ravizza, Hambrick, & Fenn, 2014; (Risko, Buchanan, Medimorec, & Kingstone, 2013);Sana, Weston, & Cepeda, 2013;Wood et al., 2012). His study proceeds to shifting focus from mental processes (analysis of classic cognitive theory) to the bodily use of technologies. After six months of observation, Aagaard interviews the students. These interviews make it clear that technologies have a tendency to draw students to Facebook especially, sometimes at a pre-cognitive level. Some of the respondents find themselves checking Facebook in class, even though it wasn't their intention. In "Breaking down Barriers" (Aagaard, 2016) Aagaard studies teachers' use of technology - videos, smartboards, the ensemble of human and material agents in the classroom, and how underlying assumptions of the benevolent nature of technologies, creates mechanisms and situations that run counter to stated intentions.

I will end this chapter, like I did the realist chapter, by counterbalancing the critical narrative. I will do this by pointing to a favorite among policy-writers: the constructivist - anti-realist - study that essentially support the project of digitizing education. They are often media studies - through observation - that conclude that devices provide

meaningful experiences, support identity formation (Turkle, 1999), how educational technologies (or technology in educational settings) are situated in learning contexts (Lave & Wenger, 1991), and how they are used in communities of practice (Lave & Wenger, 2014). The "demonstrationsskoleforsøgene" mentioned earlier contains numerous elements from this school of thought: quotes from interviews about stakeholders about their subjective perceptions of the experiment, how technology altered practice, and potentially support deeper values: a playful approach to learning, a focus on the well-being of the individual subject etc. I also recommend Estrid Sørensens "The materiality of learning" (Sørensen, 2009) or Poul Dourish's "Where the action is" (Dourish, 2004) or "The stuff of Bits" (Dourish, 2017).

Let us give the final world to Estrid Sørensen:

"*We find descriptions of technologies failing to deliver the expected educational outcome [...], but researchers rarely ask what was performed by and through the technologies in place of the expected outcome*." (Sørensen, 2009, p. 7).

## 3. Methodology

The literature review approached literature from two positions:

A) A realist, evidence-based position: This uncovered studies that attempt to provide empirical proof of effects on diverse factors (where we looked for studies on learning effects). This school of thought treats the methodological problems in terms of a disciplinary-technical challenge. Results are often interpreted according to whether the right support factors are in place. The quest for knowledge can be strengthened or refined by access to more data and stronger calculation. These included RCT-studies, systematic reviews, neuro-science and reviews of data based on tests. There are more we could have included (some have appeared elsewhere in this dissertation): positivist studies that measure the number of devices, access to Wi-Fi and so on.

B) A socio-technical position: This uncovered studies that reflect on how the evidence-debate (of the value of ICT) influences social domains, and how technology influences (and is a part of) social and cultural praxis. It also has a strong focus on how language is used in social relations. There is in principle no end to this work: social reconfigurations in the field require renewed attention. These studies included discourse analysis, network analysis, ethnographic observation, material studies and post-phenomenology. There are more studies we could have included: Interviews, grounded theory, variants of hermeneutical methods.

The review served the purpose of offering different approaches to dealing with educational technology. To simplify, either the analytical object is to be grasped in its essence (what it can do or what it is, independent of context, with predictable outcomes). Or it should be understood, as it is embedded in social dynamics, contingent on a variety of factors, dependent on specific use plans, relying on users' competences, and on analysis of the institutions that build the frameworks in which the phenomenon can be observed. To contribute to the evidence-debate there is, in my opinion, not much to add to the quality, scope or the methodological choices from which they arise. The project I propose is to investigate how evidence is used in a justificatory process. It combines the two approaches: a

respect for the realist findings, but with a focus on how they are interpreted by analysing concrete, written practice.

### 3.1. Empirical data: The political domain

There are several empirical sources we could consult, in order to do such a structured reading of the perceived value of educational ICT - each one of them would demand their own theoretical framing. Each one also represents a different actor-perspective, in the form of students/pupils, parents, administrators, teachers, politicians, vendors, researchers or combinations thereof.

One source could be vendor-literature, i.e. commercial texts and media-products designed to boost sales of educational commodities. This would require a media-literate genre-analysis, as commercial texts seldomly announce themselves as such, often by going under the name of "thinkpieces", blogposts, whitepapers, informational campaigns etc. Such an analysis could analyze how messages are crafted (through a rhetorical framework), and try to define, index, develop theories about their persuasive power, e.g. through an audience-orientated investigation: what made you choose product A compared to product B? Which associations does message A give you?  Other empirical sources we could consult or analyze for the same purpose is qualitative investigations of actors that resist change e.g. (that are sometimes offered as explanations for lack of effect). This could be done by interviewing teachers, or observations of how teachers use technology. It would also be relatively simple to make an economic analysis, to test the theory that there has not been allocated enough funds for training personnel in the use of digital technologies.

Another source could be the mapping of research literature advocating for the use of educational ICT, either directly or implicitly. What is the perceived relevance of engaging with educational technology at all? How is the phenomenon's influence gauged? What issues are at stake? How does the research field itself, ascertain its importance? Which epistemological advances is the research perspective claiming to be furthering? How do actors argument for the importance of funding their research agenda? A more interesting route is to analyze political reason itself. It is a philosophical project that springs from the view that "philosophy

consists in description and not causal explanation" (Moran, 2000:7), and that this description is a prerequisite for analysis. It is an appreciation of empiricism, and it is at the same time an antipathy towards idealism. I want to propose an analysis of policy papers, and the written practice in them. Political institutions do not hold complete power over how education happens, but political institutions legislate and fund education. It is a trivial observation that political institutions influence how education is thought about, by developing funded frameworks in which actors are assessed, encouraged, rewarded or punished - in the continuous effort to align them with adopted strategies. So why mention it? The ambition of focusing on justificatory, intellectual activity in the political domain, is based on the simple assumption that arguments made in this domain have more impact on the realities of education, than many other factors or agents in the field. This does not mean, that we should succumb to the illusion that there is a 1:1 relationship between politically projected realities and the lived realities of education. Political strategy is always interpreted, negotiated and ultimately distorted by actors, often in ways that render the original vision into something that is difficult to recognize. My point is rather a point of scale: of all the factors that influence education, political ideas carry more weight and instantiate more "events" than negotiations and subjective interpretations at the "ground level". I mention this to anticipate a critique of being naively theoretical: just because political policy papers formulate an array of theories on learning and pedagogy and the future of education, does not mean that this automatically becomes reality. Analogously with a phenomenological view on the subject as guided by lived experience rather than theory, educational actors are not theoretical or political creatures: I suspect that it would be very difficult to find a teacher or a school-leader that reads policy papers, and acts according to them - and whose actions can be understood purely in that light. What concerns me, is not how power is brokered, nor how networks of actors co-constitute power, but the political subject in policy papers itself: how does the political subject (who writes policy papers, and proposes laws), "see" the world? What metaphysical claims are being made, what common sense assumptions guide their reasoning?

The motive for the choice of empirical domain is based on the assumption that political institutions exert more power on the realities of education, than other educational actors do. They allocate funds for the production of policy, infrastructure or purchase of devices - or have the capacity to pass laws that make it happen.

### Selection of texts for the corpus:

*"...a discipline without exemplars is an ineffective one." (Flyvbjerg, 2006)*

I want to do this by building a corpus of texts and analyze them "in order to elicit meaning, gain understanding, and develop empirical knowledge" and to "identify overarching themes", and finally to "generate new research questions" (Bowen, 2009). The criteria I propose are the following:

1) A topical criterion: the reports have educational ICT as the theme of their considerations.
2) A quantitative criterion: They are limited to a manageable number, which I set to 8-10 representative reports.
3) A historical criterion: They span the entirety of the period (early 1980s to mid 2010s).
4) A representative criterion: a representative number of influential international institutions are included.
5) A comparativity criterion: inclusion of local reports to compare local (re)production of internationally centrally formulated ideas (in reference to Korsgaard et als. observation that educational policy in our epoch is centrally dictated).

### Representativeness

The aim is to build a representative corpus. McEnery et al. provide a technical explanation, that I will lean on:

"What does representativeness mean in corpus linguistics? According to Leech [...] a corpus is thought to be representative of the language variety it is supposed to represent if the findings based on its contents can be generalized to the said variety." (McEnery, Xiao, & Tono, 2006)

In more prosaic terms, the corpus should be able to identify characteristics that can be generalized to the variety (policy papers on the effects of and arguments for educational ICT). The attempt to ensure representativeness does not itself ensure representativeness - it must be examined a posteriori whether the generalizations can be identified in reports outside the

corpus.

### Ad. item 1, choosing Denmark as a case:

> "...by seeing how other cultures frame and resolve the quandaries of uncertainty and accountability, and how they uphold their own regimes of reason, we can become better observers of naturalizing moves in our own politics". (Jasanoff, 2012)

Although this is not an in-depth case-study research, we will use Denmark as a specific case study as an exemplar for many of the theoretical discussions. This choice could be criticized as the result of a personal bias, the writer of the thesis being Danish and all. One might also object, which is often a criticism of case-research in general, that the choice of case is an expression of "verification", the tendency to confirm the researcher's preconceived notions. The researcher is formed by his upbringing and professional experiences in the country he is using as a case, and hence is full to the brim with notions about the state of affairs (derived from personal and professional experiences), inevitably leading to an analysis that is tainted by subjectivity.

In the following I will argue, that those are important issues to keep in mind, but that the choice can be justified

1) By Denmark's long history of being placed at the top of different large-scale, highly publicized and highly cited digitization-indexes by influential international institutions.
2) That Denmark is closest to many of the visions formulated early in the period - in terms of integration of technology into education and the embracement of the pedagogical ideas linked to much technological advocacy.
3) Thus is a useful and productive exemplar to illustrate how ideas are appropriated politically and translated into national legislation that in turn translates to a tangible reality for pupils, students, teachers and educational administrators.

Different sources point to Denmark as "best in class" or "world leader" when it comes to

digital infrastructure:

The Digital Economy and Society Index (DESI) ranked Denmark as world leader in 2017 and fourth the following years (EU-Commission, 2019).

On the UN e-government survey (UNITED NATIONS, 2018) Denmark topped the index in 2018, after starting on 4th place in 2003, populating different spots in the top 10-list in the meantime.

In 2006, 2007, 2008 and 2009 Denmark was the number 1 country on World Economic Forum's "World Readiness Index". In 2016 Denmark's place is on spot number 11.

There are other reports that point to Denmark as one of the most digitized countries in the world.

- Denmark 'has highest smartphone penetration rate in the world' (Netimperative, 2017).
- In the OECD-report "Students, computers and learning" (OECD, 2015), Denmark tops the charts on "home ICT equipment and internet use" (p. 18).

### Focus

The analytical focus on the corpus will be to

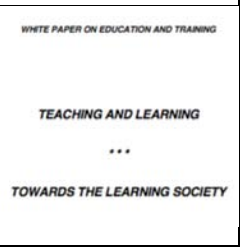
1) To map the arguments.
2) To describe the knowledge foundation underpinning the arguments (if any).
3) How arguments and knowledge foundation relate to the evidence-problem (if possible).

The reading will look for problems and challenges described in the literature review, and is carried out to discuss whether policy practice in the area, itself is a realist or an anti-realist endeavor.

The corpus I constructed for the purpose includes The United Nations Educational, Scientific and Cultural Organization (UNESCO), the European Union (EU), World Economic Forum

(Wef), and The Organisation for Economic Co-operation and Development (OECD). From Denmark I have chosen reports from the ministry of education, the ministry of research, the ministry of science and the government ("regeringen").

## 4. The corpus:

| 1980s | | |
|---|---|---|
| | Abbreviated name | |
| Bollerslev, P. (1983). *Statusrapport. De nye teknologiers anvendelse i undervisning og uddannelse i Danmark.* | "Statusrapport" |  |
| Daley, H., Loop, L., & Carnoy, M. (1987). *Education and computers: vision and reality*. Paris. | "Vision and reality" |  |
| **1990s** | | |
| Forskningsministeriet. (1994). *Info-samfundet år 2000 - bilag*. Forskningsministeriet. | "Info-society 2000" |  |
| European Commission. (1993). *White paper on education and learning - Teaching and learning: towards the learning society, 70.* | "The learning society" |  |

| 2000s | | |
|---|---|---|
| | Abbreviated name | |
| Kirkman, G. S., Cornelius, P. K., Sachs, J. D., & Schwab, K. (2002). *The Global Information Technology Report 2001-2002*. *Computer* (Vol. 46). | "Network readiness" |  |
| Videnskabsministeriet. (2007). National strategi for IKT-støttet læring. | "E-learning" |  |
| **2010s** | | |
| Regeringen. (2011). *En digital folkeskole* | "A digital school" |  |
| OECD. (2015). *Students, Computers and Learning*. | "Students, computers and learning" |  |

### A few notes on readability:

Style guides warn against the exaggerated use of numbers, acronyms and italics. They can hinder a smooth reading experience, with the risk of reducing overall intelligibility. In the guide above I have given the reports abbreviated and more relatable names, and supplied visuals, to enhance the reading experience. I have translated all quotes from Danish reports.

## 4.1 Analysis

In the following 8 sections, I will present each report, the context in which it was published. I will identify arguments, potential problems and epistemic sources.

### 4.2. The ministry of education - the application of new technologies in education in Denmark" (Bollerslev, 1983), aka. "Statusrapport".

The "statusrapport" is a thin blue pamphlet is a 111-page long publication, published by the Danish ministry of education. It is a revised status-report based on a report submitted to UNESCO in 1982 (called "joint study no. 11"). Joint study 11 was one of 14 joint study projects, in which Denmark chose to participate. It was given the title "*New technologies in information and communication and their impact on education*". It is not available in a digital format (except from my scanning of it, included in the downloads folder made available). It is a small (A5) publication with a light-blue cover. On the front page there is a hand-drawing of a female figure engaged with a machine of some sorts, surrounded by smaller drawings of people in work-related situations. Beneath the drawing there is the quote: "Teachers are potentially the most sensitive, flexible and divergent reaction-capable components of any instructional system".

In the preface, the context is set. The purpose of the joint study was (among four in total) to "*develop a comprehensive study of the applications of technology to education through a co-operative exchange of research and experience-based information among the member-countries of the UNESCO European Regio*n", to make available descriptions of new information and communication technologies "from the point of view of their potential" and to bring awareness of "the social implications of new technologies in education". The program consists of two phases. In Phase 1 the plan is to review state of the art technologies in view of their potential contribution to education. Examples of state of the art technologies are mentioned as "*videotext, videodisc, cable, satellite, teleconferencing and personal computer*". In phase 2, the mission is to identify "significant issues involved in applying technology to education". The purpose of it all is threefold:

- to improve the effectiveness of conventional educational systems
- to extend the services provided by educational institutions
- to introduce new learning opportunities

The rest of the introduction is dedicated to describing methodological concerns (how the literature review was made, and how state of the art descriptions from "prominent specialists" were gathered), and some less interesting communication about the timetable and how the production of the report is financed. The content of the report consists of chapters on the use of "Radio, TV, cassette and video in teaching", on the status of the national ICT-infrastructure, a review of the technological facilities of libraries, the different international institutions that Denmark participates in (where educational ICT is studied), and a review of how educational technology is used in different parts of the Danish educational system. Then follows 10 different "monographies, where we will focus on "*Datamat-støttet undervisning og datamat-formidlet undervisning - Hvordan, hvorfor og hvor meget*?" ("Computer-supported teaching and computer-mediated teaching - How, why and how much", by Lars Qvortrup) from "telematik-projektet" (the telematic-project), university of Odense. This monography most clearly develops arguments for the use of educational ICT, and most explicitly reflects on pedagogical themes, and the relationship between the learning subject and educational ICT.

### Telematics and the individual

The monograph starts with an anecdote about a common math-question, that casts light on what has since become a prototypical post-phenomenological problematic: how does technology alter the way we go about thinking about problems, and how does this affect different practices in problem solving? The case that is described, is the development in how students answer a math question, depending on whether they use conventional calculus methods, or whether they use a calculator. The question departs from a real-life situation (how many times does a bus have to go back and forth between Ford Ritchie and Boston, to transport 16.900 soldiers. There are 10 busses, each of them seats 61 soldiers). Qvortrup's point it that the use of a calculator affords a number with decimals (27, 7049), where the correct result - to make the answer realistically possible - is that all busses have to make the trip 27 times, and 8 busses have to make each one additional trip. The example is summoned to illustrate that the use of technology in education creates the risk of producing results that do not mirror a practical reality (after the introduction of calculators, the amount of students that answer with the decimal number has risen), and that calculators have no clue about the

realistic context they are calculating. The example also serves to make a more general point: the introduction of technology alters the way students reason about the world.
Lars Qvortrup uses this example to reflect on the relationship between *telematics* and the individual - and paints a scary scenario of the individual becoming an appendix to technology, instead of how it should be: the other way around. This risk is imminent, as the technical system is so comprehensive, invading the private, the cultural and public spheres. Qvortrup references Karl Marx and the development of humans controlling machines versus machines subsuming humans. In this respect he is also channelling Heidegger and his concept of "enframing" and "Gestell". Lars Qvortrup wants us to remember these facts, when discussing educational ICT (or *DFU* - **D**atamat**F**ormidlet **U**ndervisning aka. computer mediated teaching). Lars Qvortrup emphasises that it is not reasonable to expect that DFU in itself can have (positive) effects on students' learning and their outlook on the world. Eventual effects depend on matters such as scale, design and use. Additionally, DFU must be understood in the light of DFU's interplay with the information-technical systems' influence on student's everyday life. Will DFU have a big impact on the school systems of the future? In pedagogical circles, in Qvortrups account, the answer is negative. DFU will only be used marginally, this is caused by, is Qvortrup's interpretation, professionals' *fear* for DFUs consequences for education. Consequently, it is predicted that DFU will only be used narrowly for fact-learning, table-based information and for some simulation-models.

But in technological circles the prognosis is radically different: Dines Bjørner (Bjørner, 1983), is quoted for saying "*the school of the future will to a large extent be marked by intensive use of informatics-based teaching systems in nearly all fields*".

On behalf of Danmedia (an organisation of private and public informatic-associations), Bjerre Lavesen predicts, for 2004, the "studiemat" (the studymat): a convergence of the videodisc-machine, discstation, computer, radio, TV and telephone. These "studymats" will be connected in a national broadband-network and will conquernot only schools and homes, but also workplaces, hospitals, homes for the elderly, kindergartens, prisons and - "in some modificated form" - ships, planes and trains.

Qvortrup muses on the differences in the prognoses - and interprets them as *intentions*

(wishes), more than educated guesses. Prognoses are used to serve professional interests. It is a big market and competition is fierce. Qvortrup makes the analysis that DFU should be interpreted as actors' means to structure education - pedagogical strategy is implemented through DFU, more than it is a *consequence of* DFU (as a neutral technology). Finally, Qvortrup notes that DFU also introduces the risk of the privatization of teaching aids, compendiums and books e.g.

### Rationalism vs. experience-pedagogics

DFU represents two positions, continues Qvortrup, representative of two divergent pedagogical ideals. The first is a learning theoretical ideal (fact-learning, control of pupils, "programmed teaching"), and an experience-pedagogical ideal ("erfaringspædagogisk"). The first is more passive, preventing the pupil from manipulating a computerprogram or the data in it. The second, inspired by Seymor Papert's "LOGO"-software and "Mindstorms"-book, builds on a vision of the learning subject as active. Computers have the potential to become advanced simulation-systems, that the subject can acquire personal experiences in.

An example of the first position, is educational software to learn English, developed by RANK XEROX. Its' advantages are

- There is a limited material to learn
- Possibility to learn in breaks from work
- The student can learn in her own pace
- Money can be saved on expenses for teachers

This is a type of learning that offers reduced, individual, cheap and abstract learning (learning that is detached from pupils' social experience, and devoid of "Bildung). Qvortrup calls this pure rationalism, and for him it is dangerous: This form of DFU is devoid of reflections on "education" (understood as *bildung*), and thus in conflict with a historically accumulated educational tradition - to a large extent inspired by Immanuel Kant and his ideals of "Aufklärung" (enlightenment), that presuppose a type of education that insists on individual liberty and the students/pupils connection to history. Rousseau is also invoked, as an important and influential figure, that would disagree with the rationalism that one axis of

DFU represents.

"LOGO", as mentioned, is proposed as an alternative to the rationalist-normative systems. In LOGO, it is the child that programs the computer, not the computer programming the child. The child learns through play, rather than having to incorporate abstract, bits of knowledge. Qvortrups criticism is that the LOGO system might be to weak - seen from a Roussean perspective: The experience built as the result of the dialectics between subject and object in LOGO is too weak in the sense that the computer cannot counteract, challenge or provoke the child. LOGO only lets the child represent her own symbols.

Qvortrup suggests a compromise between the two pedagogical positions. A DFU-system that is neither rationalist-normative nor purely student-centred. But a system that enables a dialectic relationship between pupil and computer. The compromise it to develop DFU where the student can tell the computer how she wants to be learned. This is a purely theoretical construct says Qvortrup, it does not exist at the time of writing. Qvortrup ends by stressing that there is a substantial risk that DFU-systems can become dangerous, if they gradually substitute the living, human educator. "The smarter, the worse!".

As has become clear in the previous account, educational ICT covers divergent views of the learning subject, that can be reduced to a conception of a passive versus an active knower. The knower is regarded as passive when the learner has no agency over the teaching system. The knowledge that is transmitted, is reduced to small, abstracted units, that do not connect to larger issues within a knowledge-field, and knowledge is abstract: the pupils' lifeworld, cultural context etc. are not relevant parameters or considerations, in the design of learning systems of this type. The other places high value on the learner as an active knower: the pupil constructs experiences by playing. The problem with this ideology, is the lack of a dialectical push-back from a (Rousseauan-type) knowing authority.

### A hung jury

Qvortrup's conclusion is that nothing definitive can be said about the matter, and he recommends further research[14]. One clear advice, though, is that experts in pedagogy,

[14]Echoing an analysis made by Langdon Winner: "Almost invariably, the conclusion of the 'innovate and measure' ritual is that the initial outcomes were very

sociology should be invited into further research: and that all actors in the field should have veto-right. Qvortrup has been summoned as a "prominent specialist" - as is the stated intention in the book's preface. In this capacity he produces a qualitative synthesis of the state of affairs, directly adressing questions pertinent for politicians: to investigate the potentials, to evaluate their impact, to consider new learning opportunities. For Qvortrup, the inquiry is a legitimate one, for the simple reason that technology isn't neutral, it affects the way we think and solve problems, and the use of computers (as a calculation device) tends to lead to answers that are abstracted from reality (hence useless).

### Arguments for

Regarding arguments *for*, Qvortrup references representatives from the industry itself, and their arguments that relate to predictions of a future, where the use of digital technology will be more intensive - in all fields. He also refers to the theory that the Pappert-inspired pedagogy, embodied in the LOGO-application, stimulates pupil-activity - albeit critiquing the weakness of the intended dialectic process.

### Arguments against

Besides a demographic argument (there will be plenty of teachers in the future, undermining the need for computers), and the argument that teachers fear technology to a degree that they will decline to adopt it, Qvortrup exhibits a degree of risk-analysis, caution and capitalist critique in his monograph, that is unique in our corpus. We must be careful, he warns, not to become an appendix to the technological system, to turn the educational system into a behaviorist system, to avoid producing knowledge that is abstracted from a practical reality, and finally we must analyse the proponents' arguments in light of their commercial interests, and be wary of privatizing the sector through technology.

With the benefit of hindsigt, Qvortrups monograph is both interesting and actual - and prescient of many of the debates today: are we aware enough, of the types of pedagogy that are embedded in devices? Does technology favor STEM over humanistic and social enquiry? Is

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promising, enough to merit additional research, and, of course, additional funding" (Winner, 2009)

the kind of activity that software claims to stimulate strong enough?

### Knowledge foundation

As described, Qvortrups views rest on his professional analysis of the strategic actors in the field, on structural conditions (the teaching workforce, the industry's commercial interests), and is prescient of many analyses today: that educational technology has created a situation of path-dependency, i.e. a situation where education becomes something that its actors have to adapt to - instead of a possibility among many. Anthropologically, he operates with notions of active and passive subjects, or to be more precise: of subjects whose activity or passivity can be determined through pedagogical choices. His diagnosis is not based on data, on bivalent verdicts, and should be understood as a subjective interpretation.
He also invokes obvious intellectual trends of his present: the excitement around Seymor Papert (he will appear later).

### 4.3 Education and computers: vision and reality (Daley et al., 1987), aka "Vision and reality"

"Education and computers" (henceforth called "Vision and reality") is a 117-page book, authored by three Stanford University employees (from the School of education). UNESCO commissioned the publication. In the research on UNESCO, it became clear to me, how active an institutional actor it has been in the domain of educational ICT, since the early '80s (see also appendix 1). Their "Quarterly Review" often took up computer-related issues, and I have - until now - counted nine reports from the '80s on the potential of ICT - many of them dealing with its use in developing countries. Themes addressed are "Computers and Education: The human Priority", "The Computer at school", "Developing Computer use in education", "Computer sciences in vocational training", "Impacts of New Information Technologies in Higher Education", and more. I was even more surprised, going longer back in time, to read Henri Dieuzeide's (the then educational director of UNESCO) books and publications (from the 70s) on the value of using audio-visual technologies in education - using many of the same arguments used later, when advocating for educational ICT.

In the publication " UNESCO and new techniques in education" (Dieuzeide, 1970) technology represents potentials, but there are also problems:

"*The new techniques do in fact offer a vast range of possibilities, but their field of application often seems to be a wasteland scattered with spare parts which no one knows how to put together to form an efficient system"* (p.5).

Potentials are especially associated to productivity benefits, that can overcome what we could call the "linear curse" of education:

"*The present crisis in education shows that attempts to meet the demand by linear expansion are financially illusory and pedagogically outdated*". (p.5).

The report we will turn to now, attempts a large-scale evaluation of the effects, risks and

potentials of educational ICT, or in the words of the authors: to produce knowledge on the gap between visions and realities.

### *Vision and reality*

From the first glance at the index, the publication raises issues that have been constant in policy papers on educational ICT since it was published 32 years ago. The index lists items such: "*The discourse on computers and education*", "*The effects of computers on learning*", "*Cost-effectiveness of computers in education*", and "*Will computers in education make a difference?*" The report presents itself as a neutral and rational reflection on pros and cons of using computers in education[15] - but doesn't abstain from hyperbolic, metaphysical terms to describe the present situation (at the time of publication): "...we are in the midst of a potentially enormous worldwide change", a change attributed to "the information revolution" (p. 1).

In the introduction (that will be the focus of our analysis), two arguments for the increasing importance of computers as tools for learning are reported. They are not presented as the arguments of the writers of the report themselves, but credited to pedagogical thinkers such as Seymor Papert (Papert, 1980) and Williams and Williams (Williams & Williams, 1985).

### Environmental adaptation:

The first hinges on what I could call an *environmental* argument: the world is becoming increasingly competitive; we are witnessing the increasingly changing nature of societies. The future will be progressively more reliant on informational skills (as opposed to manual skills). Computers are perceived as information-processing tools, and it is important for youth to get acquainted with the artifacts populating this new cognitive/informational environment. This raises the questions: how do schools prepare for radical innovation? How can we be sure that the computer skills taught today will not be obsolete tomorrow? We cannot rely on the students' future employers to train them in the use of software A or B, to solve task X or Y. We can expect that they will demand more than just high levels of attainment in classical subjects like mathematics and reading.

[15] Curious fact: Steve Wozniak offered the first ever Apple I produced, to Liza Loop in 1976, according to https://en.wikipedia.org/wiki/Liza_Loop

### Increased student achievement:

The second argument is based on digital tools' ability to improve the overall level of student attainment - computers can optimize or boost learning processes, either as a replacement of the teacher, or as a supplemental tool for teachers. This argument rests on the assumption that computers potentially can assume the role of interactive, individualized tutors, and help teach math and reading e.g. In this category of arguments, Loop et al. include the claim by Seymour Papert, that interactive computer-based learning "can change human thought structure". The book is an evaluation of those arguments, by comparing *claims* about computer education to *actual* outcomes "*by reviewing the growing body of empirical literature".* It also examines the distribution of computers and *"the cost-effectiveness of computers...for increasing pupils' achievement*" (p. 1).

The empirical research that is referenced in the introduction of the report, points to the dramatic growth of a) of the microelectronics industry (and thus in the size of the workforce of computer specialists involved in developing computers) and b) in an increase in the number of jobs that use computers. It is argued - through Yourdon (Yourdon, 1985) - that by the year 2000, 80% of jobs will require computer literacy (requiring a "minimal amount of computer training")[16].

### Arguments against

A counter-argument to the agenda of educating for digital literacy is put forward:

*"...the counter argument can be made that software will tend to be increasingly 'user friendly', so much so that almost anyone, even those totally unfamiliar with computers can be easily and quickly trained to use them. This is clearly the trend."* (p. 2).

As for more specialized skills the authors of "Vision and Reality" also develop the argument that digital literacy is already, to a large extent - "embedded" in other skills:

"*Furthermore, it appears that the kinds of skills associated with the somewhat more*

[16] According to the national labor bureau of labor statistics, 4% of the workforce in 2017 is occupied with programming https://www.bls.gov/oes/

*sophisticated 'computer literacy' uses of computers that are general skills training in the computer applications word-processing, spreadsheets, feeding and extracting information, an factory applications include a much more important element of traditional skills, such as typing, accuracy, working with complex machines, and statistical and math skills. These are much more the product of overall quality in the educational and job-training system than in the availability of computer education."* (p. 2).

In the above passage, what we today call STEM-education is considered fruitful, or transferrable to digital skills, and is recommended by the authors (implicitly, considered more fruitful than arts and humanities):

"*Such participation will, however, take much more than just making available programming courses for high school students. It will require secondary and university education much more geared to physical sciences, mathematics, and their applications*." (p.3)

### Computer mediated learning

The passage above had to do with the first argument of two, the focus on the need for digital literacy and computer skills, as a preparation for the future workplace. The second argument focuses on the potential of computers to mediate learning. The authors make seven points, based on empirical studies that, for some readers, all in all could seem to be good arguments for investing in computers as learning tools.

1. Reading and math scores increase, when using "drill-and-practice sessions" of limited duration over extended time (of primary school students).
2. CAI (computer assisted instruction) proves to be an effective supplement to classroom teaching.
3. There appears "*to be as lightly greater cognitive gain at the high school level when the computer acts as a complete substitute for teacher, textbook, etc. than when the computer acts as a supplement, but not at the primary level, where the opposite is the case.*"
4: There appears to be greater gains for pupils with lower academic skills than for those with higher skills.
5: Computers are not better at raising math over reading scores.

6: The effect of CAI declines, the longer the length of instruction.[17]
7': There is no indication, which aspects of CAI affect these gains: software design, intensity of contact, external reinforcement etc.

This evaluation has a narrow focus on 1) reading and math 2) as instructed through "drill-and-practice sessions". In pedagogical terms i.e. in a theoretical context where skill acquisition is subsumed a much broader project of empowering the subject in a democratic society in the tradition of John Dewey e.g. (Dewey, 1920), this is indeed a narrow focus. Drill-and-practice, like memorization, involves repetition of specific skills, such as addition and subtraction, or spelling.[18]

An alternative to drill-and-practice didactics is the Seymour Papert driven vision of using a problem-solving application, that, as we mentioned earlier "could transform human thought structure". The technological embodiment of this pedagogy is the "LOGO"-software (also mentioned by Qvortrup) where pupils can manipulate a turtle-symbol on a screen, using a command-line interface). The authors refer a "...*two-year study of LOGO [that] found no significant effect on cognitive skills. Neither do any studies sustain Papert's claim that learning with LOGO-type programs will create new conceptual skills in children*." (p.4).

To sum up, the authors' evaluation is that STEM-education should be encouraged, educational ICT shows some effects on drill-and-practice sessions (but the cause of this effect is unknown), there is no basis for claiming that educational ICT can create new conceptual skills, but, more drily: "*Fabulous claims of computers' effect on the educational process have not been observed in the real world*". (p. 4). As to the theoretical basis of the evaluations, the authors conclude: "*What seems to be lacking in all of these studies is an underlying theory of learning that can explain why or why not computers will enhance learning.*" (p. 4).
The authors also put an emphasis on context: findings in one educational setting cannot be transported seamlessly to another educational setting, echoing some of the issues related to RCT-studies, mentioned earlier.

### Cost effectiveness:

From a political point of view, the issue of cost-effectiveness is of course important. The

[17] Much like the Hawthorne-effect, mentioned earlier.
[18] http://public.callutheran.edu/~mccamb/drillpractice.htm

evaluation of cost-effectiveness from the authors is simply that CAI does not do as well as peer tutoring.

"*Given these results, and focusing on the single objective of improving reading and math achievement, schools would do well to increase peer tutoring and reduce CAI*" (p.5).

From the perspective of an educational ICT-enthusiast, the sum of all the evaluations is not particularly uplifting, but the authors offer a lifeline:

*"First, CAI may have more potential to improve its cost-effectiveness in the future than other interventions because of improved software, more effective applications, and so forth. Improvement potential may be much smaller with simpler technologies. Second, there are other objectives to technologies than just raising learning speed: in the case of computers, CAI also introduces pupils to the computers themselves and may end up creating both interest and skills that carry over into the job market."*

In other words, the project should not be abandoned, as future innovations may change this picture, secondly computers *may* end up creating both interest and skills that carry over into the job market.

### *Knowledge foundation*

The empirical sources in this text are economical reports & projections (job growth, and estimated future job-creation), a literature review (including the work of Seymour Papert, Larry Cuban & others), i.e. " ...the growing body of empirical literature that treats computers' educational and labor market roles". Daley and Loop's are - like the previous report's author - risk assessing, cautious and skeptical: peer tutoring does better than CAI, and in a cost-effective perspective "schools would do well to increase peer-tutoring and reduce CAI". They also note that Papert's theories of active learning are based on "implicit and explicit assumptions", and they conclude "the impact of computers is controversial enough that [such] research should be carried out before any large scale investment is committed. " (p. 6). Further research is necessary.

### 4.4. Forskningsministeriet. (1994). Info-samfundet år 2000 - bilag. Forskningsministeriet, aka "Info-society 2000"

We are leaving the '80s, and moving into the '90s. Info-Samfundet år 2000 ("The info-society year 2000", my translation, and henceforth referred to as "Info-society 2000") is a report published in two volumes in 1995 by the Danish ministry of research. The preface describes the context of the report's genesis, and how the government created a committee of two persons, Lone Dybkjær (former minister of the environment, and member of the European parliament the year the report was published), and the government official Søren Christensen. On the basis of work done in working groups, conferences, input from experts and organizations, and suggestions from the broad public, the report puts forth a range of recommendations, to

1) Paint a picture of the Danes' possibilities in the coming information-society
2) Formulate a general informatics-policy
3) Identify special areas for the years to come, and point to eventual need for legal changes

The first volume is 100 pages long (with two floppy disks included, containing a digital version of the report), and covers recommendations for a broad, national IT-strategy: a "public servicenet", protection of personal data, how to make the health system more efficient, "the global village of research", how to create new inroads in education, educational ICT in public schools, the role of the libraries in the IT-age, IT's effects on mass-media, traffic, private companies, tele-services, the possibility for working at home, and finally the status of the handicapped in the information society. It is the report in our corpus that has the largest societal scope, and formulates the biggest ambitions in terms of societal domains that should be analyzed in the light of the IT-revolution. The second volume is 461 pages long, and consists of background articles, data and knowledge that support the recommendations in the report.

We will of course focus on the chapters that deal with education, but will start by reporting

the basic premise of it all, as it is communicated in the first chapter.

### Revolution and information explosion

The description of "our times" is a hyperbolic one of *revolution*, described with words like "information explosion" and "global short-circuiting". According to the authors, it all began with the moon landing in 1969, which was followed by TV-viewers all around the globe. That event was a technological, but especially an *information-technological even*t, assembling the global village of spectators in one community. Since then, the world has been connected in a global network, as can be witnessed by how scientists, "computer freaks" (sic) are connected on the American-started "internet", used by millions of people worldwide to send electronic mail, to discuss on message boards, discussion groups etc. All this causes disruptions (short-circuiting) of the fundamental premise of sharing and building of knowledge - it is the changes in these processes that are at the core of the revolution, more than the technical advances themselves. According to the authors, this has a range of consequences:

Information floats freely. Products with a high content of knowledge will replace traditional production of goods (as a driver for developed societies). Knowledge-based services will become an export good. Companies and organizations will be geographically split and virtualized. The internal organization in companies and public institutions will be more open - management's monopoly on knowledge and coordination will disappear. Humans will become more mobile. Lots of routine-work will disappear. The driving force behind many imagined futures in this foreword is the projection of a dramatic increase in computer capacity, and radical drops in price. A final imaginary is the projection of a range of specialized, advanced applications of IT, like "the intelligent house", "the intelligent car", better management of energy, better diagnosis-systems in air flight, medicine etc.

But there are also risks: the population risks being divided into an A- and a B-team (IT-wise).

The final part of the introduction is allocated for describing tendencies, some of which have been mentioned by Daley & Loop in their report (increased capacity and falling price), converging media, and the rise of virtual reality.

## "New inroads in education" & "Children, IT and the primary school"

Chapters 7 & 8 of the report are focused on education. They are very short, starting by formulating a principle, and then proposing political initiatives.

Principle 1.3. in chapter 7 is

"*The possibilities for technology-supported instruction have to be exploited maximally, especially in adult and further education*" (p. 55).

The context is that the workplaces require adaptable and flexible workers. Special knowledge and the constant furthering of education will become a mandatory demand for all. Educational ICT will make it possible to spread educational offers geographically, and can be tailored for organizations' individual needs. The concrete initiative to meet this challenge is to establish a development center for technology-supported instruction (a project under the ministry of education).

The principle in chapter 8 is much longer:

"*All children must be equipped to master modern IT. Teaching in primary school must be planned so that IT becomes a natural part of teaching in the individual subjects.*
*This includes using the unique possibilities of IT to ensure that teaching is adapted to the individual pupil - just like the new reform for elementary school is geared towards.*"[19]

Four initiatives are proposed:

1: A general initiative, including, making all teachers users of IT, introduction of IT in the first grades.

[19] A school reform was passed in 1993, proposing increased differentiation of education - adapted to the individual pupils' disposition.

2: The establishment of an IT-net in all elementary schools.
3: IT on the agenda on the board of directors of schools - to ensure parental engagement, and influence on the speed of IT-development in particular schools.
4: The establishment of a board to shed light on initiatives, to equip children with a better overview in the rising flood of information, and to use the IT to search and critically information.

The four initiatives are justified by a number of arguments, over the next two pages. The main warrant is the competitive one, one we have encountered before: in order to compete in the future, international knowledge society, it is crucial that children are offered the possibility to grow up and develop themselves, with IT as a natural part of everyday life. Another one is pedagogical: IT offers new pedagogical possibilities that can be compared with the new pedagogical possibilities that followed the invention of the printing press.
IT gives the individual child possibility to work with problems in their own tempo, and with the level of difficulty that suits her. This can release resources for the teacher to more effectively support pupils in need of one-on-one interaction. The teacher will "to a higher degree" transition to the role of a consultant who advises and supports the individual pupils - instead of a practice where the whole class has to move at the same tempo, with the consequence that the gifted students get bored, and the weaker students fall behind.
The authors find it curious that IT only to a lesser degree has broken through to the school system, considering that Denmark is one of the countries that have been using the most resources on teaching in the early classes. A suite of possible explanations is suggested: teachers can't access IT, and thus can't become personal users. The teacher seminars are underdeveloped. There is a lack of educational material. There is a lack of pedagogical development to integrate IT into teaching. There is a group of teachers that haven't grown up with IT to the same extent as the younger generation, and therefore feels insecure when confronted with IT.

The chapter ends with recommendations for investing in IT-equipment, to experiment with "future-schools", whose aim it is to experiment with "global village schools", and finally to engage in new ways of creating contact with global networks ("kidlink" e.g., now defunct) - they make it easy to exchange ideas and to gain intercultural understanding. The knowledge of the future will to a higher degree go from being paper based to electronic - and

here the network is a unique possibility.

### Appendixes to info-society 2000

There are three appendixes concerning educational ICT. Two of them deal with political-strategic concerns (legal frameworks, legal barriers, overview of political stakeholders, and overview of network- and database resources), and their main points and findings are loyally represented in the main reports. The third appendix is written by a journalist who has worked for more than 10 years in the intersection of children, education and computer programs for children). The article develops extensively on passive-active theories of the child-subject, and how this pedagogical anthropology affords recommendations for educational ICT. Children are playful, is the observation, and they love to learn - for them there is no discrepancy between the two - according to the author Pia Grünbaum. But as children grow older, we adults start separating the two (the author uses an universal "we"). We establish norms for what children must learn and for how fast they must learn it. We hire teachers to transmit this knowledge to children via specific methods: speech, books and blackboards. We judge the children by norms established by the school system. It all happens in a building. Play is reduced to something that should happen outside of school, in the spare time. But children, especially in their younger years, are resilient, curious, playful creatures that can acquire an enormous amount of skills by themselves (crawling, walking, speaking and so forth).

On the other hand, the computer is a wonderful toy, with as many possibilities as programs - it is in fact numerous toys in one. When children use a computer, the close connection between play and learning, is made visible again. In the computer the child rediscovers the possibility to acquire knowledge on the same terms as when knowledge was predefined. At that time, one of the most substantial conditions for learning was curiosity and enthusiasm, claims Grünbaum. But the child also wants to make something that can be used - children's play is serious business. The computer offers opportunities to both experiment and create finished products - text, images and sound can be used to create stuff of professional quality. Soon, they will be able to use robots to create artifacts out of textile and metal e.g.

The computers' difficult interfaces are not a problem for children, they venture into the

command-systems without fear. Unlike the adult, who needs everything served "rationally", expecting that it pays dividends - time spent on it, must be rewarded by gains - causing the adult to moan and suffer in the archaic interfaces.

The Internet, the author continues, is a world of people and information that the child can contact - from school or from home. This has implications for the normal spatial dependency on the school. With the Internet, teachers and pupils don't necessarily need to be at school, and the group of teachers can be expanded globally. If a child loves to write, there is no technical hindrance for the child to attend courses with an internationally famous writer e.g.. The child on the Internet is a child in a world of endless possibilities. By communicating globally, we also increase the possibility of understanding the common ground we all share, thus increasing the respect for each other's different lives.

The new role of the pupil will not be a development forwards, but rather a return to old pedagogy, but renew the possibilities to develop them and be engaged. To think freely, think more, and think well. As Grünbaum notes: Seymor Papert calls the computer, "the child's machine". Grünbaum posits that there clearly is a potential for completely replacing textbooks - in favor of a learning situation where the child learns to acquire information by himself (which of course will need skills in source criticism and information sorting).

The role of the teacher will be to help the child to work with all this information, to retrieve it into the child's life - instead of lecturing. The child will learn something about how it is to learn, when it uses a computer, and will learn techniques to learn. The computer affords creativity with its multimedia-possibilities, it doesn't mind repeating itself, and it teaches without being judgmental. In front of the computer it doesn't matter which morals, politics, religion, race, gender or skin color the child has grown up with. In front of the computer, the child acquires self-confidence and self-respect, because it is no longer constantly dependent on the adult's feedback. All this requires trust in the child, but also that the teacher trusts herself, and her own preconceived notions of how a child ought to learn. Grünbaum continues: It is a common misunderstanding that children who like to spend time in front of the computer often are lonesome, isolated and anti-social. We should permit our children to immerse themselves and work independently. In the current system there is a tendency to force children into socialization, without questioning whether it serves them well. Grünbaum finishes her article by describing a vibrant computer-culture. When children play games, they help each other across levels of aptitude (like siblings do). The school of the

future will use peer-to-peer learning, in schools where children no longer are divided into age-segregated classes. Grünbaum's closing remark is that it is not viable to *not* use childrens' resources. Like today (at the time of the writing) the children in our society are essentially superfluous. Maybe educational ICT can help change this situation.

### Arguments for

The main premise of the report, is the revolutionary argument, the argument of global change and ensuing projections of how the future will develop, how known structures will be disrupted (as we would say today). In that respect Info-Society 2000 echoes Daley and Loop's environmental argument - digitizing the infrastructure is a matter of global adaptation. Another strong, pedagogical, argument is the conception of the computer as a toy for learning, a technology that somehow is much closer to what the child authentically *is,* a technology that affords curiosity, breaks down arbitrary barriers (enforced by adults who are industrial in their mindset and afraid of technology). Additionally, the computer is neutral and is portrayed as an entity that treats all children equally.

### Knowledge foundation

The startling aspect of this report, is that it largely abstains from basing its findings, visions and recommendations on empirical sources or previous evaluations (be they qualitative or quantitative) - had it done so, it might have stumbled upon Daley's and Loop's advice of carrying out research, "before any large scale investment is committed". It is the only report in our corpus that - in the educational domain - is based on visions and conjecture, to that degree. This might be a formal issue however - literature and expert testimonies etc. may just not have been referenced. We may never know. Anyhow, there are no arguments against, except words of warning about creating a digital b-team. The reality is, that the report laid the political tracks for a large scale transformation of Danish society: many of the visions in it, are still being rolled out. It is not proposed how the effects of this project will be evaluated.

## 4.5. White paper on education and training. Teaching and learning - Towards the learning society" (1995), aka. "The learning Society".

"*We must have the courage to examine everything, discuss everything and even to teach everything.*"

- Condorcet (quoted on page 1 of The Learning Society)

The criteria for selecting the next report are, as stated in the methodological chapter, its' provenance from an influential international institution, in a decade following the '80s - it contains passages/chapters on the importance of educational ICT that had substantial European impact.

According to a press release issued by the European commission in December 1995[20], the European commission presented the White Paper "Teaching and learning - Towards the learning society". The white paper, it was announced, would be submitted to European heads of state at the Madrid European council. The paper was put in motion by Edith Cresson, Commissioner responsible for research, education and training and Mr. Padraig Flynn, Commissioner for social affairs, "and in agreement with Mr. Martin Bangemann, Commissioner for industrial affairs, information and telecommunications technologies". The press release also mentions that debates around the issues in the white paper would be initiated in 1996 - "The European year of lifelong learning", on the basis of which the commission would submit proposals for future action. According to one on-line source[21] the commission funded more than 500 conferences in European countries in 1996, on lifelong learning. In the following we will focus on the arguments for reforming European education, but will disregard legislative and operational aspects of the proposed reform elements in the white paper (including pages 34-66 that consist of objectives, examples and annexes).

[20] https://cordis.europa.eu/news/rcn/5257/en
[21] https://leksikon.org/print.php?n=5158

Even though the white paper does not deal exclusively with educational ICT, its relevance is justified by its importance and impact on defining European policy (Korsgaard et al., 2017) in the decades following its publication. As we will see, ICT plays an important role in a formulated vision for a competitive Europe - the dominant theme in the paper. The white paper launches concepts, that today are used broadly in vocabulary used to discuss what education should be for, and what its' basic premises are: Lifelong learning, employability, the information society etc.

In the foreword it is mentioned that the white paper is designed to "simultaneously provide an analysis and put forward guidelines for action in the fields of education and training". It builds ("takes forward") on another whitepaper, namely "Growth, competitiveness, employment. The challenges and ways forward into the 21st century skills" (EU, 1993) that stressed the need for "intangible investments", particularly in education and research. The focus on education has an important legal justification, written into articles 126 and 127 in the treaty establishing the European community: "the Community shall contribute to the development of quality education by encouraging cooperation between Member States and, if necessary, by supporting and supplementing their action". Main lines of action are:

- To encourage the acquisition of new knowledge.
- To bring school and the business sector closer together.
- To combat exclusion.
- To develop proficiency in three languages.
- To treat capital investment and investment in training on an equal basis.

The introduction of the white paper, is written in the light of an unemployment crisis, "which continues to increase", furthermore "...the spread of social exclusion, particularly among young people, has become a major problem..." (p. 1). Education and training, according to the authors, have emerged as the latest means for tackling the employment problem. In that regard, there are two challenges to address: providing immediate solutions and to prepare for the future by outlining an overall approach. These problems are situated in epochal terms, in the sense that they are discursively situated in what is perceived as a historically new situation, i.e. "the internationalization of trade and the global context of technology and the arrival of the information society" (p.2). In the white paper this new historical situation is

implicitly linked to the unemployment crisis. Even though this "information society" has boosted possibilities of access to information and knowledge, it has also changed how work is organized and the skills needed to navigate in a new reality - creating uncertainty for all, and "intolerable situations of exclusion for others". This requires a capacity to adapt, "particularly in assembling one's own qualifications on the basis of 'building blocks' of knowledge acquired at different times and in various situations. "**The society of the future will therefore be a learning society**." (p.2. emphasized in bold in the report). The white paper builds on a former white paper that revolves around competitiveness, i.e. Europe's financial status in a globalized economy. Education and training are components in a strong value-based vision for the individual: "Education and training will increasingly become the main vehicles for self-awareness, belonging, advancement and self-fulfillment" (p.2).

The premise is akin to the environmental concerns put forth by UNESCO a decade earlier. There is a "new" environment that we have to adapt to. But what is the role of computers in all this? The white paper does not use the terms "ICT" or "digital", but under the heading of "the impact of the information society", it becomes clear that digital and electronic technology has brought about an industrial revolution

*"...throughout the world, information and telecommunications technologies are bringing about a new industrial revolution which already looks to be as important and radical as those which preceded it*". (p.6).

Though it is stated that it "has not been demonstrated that new technologies reduce employment levels", there is, in the authors' opinion, no question that information technologies have radically altered the nature of work and the organization of production. Some of the consequences of this radically new nature are a turn toward decentralization, network-based cooperation and the development of work in teams. Routine and repetitive work can be codified, programmed and automated, and " Work content will increasingly be made up of intelligent tasks requiring initiative and the ability to adapt." (p. 5).
At the core of this new work-situation, is the obligation to learn to coordinate tasks in interactive on-line communication networks, which in turn puts new and increased demands on the autonomy of the worker. This situation is a double-edged sword: the role of the human factor in production processes is increased, but on the other hand makes workers "more

vulnerable to changes in work organisation because they are mere individuals within a complex network." (p.6) This development is not risk-free. In an interesting passage, the authors express worries that there is a risk that multi-media products in educational software "could lead to knowledge of the 'lowest common denominator' in which people lose their historical, geographical and cultural bearings" (p. 7).[22]

This could be interpreted as a veiled worry that US producers of educational software, won't be able to design their products to address the local and cultural context of the European learners, and instead will aim for generic levels of learning - a highest denominator logically being specialized local knowledge in specific, national job markets. This concern is one of several in the paper, others being the publics anxiety about technology as a threat (an irrational situation that can be overcome by disseminating knowledge), the indiscriminate bombardment of information from the mass media (literature and philosophy will help make sense in that situation, by arming the individual with critical sense) and the risk of young people finding themselves "inundated with messages offending human dignity" (p. 9). The report spends considerable energy developing a theory of passivity, in relation to learning. The information society promises to "change teaching methods by replacing the excessively passive teacher/pupil relationship with a new - and seemingly promising - interactive relationship" (p. 7). Later in the report this perception of a passive reality in education is repeated: "Observation, common sense, curiosity, interest in the physical and social world around us and the desire to experiment are qualities which are often neglected" (p. 12). It is a simple theory: education in the past has been passive, active qualities such as curiosity and interest have been neglected. The information society will change all that.
We will end the account of the themes in the white paper, with the conclusion reached in another report by the European round table of industrialists, advocating for "flexible training with a broad knowledge base, advocating a 'learning to learn' approach throughout life. It [the report] stated that, 'the essential mission of education is to help everyone to develop their own potential and become a complete human being, as opposed to a tool at the service of the

[22] **Full quote:** "The information society, notwithstanding the new knowledge techniques it heralds, raises the question of whether the educational content it carries will enhance or, on the contrary, diminish the knowledge of the individual. The focus up to now has been on the potential offered by information highways, through the revolutionary quasi-instantaneousness that the INTERNET, for instance, brings to contacts between firms, researchers and academics. The fear is the risk that the quality of multi-media products, particularly in educational software, could lead to knowledge of.

economy; the acquisition of knowledge and skills should go hand in hand with building up character, broadening outlook and accepting one's responsibility in society.'" (p. 10).
It is a vision of the constantly learning individual (that has learned to learn), developing her own potential, instead of simply being a tool at the service of the economy - but at the same time in harmony with societal demands for a competitive work force.
This EU-report is heavy on predictions, diagnoses and plans for the future. There are however many challenges associated with this future (human dignity, digital b-teams, the quality of digital software, increased vulnerability on the labor market etc.). The epistemic sources are often the EU's own previous publications, there is practically no inclusion of scientific evaluations of many of the claims in the report.

## 4.6. World Economic Forum "The global information technology report 2001-2002", aka. "Network readiness"

The Global Information Technology Reports have been published by the World Economic Forum since 2002. Each report consists of a series of articles revolving around a theme, and features the "Network Readiness Index" (NRI). NRI is a global index of the network-readiness of nation states. "Network readiness" is a term used by WEF to describe "countries' capacity to exploit opportunities offered by ICTs", and the index ranks 75 countries "on their relative ability to leverage their ICT networks". Denmark is ranked 7th. The index does not rank the *benefit* of ICT on countries' economies; it is a measurement of the *potential* opportunities offered by ICT. "The top-ranked country is the one with the most highly developed ICT networks and the greatest potential to exploit those networks' capacity" (p. 11). This capacity is measured on four clusters of "enabling" factors such as access to networks, ICT-friendly policies, social capital (meaning level of ICT-competences in the population) and "networked economy", such as levels of e-commerce infrastructure.

There are two chapters in GITR 2001-2002 devoted to education, which we will examine in a moment, authored by Mitchel Resnick and Robert Hawkins respectively. The report is prefaced by Klaus Schwab, well-known for his concept "the 4th industrial revolution", published in a book by the same name (Schwab, 2017). The 2001-2002 edition of the report was published in the wake of a recent, global economic crisis. In the words of Klaus Schwab, in the preface, the dust had just settled on the "new economy"-optimism of the late '90s and some of its "wilder claims". In the executive summary, Geoffrey S. Kirkman also references the recent crisis, and the political and economic volatility of the last eighteen months, causing many observers to "dismiss or forget the promise that the internet offers" (p. xiii).

### Rethinking Learning in the Digital Age

Mitchel Resnick's article, is also written on a somewhat somber background: "*Even though digital technologies make a learning revolution possible, they do not guarantee it. Early results are not encouraging*" (p. 32). According to Resnick, the problem is rooted in the fact that educational ICT is used "to reinforce outmoded approaches to learning". Approaches to

teaching and learning remain unchanged, while other domains in society (agriculture, medicine and industry) have been transformed by technological innovations. This requires a fundamental rethink of approaches to education. Resnick wants to contest a popular information-centric view on the value of computers, and invokes the Swiss psychologist Jean Piaget, to develop the notion of more active learning. Understanding is gained through "active exploration, discussion and reflection" (p. 33). The computer, is Resnick's main proposition, is a new medium for just that. There is a revolutionary potential in regarding the computer as a device to create and express oneself. Resnick mentions how people can create their own web pages, compose their own music or create simulated worlds on a computer. These are design activities, and the computer "is the most extraordinary construction material ever invented, enabling people to create anything from music videos to scientific simulations to robotic creatures." (p. 33). The problem with current practices with the computer, according to Resnick, is that people are taught to look up information, or use a word processor - instead of being taught to be "digitally fluent". To be fluent, is "to be able to articulate complex ideas or tell engaging stories" using a computer. The digital variation of this, is to be able to "construct things of significance" with computers - which will be a prerequisite for obtaining jobs in the future and for participating meaningfully in society, is Resnick's bold claim. Resnick's main concern is not the "digital gap" or the "digital divide", i.e. the differences in access to technology, because technology is on the verge of becoming virtually free and ubiquitous. The gap, that should be addressed instead, is "the fluency gap". To alleviate "fluency gaps" among the disadvantaged, Resnicks Media Lab and the Boston Museum of Science, have established a network of learning centers called "Computer Clubhouses"[23]. The clubhouses' aim is to help pupils (between the age 10-18) express themselves and "gain confidence in themselves as learners" through creative processes. How learning occurs in these settings is exemplified through the cases Mike and Jenny. Mike and Jenny work autonomously and inquiry-based, in a rich media context that provides "design leverage", and they report that they are very proud of their achievements, in some instances they even engage in subject matters, that otherwise first would be taught at university level.

[23] Today there are 100 computer club houses in 18 countries: https://theclubhousenetwork.org/locations/

### Reform

Resnick bundles these experiences and his analysis of the potential of computers and programmable bricks, into suggestions for reform, that essentially propose a more entrepreneurial approach to learning: students should be stimulated to be more active and more independent, and the teachers role should be reduced to serving as consultant (instead of "chief executive"). The curriculum based school, segregated into subject matters and age groups, should also be abolished. There should be a focus "on themes and projects that cut across the disciplines, taking advantage of the rich connections among different domains of knowledge" (p. 36), and where students of all ages work together in extended periods of time, enabling them to work more deeply and meaningfully. The ultimate aim is to focus more on "strategies for learning", than "things to know". All this prepares pupils for the digital age, where learning is a day- and lifelong experience. This is no longer the information society, he claims, it should be named the "creative society" - where digital tools provide the tools "that can help us improve and reinvent ourselves".

### Ten Lessons for ICT and Education in the developing World

The following article in GITR 2001-2002, written by Robert J. Hawkins from the World bank Institute, is aimed at developing countries, and picks up on some of the themes that Resnick touches upon. A shared analysis between Resnick and Hawkins is the fact that amazing advances have been made in the sciences in the last 100 years ("commerce, health care, transportation"), but that no similar advances can be observed in education: the classrooms look the same, students "furiously copying all that is written and said" (p. 38). This is an untenable situation, as a whole new set of skills is required in an information and knowledge-driven world. This world is also a networked world, where the ability to work in teams, "analyze issues from at multidisciplinary perspective", and to process information and share it are skills required by employers. These knowledge workers need to be flexible and "learn how to learn" and "quickly acquire new skills". Robert J. Hawkins proceeds to promote the "World Links" grant program (which he represents), whose mission it is to bridge the gap in skills, knowledge and educational opportunities between rich and poor countries. Ten lessons can be learned from the work with "World Links". I will not list them all here, they are a mix of technical recommendations, economic recommendations (to stimulate competition and promote private-public partnerships), technology-recommendations (to push for wireless

technologies e.g.), social recommendations ("get the community involved"), political recommendations ("link ICT to broader education reforms"), recommendations to alleviate teachers' intimidation with technology (and the complacency with their own teaching styles), by spending more resources on training. The last lesson is that ICT motivates students and energizes classrooms, makes students more attentive, develops students' sense of confidence, and finally: breaks down barriers between teachers and students.

Robert J. Hawkins is optimistic, that if these lessons are learnt, "schools a hundred years from now will sit at the heart of a learning society and allow youth from any country in the world—rich or poor—to have the same opportunities to create a better world." (p. 43).

### Summary of arguments

Mitchel Resnicks' article distinguishes itself, by the radical nature of its anti-informational stance - for him the value of computers does not consist of their capacity to find, or analyze information, but - like Pia Grünbaum earlier - to let youngsters express themselves creatively, through self-directed, inquiry based principles, and not least, "leverage" this creativity technologically. The problem, it seems, is that our conception of the benefits of computers is stuck in this information-centric mode - and the main explanation for the "discouraging result" that the revolutionary potential hasn't manifested itself.

### Barriers/problems

Besides the information-centric impasse in which we're stuck, Resnick doesn't identify (or mention) any negative consequences or risks associated to the technology-rich creative environments that he proposes

The implications for policy, is to abandon the cognitivist (or representationalist) mode, and bet on developing systems that can help students attain "digital fluency", through "Computer Clubs". Along with Seymour Papert, I suspect that Resnick has been one of the driving forces behind the popularity of the so called "fab labs", the open spaces that permit playful engagement with technology, and is often used as the theoretical justification for the value of Lego robots. Robert Hawkins' recommendations are one-sided: they consist of support for investment in digital infrastructure; getting the community onboard etc.

This report is a peculiar mix of realist and anti-realist positions. Clearly there are some facts out there to be discovered, notably "countries' capacity to exploit opportunities offered by ICTs". These can be identified, documented, aggregated, indexed - and related internationally. On the other hand, the evidence this analysis provides is of a "capability", not of a *reality*. This capability is abstract, intangible. For good measure, I have consulted the subsequent reports published by the WEF (where the network readiness index is also published), to find data points or interpretations that reveal knowledge about whether capability has translated to reality, or to be more precise: whether digitization has caused societal benefits. I can not find them. One would be inclined to say "Yes, of course! There is a clear correlation between GDP and digital infrastructure". On the other hand, some analyses say that such a connection does not exist, or that the causal chain runs they other direction: the richest countries invest in digital infrastructure *because* they have the funds. Michael Minges, for example, has tried to establish the causal relationship between GDP and broadband in "Exploring the Relationship Between Broadband and Economic Growth" (Minges, 2015) a cross-sectional study of econometric studies trying to establish the relationship between broadband and economic growth**.** His conclusion: "while econometric models are useful tools for estimating relationships, they cannot prove causation." and "One challenge in analyzing broadband and economic growth is the direction of the causality. In other words, does the level of economic development impact broadband penetration or is it the other way around?" (Minges, 2015).

As to Resnick's pedagogy, it emanates from a distinctly anti-realist position. He rejects the information-centric position. For him, the individual itself constructs education, and does so by playing with technology, and therefore rejects all classic and known hierarchies (to divide children by age), the use of a curriculum. He is a strong advocate for the social nature of learning. This is the Papert/Piaget position we have seen several times, and there is nothing exceptional about it - except that it happens in an econometric frame - where the truth is calculated and hierarchized and used to make nations accountable for their digital investments. If WEF were make an index of Resnick-inspired technology-fluency, what would the accountability yardstick look like? How could one measure this fluency (and the pedagogic strategies to support it)? The report relies on case studies and personal observations. Reflections on how to evaluate effects are absent.

### 4.7. National strategi for IKT-støttet læring (2007), aka. "E-learning"

This report is published by: The Ministry of science, technology and development
In the foreword of the report, the minister - Helge Sander - states that one of the biggest challenges to preserve our welfare society, is to continually develop competences and skills. Today, Sander continues, we have a well-developed technological infrastructure, but that should not restrict us from setting new goals. We have to exploit the potentials in technology contains, to strengthen education through e-learning. The general goal is to increase the use and quality of e-learning and make Denmark a world leader in e-learning. In the three years following the publication, with the cooperation of ministries, educational institutions and interest groups, a series of initiatives will be deployed. There are proposals for universes that make it more entertaining to learn, setting goals for e-learning in universities, and the development of e-learning processes for professionals in public employment.

The report consist of seven sections (mostly worded as recommendations or imperatives)

- E-learning, development of competences and results. We have the potential, now we will realise it!
- Children and youngsters should be motivated to use e-learning early in their lives
- Secondary education must use e-learning to reach pedagogical and strategic goals
- Public workplaces must be at the cutting edge of the use of e-learning
- E-learning should be a natural offer for private companies and their workers
- The citizens can become more capable via e-learning
- Good experiences should be documented, communicated and exploited across sectors

We will focus on the arguments in part 1 & 3 as they specifically explore the educational sector. In chapter one there are two premises set simultaneously: preservation of the welfare state, and the ability to do well in a global competitive society. This requires the ability for ongoing adaption, for development and to live up to new demands. Regarding the term e-learning: This report is the only one in our corpus that uses the term. In the report it is

acknowledged that a lot of different terms have been used through the times. Alternative names have been "ICT-supported learning", "technology-supported teaching", "computer based training" (CBT), distance teaching, blended learning, and mobile learning. The term e-learning is used in the report to cover all forms of ICT-supported learning methods.

On page 11 of the report there is a schema that outlines goals, initiatives for five different target groups: children, higher educational institutions, the public sector, private companies, and citizens. There is also a layer that transverses all target groups. I won't go through all the initiatives, but there is of course a strong focus on ICT-competences. For children, the project is to develop universes where they can learn in fun and entertaining ways - that resemble the fun and entertainment in the media they use outside school. In higher learning, the aim is to increase knowledge of ICT, strengthen the strategic use of ICT, increase the amount of ICT-based offerings, the establishment of a knowledge center and so on. Laudably, there are also initiatives to gather more knowledge about the quality and effects of e-learning, and in the transversal layer, to set in motion studies on the effects of ICT.

### Knowledge foundation:

It is a document rich in references. Despite its small size (26 pages), it manages to cite many different sources, of different types. There are references to publications and websites from other organs (consultancies, statistic bureaus, private organisations like the "e-learning monitor"), expert testimonies (the Dutch professor Wim Veen, author of "Homo Zappiens), private actors (Bill Gates), a professor at the pedagogical university (Birgitte Holm Sørensen, as quoted from a newspaper-interview). Past literature on the subjects, or former reports on the matter (like the ones in our corpus, or others) are not consulted or referenced.

### Arguments for:

This specific report is heavy on potential benefits, and does not see any risks at all - although it does mention that children should learn to use the technology critically. The arguments are all well-known. Educational ICT possesses "motivational force". It provides access to learning opportunities (outside the schools), opens up for flexible learning- and evaluation forms. The recurrent argument of differentiation also appears, and it extends to children with special needs. This differentiation can release resources for the teachers (who also have to spend less time on preparation). This can create additional learning.

### Arguments against:

There are no arguments against the use of educational ICT, but a cited survey (from companies using e-learning) shows that there are *barriers*, where six are listed: lack of IT-competences, lack of interest, lack of time, lack of overview over the market, lack of social aspects, and no offerings that match the demand. But these are barriers to further digitization, and not evaluations of whether digitization (in general or in certain forms) themselves could be a barrier to learning.

### 4.8. En digital folkeskole - national strategi for it i folkeskolen (2011), aka "A digital school"

In 2011 the Danish government published "*A digital elementary school - national strategy for IT in the elementary school*", it is 26 pages long.

The strategy is centered around 7 initiatives:

1: Financial aid for the purchase of digital learning materials
2: Effective distribution of digital learning materials
3: Wireless network in schools, towards 2014
4: Global access to computers
5: Development of national tests and graduation exams
6: Clear goals for the use of digital learning materials and digital learning goals
7: Research and development of it-based learning forms

Why is there a need for a strategy, the report asks rhetorically. There is a big, unexploited potential for an increased use of IT in elementary school. The elementary school must be at the cutting edge of exploiting and developing pupils' IT-knowledge by using digital learning materials and tools like portable pc's, tablet and mobile phones. The elementary schools must exploit both the motivational force and the learning potential in IT - and the possibilities that IT holds for differentiated teaching.

The initiatives support the government's general goal for the school that Danish pupils become "among the best in the world". An important step in that direction is the premise of the argument, is an increasingly digitized education. The role of digitization is to heighten the academic ("faglig") level of pupils and ensure that more people get an education. Digitization, can, is the argument, give better opportunities for differentiating and varying teaching, and by opening up for new and more flexible learning and evaluation forms. A better use of IT can also support the project of including pupils and students with special needs, because

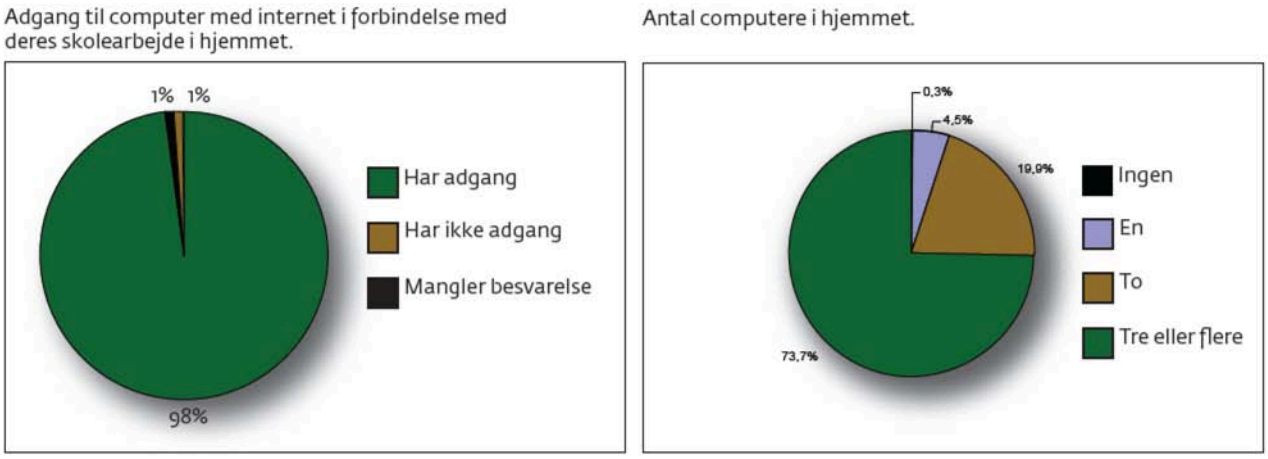
digitization makes it possible to learn in the tempo and at the level that matches the individual student. A stated goal is to teach pupils to use technology creatively and critically. They must be able to assess the quality of the information on the Internet and learn to express themselves on new media, and finally to co-operate digitally and internationally.
But there are more benefits: digitization can help teachers in their preparation, teaching and evaluation, so more resources are released to teach the individual pupil - thus creating more learning.

A supporting argument is made, by ascertaining that Denmark has the highest level of access to computers at home (according to OECD) - they are used to communicating on the internet with other children and youngsters, across national borders. They chat, seek knowledge, train, play, and engage in games. This preamble leads to the government's national strategy:

1. Support for the purchase of digital learning media
2. Effective distribution of digital learning media
3. Wireless networks on the schools towards 2014
4. That all students have access to computes towards 2014.
5. The development of national tests
6. Clear goals for the use of digital learning media and digital learning goals.
7. Research in, and development, of IT-based learning forms

### The knowledge foundation

To support the visions in the document, the text is accompanied by two infographics that visualise how many children have access to computers at home, and a chart that shows the amount of computers in the home.




**Figur 4 - graphs from "A digital school".**

There is also a reference to OECD (from 2009) declaring "internationally, the Danish school children have a unique IT-readiness". The strategy's goal is to stimulate a culture where IT to a much larger degree is used to further the pupils' learning. IT has to be used to strengthen differentiation so more are included in the daily teaching, and that all pupils are maximally challenged in relation to their abilities. The proliferation of IT has to support the teacher's ability to assess the pupils' development, and the parents should be offered means to better follow development, and thereby strengthen the dialogue with the schools. Finally, there a platform is imagined, a combination of a user portal and a learning managements system - i.e. a unified, centralized virtual location where schedules, homework, grades, messages and learning media are made accessible

Figur 2. Eksempel på et digitalt læringsmiljø på en skole

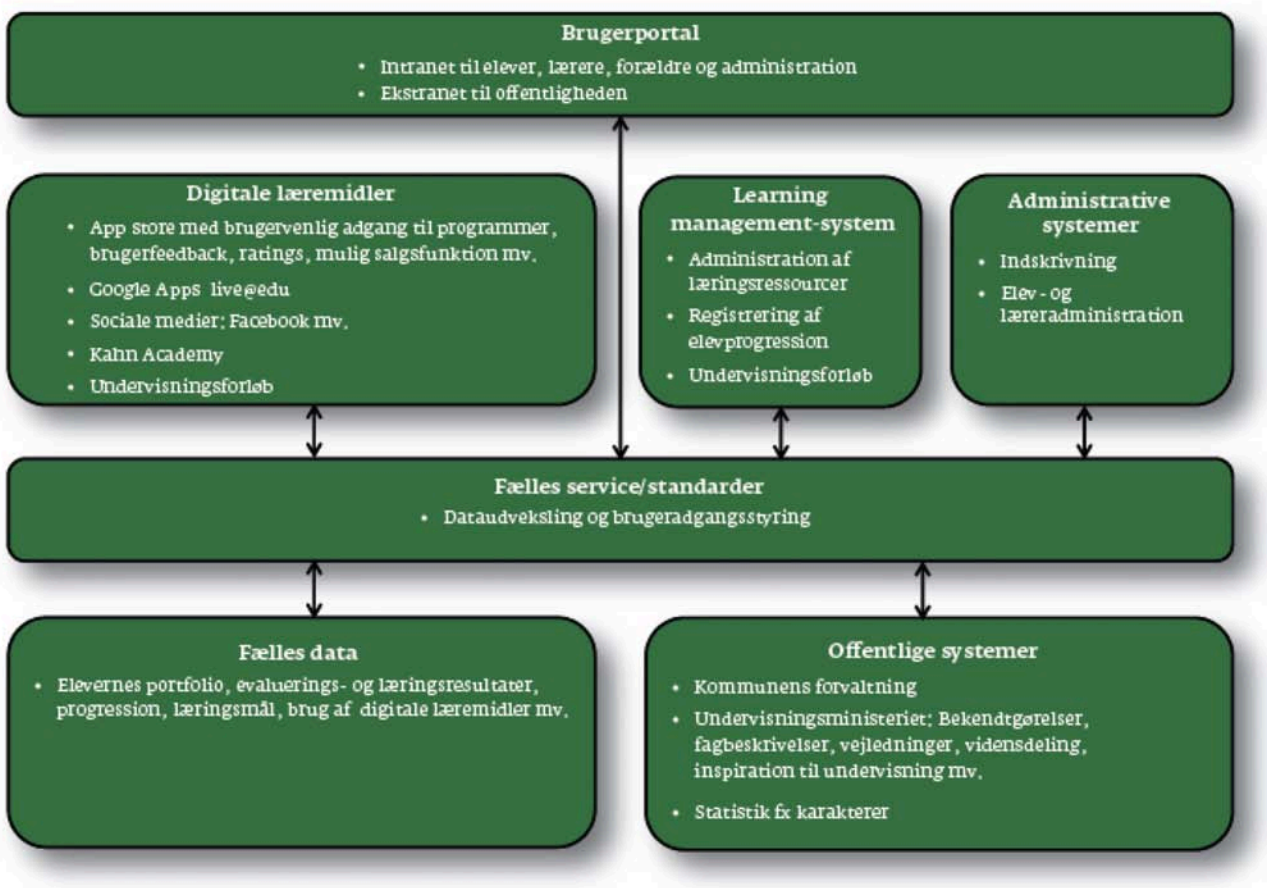



Figure 5 - a proposed schema of a digital learning environment

## Arguments and barriers?

Arguments for have been covered - efficiency, differentiation and engagement etc. There is no risk-assessment, but there are barriers, the document highlights four of them:
The potential is not being fully realized*:* Even though cited studies document that both teachers, children and parents to a large degree use the internet in relation to school, that teachers have foundational ICT-skills, and show willingness to explore digital software for use in education, that 2 out of three teachers have passed a "drivers license for computer skills" (IT-kørekort). Interestingly enough, it also mentioned that no effects of ICT can be measured. Explanations offered are, that IT is used as a *supplement* to education, instead of *integrated* into education. Other explanations are teachers' unwillingness to integrate ICT - despite their competences - which is caused by a bad IT-infrastructure, and the lack of digital materials of high quality and a underperforming distribution system. The market is characterized by

fragmentation and low sales volume. It needs to be kick started through public funds.

Material concerns: Not all students have their own computers, and many teachers point to the fact that the Internet can be unstable.

Lack of IT-based didactics: There is a need for more research.

There are no references to earlier evaluation studies, and there are no suggestions as to how the initiatives could be assessed.

### 4.9. Students, computers and learning (OECD, 2015)

We are reaching the end of our four-decade long journey through institutional reflection on the purpose, value, potentials and effects of educational ICT. The final sample in our empirical material is OECD's analysis of the value of educational ICT in their report "*Students, computers and learning - making the connection*." (SCL). As is noted on the back-cover, the report "*discusses differences in access to and use of ICT – what are collectively known as the 'digital divide' – that are related to students' socio-economic status, gender, geographic location, and the school a child attends.*" It is the report in our corpus, which most extensively rests on empirical data (statistical) data. In that respect it is less forward looking, less speculative, and "white papery" than our other samples, even though I would concur, that it to a very high degree bases the soundness of educational ICT on future political interventions, and uses its data and conclusions for the same breed of vision-making that we have been witnessing so far.

Students, Computers and learning is published by the OECD (Organisation for Economic Co-operation and Development), is 204-pages long. Andres Schleicher, director for "the directorate for education and skills", writes the foreword. On a methodological level, the statement is based on PISA-results. In it's own words PISA (Programme for International Student Assessment), "*is a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. In 2015 over half a million students, representing 28 million 15-year-olds in 72 countries and economies, took the internationally agreed two-hour test. Students were assessed in science, mathematics, reading, collaborative problem solving and financial literacy.*"[24]

[24] In the 2012 questionnaire (that the 2015 report analyses) the choice was made "to distribute the optional ICT familiarity component of the student questionnaire. In 2012, this component contained 12 questions, some of which were retained from the previous PISA survey (2009) to allow for comparisons across time. New questions focus on the age at first use of computers and the Internet; the amount of time spent on the Internet; and, since mathematics was the major domain assessed in PISA 2012, on the use of computers during mathematics lessons.
The OECD countries that participated were Australia, Austria, Belgium, Chile, the Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland and Turkey."
http://www.oecd.org/pisa/aboutpisa/

The empirical basis of many of the analyses in the report is based on results from PISA 2012. PISA is an "ambitious" (Kreiner, 2011) and large-scale attempt to measure and compare literacy in reading, mathematics and science in its 63 member countries. This is done by submitting 15-year olds a standardized test, and a background questionnaire. School principals also fill out a questionnaire about how their schools are managed[25]. The first survey was launched in 2009, and has been followed up every three years since then. In 2012 an addendum was made to the usual PISA-test, where the student survey asked questions about the ICT-habitus of the respondents. The report consists of 8 chapters, many of them featuring indexes that compare countries' performance on different measured parameters.

Chapter 1. How students' use of computers has evolved in recent years: a statistical account of access to ICT time spent online, use at home and at school, and first use of computers.
Chapter 2. Integrating information and communication technology in teaching and learning: A statistical account of education policies that seek to embed ICT into teachers' and schools' practices.
Chapter 3. Main results from the PISA 2012 computer-based assessments.
Chapter 4. The importance of navigation in online reading: Think, then click.
Chapter 5. Inequalities in digital proficiency: Bridging the divide.
Chapter 6. How computers are related to students' performance.
Chapter 7. Using log-file data to understand what drives performance in PISA (case study).
Chapter 8. Implications of digital technology for education policy and practice.

In the foreword, Mr. Schleicher describes how ICT has revolutionized every aspect of our life and work. Inability to "navigate through a complex digital landscape" will hinder students in participating in the economic, social and cultural life around them. This landscape is loaded with challenging issues such as information overload, plagiarism, online fraud, privacy violations, online bullying and unhealthy media diets. OECD, says Mr. Schleicher, expects that schools educate students to become critical consumers and avoid harmful behaviors, i.e. to raise awareness about the risks that children face online. As to the result of the empirical analysis, the situation is less than optimal, or in Schleicher's words: "The reality in our schools

[25] http://www.oecd.org/pisa/aboutpisa/

lags considerably behind the promise of technology". The first element of this lag is the fact that only 72% of the questioned pupils have access to a laptop at school (in some countries less than half of the students have access). Surprisingly, students who use computers very frequently do a lot worse in most learning outcomes. Additionally, countries that have invested heavily in in educational ICT show no appreciable improvements (in the three tested areas, mathematics, reading and science). Finally, the promise of social mobility that ICT has carried (that access to internet could lift less advantaged students out of poverty), remains elusive. One very straightforward explanation of these findings is that "building deep, conceptual understanding and higher-order thinking requires intensive teacher-student interactions, and technology sometimes distracts from this valuable human engagement" (p. 3). This does not lead Mr. Schleicher to suggest that (his and OECD's) emphasis on educational ICT should be revised or minimized, but instead proposes three other hypotheses, that lend themselves to policy advice that can remedy the situation. Without having to restrict the use of educational ICT. After all, "technology is the only way to dramatically expand access to knowledge." (p. 4).

1. The overestimation of digital skills.
2. Naive policy designs and implementation strategies (rooted in a poor understanding of pedagogy).
3. The poor quality of educational software and courseware.

For convincing strategies to be developed - that address the suggested root-problems - investments in development and change-management skills are needed. One part of the solution is to turn teachers into "active agents for change" (they have the tendency to "opt to maintain the status quo" (p. 4) in the face of uncertainty) is Mr. Schleicher's analysis.

### Knowledge foundation

Students, Computers and Learning, is remarkable by relying exclusively on its own data. We are a long way from the early '80s where it was normal to include theoretical literature to interpret data and observations. It is also an interesting document in our corpus: it is a disappointing climax after four decades of formulating hopes - it is confident in the evidence it produces, even though this evidence contradicts the project itself.

### Arguments for and against:

In the foreword, Mr. Schleicher highlights problems as they appear in the data-set:

- On a general note: the reality in schools lags behind the technological promises.
- Not enough have access to a computer (only 72% report that they have a laptop, a tablet computer or a desktop at school.
- Students who use computers very frequently as school do a lot worse in most learning outcomes.
- Countries that have invested heavily in ICT for education show no appreciable improvements.
- Technology is of little help in bridging the skills divide.

But we must not be led to despair by these findings. There is a lot of potential:

"*Technology is the only way to dramatically expand access to knowledge. Why should students be limited to a textbook that was printed two years ago, and maybe designed ten years ago, when they could have access to the world's best and most up-to-date textbook? Equally important, technology allows teachers and students to access specialised materials well beyond textbooks, in multiple formats, with little time and space constraints. Technology provides great platforms for collaboration in knowledge creation where teachers can share and enrich teaching materials. Perhaps most importantly, technology can support new pedagogies that focus on learners as active participants with tools for inquiry-based pedagogies and collaborative workspaces. For example, technology can enhance experiential learning, foster project-based and inquiry-based pedagogies, facilitate hands-on activities and cooperative learning, deliver formative real-time assessment and support learning and teaching communities, with new tools such as remote and virtual labs, highly interactive non-linear courseware based on state-of-the-art instructional design, sophisticated software for experimentation and simulation, social media and serious games." (p. 4).*

## 5. Findings

In the following tables I have summarized arguments for, perceived problems and epistemic sources. I will discuss them in the conclusion (next chapter).

### 5.1. Positive arguments, summarized, international reports:

| Visions and reality | The cognitive society | Network Readiness | Students, computers and learning |
|---|---|---|---|
| - Affinity of children to machines<br>- Computers as interactive, individualized tutors<br>- Develops skills that allow good jobs in information based national economy<br>- The capability of computers to improve the overall level of student achievement<br>- Potential multi-dimensionality of computers as interactive, individualized tutors. | -Enhancing knowledge<br>- Mobility<br>- Potential for self-teaching<br>- interactivity<br>- Skills | - Accessibility (due to declining costs)<br>- Potential to fundamentally transform how and what people learn Throughout their lives<br>- Enable people to transmit, access, represent, and manipulate information in many new ways<br>- A new medium through which people can create and express themselves<br>- Computers can be used for designing and creating things<br>- Computers can also be used as a “material” for making things | - Dramatic expansion of knowledge<br>- Up-to-date<br>- Access to specialized materials, in multiple formats, "with little constraints".<br>- Platforms for collaboration<br>- support new pedagogies that focus on learners as active participants<br>- With tools for inquiry-based pedagogies and collaborative workspaces.<br>- Technology can enhance experiential learning<br>- Foster project-based and inquiry-based pedagogies<br>- Facilitate hands-on activities and cooperative learning<br>- Deliver formative real-time assessment and support learning and teaching communities, with new tools |

## 5.2. Positive arguments, summarized, Danish reports

| Statusrapport | The info society 2000 | E-learning | A digital school |
|---|---|---|---|
| - Limited material to learn<br>- Possibility to learn in breaks from work<br>- The student can learn in her own pace<br>- Money can be saved on expenses for teachers | - Unique possibilities<br>- Adaptive teaching<br>- Communication via international networks<br>- Work in your own tempo at your level<br>- Release of teacher resources for needy children<br>- Different and exciting contact | - Potential to strengthen education and development of competences through e-learning<br>- Flexibility: independent of time and space<br>- More people can participate (special needs)<br>- own tempo, repeat as needed<br>- sensory stimulation<br>- strengthen reflection by communicating directly with teacher and peers<br>- whiteboards: more pedagogical possibilities, less dependency on traditional learning aids, new ways of thinking teaching and inspiring<br>- teaching across geographical boundaries<br>- repetition | - Digitization makes it possible to learn in the manner, in the tempo, and at the level that best matches the individual pupil<br>- it can help teachers in their preparation (and thereby release resources for the individual student)<br>- IT has motivational force and learning potential<br>- Possibilities for differentiated teaching |

### 5.3. Critical arguments, summarized, international reports:

| Visions and reality | The Cognitive Society | World-readiness | Students, computers and learning |
|---|---|---|---|
| - Papert's seminal work is as yet unsupported by firm data.<br>- Fabulous claims of computers' effect on the educational process have not been observed in the real world.<br>- We must be cautious before we move forward | - Affront to human dignity<br>- Risk of generic learning materials<br>- Risk of creating a digital b-team<br>- indiscriminate bombardment of mass media<br>- Vulnerability of labor | - Information-centrism | The digital milieu:<br>- Information overload<br>- Plagiarism,<br>- Online fraud<br>- Privacy violations<br>- Online bullying and unhealthy media diets |

## 5.4. Critical arguments, summarized, Danish reports:

| Statusrapport | Info-society 2000" | E-learning | The digital school |
|---|---|---|---|
| - Risk of abstracting knowledge<br>- Risk of commercialising education<br>-Risk of education having to adapt to the technical system instead of the other way around<br>- Papert-pedagogics too weak<br>- Lack of bildung<br>- Excessive rationalism | - Lack of possibility to become personal users<br>- Not enough education in the seminars<br>- Lack of programs<br>- Lack of pedagogical IT skills<br>- Insecurity towards IT | - E-learning is not yet a natural choice (to the same extent as peer-learning or "presence-learning")<br>- Not all institutions see e-learning as a strategic tool for building competences<br>- Lack of knowledge about what e-learning can be used for<br>- High development costs<br>- Limited availability of good learning materials<br>- Institutions hesitate<br>- Teachers feel insecure about the pedagogical possibilities in e-learning<br>- Educators don't possess the necessary ICT-competences<br>- Some citizens don't possess the necessary ICT-competences to use e-learning<br>- Not all citizens have access to e-learning.<br>- Many think that e-learning is an isolated activity with no social relations<br>- Some participants lack will and desire to participate | - Underutilized potential<br>- Limited access to educational technologies<br>- Lack of access to stable wifi<br>- Lack of knowledge about it-based didactics<br>- Insecure teachers<br>- Lack of knowledge sharing<br>- Lack of access to digital materials of high quality. |

## 5.5. Epistemic sources, international reports

| Visions and Reality | The cognitive society | Network readiness | Students, Computers and Learning |
|---|---|---|---|
| Papert, 1980; Williams and Williams, 1985; see also Cuban's (1986)<br><br>Yourdon 1986<br><br>See appendix 3 for full list of sources | Condorcet (quote)<br><br>Historical legal instructions<br><br>Reports on prior initiatives<br><br>Use cases<br><br>EU-initiatives<br><br>Annex 1: Statistics from EU and OECD<br><br>Annex 2:<br>Cases: Examples of Community programmes in the field of education and training<br><br>Annex 3: Case study: Alyat Hanoar (Israeli school)<br><br>Annex 4: The experience of "Accelerated schools" in the USA | - WEF data<br>- Prior initiatives<br>- Personal reflections<br>Case study: computer clubhouses<br><br>Case study Denmark (Learning Lab Denmark)<br>Martin, F., B. Mikhak, and B. Silverman. "MetaCricket: A Designer's Kit for Making Computational Devices." *IBM Systems Journal* 39, 3 & 4 (2000): 795–815.<br>Papert, S. *The Children's Machine: Rethinking School in the Age of the Computer*. New York: Basic Books, 1993.<br>Papert, S., and M. Resnick. "Technological Fluency and the Representation of Knowledge." Proposal to the National Science Foundation. MIT Media Laboratory (1995).<br>Resnick, M., F. Martin, R. Sargent, and B. Silverman. "Programmable Bricks: Toys to Think With." *IBM Systems Journal* 35 (1996):443–452.<br>Resnick, M. "Technologies for Lifelong Kindergarten." *Educational Technology Research and Development* 46, 4 (1998).<br>Resnick, M., N. Rusk, and S. Cooke. "The Computer Clubhouse: Technological Fluency in the Inner City." In *High Technology and Low-Income Communities,* edited by D. Schon, B. Sanyal, and W. Mitchell. Cambridge: MIT Press, 1998: 266–286.<br>Resnick, M., R. Berg, and M. Eisenberg. "Beyond Black Boxes: Bringing Transparency and Aesthetics Back to Scientific Investigation." *Journal of the Learning Sciences* 9 (2000): 7–30. | PISA data<br><br>Prior reports |

## 5.6. Epistemic sources, Danish reports

| Statusrapport | Info-society 2000 | E-learning | Digital Society |
|---|---|---|---|
| Informationsteknologiens betydning for individets socialisering in "Nyt om uddannelsesforskning" nr. 2, 3. årg. 1983<br>Dines Bjørner: "Informatoriske undervisnings-systemer" in, Egmont Fondens årsberetning<br>Bjerre Lavesen Uddannelse via Informatik, Danmedia 1983<br>Seymour Papert, Mindstorms<br>Immanuel Kant: "Beantwortung der Frage: Was ist Aufklärung?" (1784), Felix Weiner erlag, Hamburg 1965<br>Jean Jacques Rousseau, op cit. Bd. II<br>Peter Bøgh Andersen: "Kommunikation i menneske-maskine systemer" i: Hans Hessellund, Ole Prehn og Ulla Burskov: "Den Papirløse undervisning"<br><br>Future trends (based on demographic data) | Expert-testimony: Pia Grünbaum & Steen Larsen<br><br>Ministerial clerks (unnanmed)<br><br>Organisations (unnamed)<br><br>Conference-participants (unnamed)<br><br>Appendix 17: Historical legal instructions<br><br>Positivist survey of no. of computers<br><br>Market surveys<br><br>Reports on prior initiatives<br><br>Speculation on the future<br><br>Appendix 18: Personal experiences, observations, attitudes<br><br>Seymour Papert & Jean Piaget<br><br>Speculation on the future | National political strategies, action plans<br><br>Ministerial reports<br><br>Danmarks Statistik (2)<br><br>Use cases: Stanford University & local highschool<br><br>Rambøll (3)<br><br>EVA<br><br>Expert testimonies<br><br>Wim Veen<br><br>Reports on prior initiatives<br><br>Computerworld (Bill Gates-quote)<br><br>Emu.dk<br><br>Eviden.net<br><br>Forskningsnettet.dk<br><br>KVL<br><br>Teknologisk institut | OECD (PISA)<br><br>Infographic (materialeplatformen)<br><br>”Digitale læringsressourcer i folkeskolen og de gymnasiale ungdomsuddannelser”, DREAM: Danish Research Centre on Advanced Media Materials og Læremiddel.dk (2)<br><br>Nationalt videncenter for læremidler, 2009<br>”It i skolen – Undersøgelse af erfaringer og perspektiver”, Danmarks Evalueringsinstitut, 2009<br>”Beyond Textbooks – Digital learning resources as systemic innovation in the Nordic countries”, OECD, 2009 |

## The end

We have reached the end of our analysis of eight political reports: Four of them are from international institutions - UNESCO, the European Union, World Economic Forum and the Organisation for Economic Co-operation and Development. Four of them are from Danish governmental organs - the ministry of education, the ministry of research, the ministry of science, and the government. The first report in the corpus was published in 1983, the latest in 2015. The focus has been on evidence-related issues, by documenting epistemic practices (by identifying which knowledge is used to evaluate or imagine effects), and secondly what the implications this knowledge - in the shape of data, experiments, expert testimonies, case-studies etc. - have for policy. These implications are often based on interpretations of empirical data, as expressed in forewords, introductions and prefaces to the reports. The analytical model I have leaned on is Lee Braver's realism/anti-realism matrix, a dichotomy that distributes onto a set of classical philosophical problems that I have judged important for the project of grasping tensions in the literature. These reflect an often-perceived divide between the realist sciences and the human sciences. The purpose has been to highlight epistemic practices, focus on perceptions of the learning subject (often as either passive or active) and the role of language versus reality as they play out in the practice of evaluating and imagineering within a political context. The proposition is that the categorization can be extended to the visions behind educational ICT itself, be it the artifacts, the software or the didactics developed for them. This discussion had bearings on evidence-practices themselves and whether evidence is used in a cumulative, realist process or a social process. Can the project expect to end sometime soon, or is it the expression of ongoing cultural configuration and re-configurations?

# 6. Findings

## 6.1. Comments on the empirical analysis

This section is structured in three parts. First I will answer some questions relating to the research goals and the pedagogical introduction, secondly I will zoom in on the use of evidence and finally I will describe secondary findings relating more generally to work with the dissertation.

### 1: Research goals

In the "Research Goals"-section, I raised a number of questions:

What is the political use of literature reviews published by entities that call themselves "Consulting Services" - and why are they commissioned for their services, instead of relying on studies from universities e.g.?

*Answer:* In the Danish reports especially, there is an extensive use of private consultancies, Rambøll being the most prominent. In the corpus there are no direct explanations as to why they are commissioned, instead of relying on academic research e.g. The most natural explanation is that they are the product of a broader ambition of creating private & public partnerships. In this instance, it means bringing in private actors to do surveys and investigations. The second, darker, explanation is that there is a long history of not being able to provide evidence for social interventions in general, and for the value of ICT in education specifically. It is very difficult to design policy on the basis of knowledge concluding that "it's complicated". As a minimum, it requires studies that take longer to carry out than the typical period a politician is elected for, and this could be an explanation for why faster studies are preferred.

Is the use of evidence indicative of a positive, irrational, bias towards ICT?

*Answer:* This question was asked following a use of the term "conclusive evidence" in a systematic review commissioned by the Scottish government (ICF Consulting Services Ltd,

2015). In our corpus, it is clear that care and caution are advised when trying to answer the question, but that there is an inflation going on, in the use of the term evidence (and in the numerous aspects of education considered worthy of providing it). The methodological problem is that many of the studies are not carried out using analogue set-ups as a controlling factor. The Hawthorne effect states that it is very easy to produce evidence in new studies (that are announced as such), and that experiments should be carried out long enough for the novelty factor to wear off. Educational ICT-studies, with their focus on innovation and demands of staying on top of the development, make it structurally very challenging to adhere to these demands, and fall prey to launching new studies for each new technological development instead of staying on track with older technologies. A more rigorous approach would be to compare analogue and digital interventions more systematically (if it can be ethically defended to deprive some groups of exciting new technology), instead of the continuous stream of new studies trying to measure the effect of MOOCs, VR, augmented writing etc. This could even be done in technical computer-subjects. Can we train programmers without the use, or with very limited use, of technology? How would students perform in settings that focused on attaining the grammatical, mathematical, logical and social skills that often constitute the background support factors of much digital professionalism?[26] My analysis is that there is a technological bias at play, witnessed by the absence of analogue control-groups.

What are "the other benefits", mentioned in the quote from the Scottish government?

*Answer:* The best example is Mr. Schleicher's long list of potential benefits (OECD, 2015, p.4). Even though evidence is hard to produce, or if evidence undermines the validity of the intervention, it is common to downplay those findings, in light of the many potential uses of the computer, and reservations in light of potential future developments. In the words of Liza Loop (Daley et al., 1987)

*"...even though computerizing education as a whole does not seem to result in more or better*

[26] "Computer Science Unplugged" is an example of such an endeavour: https://csunplugged.org/en/

*jobs for the average pupil, there is a potentially highly skilled group of programmers and engineers who are needed and might be trained by considerable investments in computer-based education, especially in secondary school*." (p. 6).

How do we categorize digital artefacts, and is it at all possible to evaluate effects over longer time periods, if the digital artefacts change radically (in form and functionality), constantly and over short time spans?

*Answer:* Keeping Liza Loop et al. in mind: Their advice for policy-makers sounds like this: "Evaluations must [...] be tailored to specific situations" (do. p, 6). I would extend this advice to tailoring evaluations to specific technologies, aware of the pedagogy behind the designs and their intended output (the pedagogies that Neil Selwyn identified), and as noted above, to compare this to groups that are taught without technology. But more importantly, it would make more sense to categorize the analytical objects by their pedagogical design and the well-meaning intentions behind them. Instead of investigating the value of collaborative platforms e.g., could we instead investigate attempts to make students aware of the value of collaboration, and increase their co-operative skills - through both technological and analogue means? Digital pedagogy can in many instances be understood as a longing for "active pedagogies" and active students. It expresses a genuine concern for the future of young people, and aims for an ideal student that we should strive for. These intentions and ideals should not be dismissed, even if the attempt to carry them out technologically fails.

How is it possible to account for local contexts, differences in pupils' individual preconditions, socio-economic backgrounds etc.?

I have already suggested that this is nearly impossible, but also reported views that increased data could solve this problem. In Denmark, there are attempts at large-scale data-collection, for the purpose of predicting problems a priori, and understanding the relationship between household-income, gender, geographical address, age and student performance among some of the data-points (the municipality of Gladsaxe is a current leader in this approach)[27].

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### 6.2. Pedagogical analysis

The analysis corroborates many of Korsgaard et al.'s characterization of the current epoch as the epoch of globalization and lifelong learning.

- Interplay between national states and global institutions like the EU and the OECD. Or perhaps more precisely, the legitimacy of national education is compared against the other nations that are members of the international or global institutions.
- That the performance of the child is cast in the light of global, economic competitiveness
- The child/the student is born with a potential that can be released through the right pedagogy, the ideal child, student, citizen is competent
- Constructivism is a dominating pedagogy (Piaget and Papert), along with social-constructivism (a focus on social competences, rather than stable, timeless knowledge).
- Educational institutions are legitimized through their global performativity, and ability to compete with other nations.
- A focus on entrepreneurial competences
- Finally: an increased use of digital learning games, the Internet, Google and Facebook.

It also seems fair to characterize the current epoch as similar to the Middle Ages: education is centrally formulated (by international institutions), the religion is financial growth, and the role of nation states and educational institutions is to manage and interpret their practice according to centrally formulated ideas.

Regarding Neil Selwyn's categories: they are useful as an analytical tool to understand the anthropology at work in the different digital learning methods (and the pedagogical perspective that determine them). They are also useful for identifying the different learning theories that are deployed simultaneously in the interfaces and designs of educational ICT-products. This dissertation has not engaged in a material analysis of concrete products, but

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http://www2.gladsaxe.dk/C12575EB003B3720/0/F0C4D17921847BA8C12581090024B0A3/$FILE/Bilag_42.1.1_Pejlem%C3%A6rker%20for%20Fremtidens%20skole.pdf

based on my own observation, it is common that the same interface can contain constructivist, cognitivist, behaviorist, social-constructivist and connectivist elements. It would be an interesting further study, to determine the proportional distribution of the different learning definitions and pedagogical perspectives in the same products, and how this potentially affects the production of evidence, or the confusion thereof. The most interesting finding however is the co-occurrence of constructivist and behavioral elements in the system itself. It is clear that education has become increasingly "output"-oriented, but at the same time there is a strong focus on the supreme individuality of the learning subject, including the supreme right to reject past knowledge and traditions in favor of the Roussean or Piagetian approach: self-directed inquiry, play, curiosity etc. These are often "sold" under the guise of innovation and entrepreneurship. There seems to be a fundamental tension between these values and attempts to numerize, compare and situate tests and measurement on indexes. A good example of that is the structured nature of the PISA-tests, claiming to measure real-life competences, and the simultaneous claim that the future needs creative and critical students. The PISA-test does not give points to students who prefer to create something in the lab, instead of participating in the test (and the preparations for it).

### 6.3. Findings on evidence

The empirical analysis revealed different types of explanations for this lack of evidence.

1) The first explanation rests on a perceived lack of support factors. There is not enough access to devices and/or the Internet connections are not stable enough. The implication is that when the technical infrastructure is in place, results will manifest themselves.

2) A second explanation leans towards a psychopathological diagnosis: there is a perception that (as a professional group) teachers are afraid, insecure or prefer the status quo when confronted with new technologies. This psychological state of mind constitutes a barrier for change.

3) A third explanation concerns the level of IT-competences in teachers: they simply do not know how to use the technology.

4) A fourth explanation relates to the quality of digital learning material (especially in Denmark): it can be to generic, the market itself is to small to spur competition that could produce learning materials of high quality.

5) A fifth explanation concerns lack of data. This explanation works with the axiom that reality itself (or the cognitive environment/the world/the present/the future/the workplace) has become digital, and that education should mirror this reality. The data will eventually reveal why it is reasonable.

6) A final explanation, stemming from especially neuroscientific studies, is that digital devices and the content on them, distract pupils or students, makes them addictive, hinders "deep learning", can create loneliness and anxiety etc. - factors that can be detrimental to learning.

It is not a consistent feature of the reports to propose concrete remedies for these problems, but we can synthesize or infer typical recommendations (based on theoretical literature and the proposals in the extensive corpus).

1. To invest in a seamless infrastructure.
2. To change the mindset, by rewarding digital frontrunners among teachers.
3. To educate teachers so they acquire the necessary competences.
4. To support the creation of learning materials of a higher quality.
5. To increase the production of data - by tying all activity into learning platforms e.g. This can facilitate the production of data on pupil or student activity, monitor progress and provide knowledge for interventions.
6: To educate in "digital literacy", i.e. to teach the learning subject to navigate the pitfalls of digital technology.

This, is my assessment, has become the standard political recipe for dealing with educational ICT. It is a resilient model, or a diagnostic tool, that transcends a given technological reality. My prediction is that we will see many reports in the future that will follow this model when it comes to discussing the merits or evidence the benefits of Virtual Reality, biometric technologies, instances of artificial intelligence etc.

### 6.4. Secondary findings

Epistemic sources: As mentioned (too many times?) before, the corpus is synthetic; it is an artificial construction that cannot claim to reflect what goes on in the totality of political report-production in the period. It is a small selection of potentially thousands of reports. The following reflections only make sense, if one accepts that they are representative of the history, because they represent the most influential organizations, and if we assume that the individual report in the corpus is indicative of general practices, attitudes and epistemic practices within the organizations. This amounts to trusting that institutions are entities that show stability, and continuity over time - despite the traffic of different employees within them.

It is pretty clear, overall, that pedagogical sources - i.e. continental luminaries from the far past, like Kant, Rousseau (but also more recent thinkers like Paolo Freire), play a very small role in policy papers, and in the instances where this is the case, it happens only in the first half of the period (continental thinkers that do appear are Rousseau and Kant in "Statusrapport" and Jean Piaget in Info-society 2000). It is safe to say that continental (anti-realist) thinkers have had a very limited influence on the political justifications of digitizing education. But that is only valid on the surface: the towering figure, in our corpus, is Seymour Papert, who takes on a radical (continental, Piaget-inspired) constructivist position that is ideologically and methodically very far removed from realist traditions. The majority of sources included (also when including Daley and Loop's comprehensive bibliography) draw their knowledge from recent literature. The practice of supplying bibliographies seems to weaken over time, indicating a detachment from scholarly practices, or a declining belief in the value of theory. Whether this is indicative of the authors' educational background or training cannot be determined, but could be used as circumstantial evidence thereof. Earlier I quoted Selwyn for stating that despite the current prevalence of the interest in "learning", there are remarkably few developed theories on learning in the space. The lack of inclusion of pedagogical thinkers corroborates this. Another explanation for this could be the epochalistic perception that this phenomenon is so new and unique causes policy writers to think that

previous knowledge does not apply.

The active learning subject: A dichotomy of active versus passive learning underpins many arguments and recommendations. Frequently, digital learning tools promise (as the following quote from the Learning Society indicates):

*"The information society is going to change teaching methods by replacing the excessively passive teacher/pupil relationship with a new - and seemingly promising - interactive relationship"*

The passive relationship references, in my interpretation, alludes to the lecture format especially. A format where a knowing authority disseminates knowledge to large groups of students, who receive it "passively". Sometimes the "activity" is veiled as a critique of the status of the teacher. In pedagogical discussions, the notion of the subject is of course crucial. In almost all pedagogical theories it is the individual subject who learns, not the class, the school, or a generation of pupils. In other words, theories of learning that do not consider the subject as the theoretical framework of learning, are practically non-existent (one exception being learning as the aggregate result of the wisdom of the crowds, in the connective model). This also means, that learning is perceived as something that happens in the individual brain, often with a subjective preference for instructional material, knowledge, and teaching delivered in a style that suits the individual. Intuitively, at least as a westerner, it seems nigh impossible to disagree with the proposal that the subject should be active (generally, and in the way she learns). An opposite proposal creates associations to mass-education, to memorizing canonical texts or cultural products (as religious education in the middle-ages often has been purported to consist of), to an oriental (Chinese) perception of the subject as relatively unimportant compared to "the state", "the nation" or some utilitarian notion of the average state of the collective. But is the lecture-format strictly "passive"? Does a political strategy of "active learning" automatically result in an active subject? And does this activity translate to higher learning attainments? Or, to be more concrete, has the claim that computers foster more active learning, and the investments in computers, had the effect that the subject has become less passive? At which levels do we situate the activity/passivity: in the body, in cognitive or mental processes, in social processes, or do we detect the positive

effects of "active"-learning in *output* (test results, exams)? Correspondingly, at what level does digital technology stimulate this activity? It is not clear from our corpus - and it is worrying (or ironic) that in some cases the opposite seems to be happening, as witnessed by the studies of the negative effects caused by a sedentary lifestyle associated to overuse of screen-media. One report by the European Parliament - in the extensive corpus - addresses this issue (Pastor & Quirós, 2015), and maybe it is what Mr. Schleicher is referencing when he talks about "appropriate media diet" (Students, Computers and Learning, p.4). Again, the theory of the active learner seems to be an expression of idealism more than it can be observed as an empirical fact - if that is at all possible.

Temporal dimension: It has been a surprise to observe the tenacity (and the redundancy?) of the arguments over the four decades (besides the ones related to evidence and evaluation). There is a consistency in the perception of a crisis - it consists essentially of the worry that education lags behind market-developments. There is a consistency in the longing for active learners, and in the perception that the educational system of the past (even the recent past) i is passive and molded on an industrial architecture. This is mirrored in the perception of the differentiating potential of technology - despite how old this idea is. And how hard it has been to provide evidence for the benefits of the active pedagogy.

Intensity: It is an (overwhelming) surprise that so many institutional actors publish so many reports with such short intervals. It is intense, but it is also seems redundant. It is surprising - given the economic power of international institutions that inspire them - that there is no project to formalize and structure the totality of institutional publications, so new writers can avoid producing redundant findings. By formalization and structure, I simply mean a central database, and a culture of structuring documents technically (equal to the W3C[28]-standards governing web-pages) for the sake of comparability. In the postscript I suggest one approach to solving this problem.

The problematic past: This leads to the last secondary finding. It is a surprise that reports are so biased towards potentials instead of identifying (and solving) consistent and invariant

[28] https://www.w3.org/

problems. This observation is based on the fact that Mr. Andreas Schleicher does not reference the analysis in Vision and Reality e.g. Or that the report "The digital school" does not revisit the visions in "Info-society 2000", to gain insight into whether recent visions have become a positive reality or not.  I am a bit unsure of the validity of this perceived lack. It implies a normative vision of institutions being aware of their institutional peers and their past publications, and that negative findings should be integrated into the practical reality of policy-making. This normative proposal, might say more about this researchers lack of understanding of the power dynamics in policy, than it does about the history of educational ICT.

### 6.5. Discussion: an alternative explanation

The work with this dissertation leads to other explanations as to why evidence is so hard to produce. The first is methodological in nature, as we have seen many times. To conduct evidence-studies requires designs that are costly and carry with them the risk that no significant effects will be detected, due to the complexity of the field and the amount of data required to catch the different factors influencing the field. Steen Nepper Larsen tries to imagine what an adequate experimental setting would look like:

"*Besides the tough and probably insurmountable technical challenges of establishing such an experimental setting (should the people be held in individual tubes?), the wildest task would be to transform something such as 60 x 20 to 40 X 13 X 1012 synaptic 'learning' data into a trustworthy scientific language."* (Larsen, 2019)

This ambition has the problematic social effect of turning the educational system into a laboratory-like setup - in order to control moderators, suppress statistical noise and reduce the number of parameters. This is at odds with the historical purpose of education (and the legal purpose of education in Denmark): to encourage liberty, to respect the individual student (there is little place for the pupil or the student who does not thrive in data-capturing environments), and other ideals connected to European and Scandinavian ideals of *bildung*.

The second, also methodological in nature, pertains to what is being measured. As we have seen, it is relatively easy to measure and test on certain types of knowledge: basic math skills and spelling are often used as examples. This knowledge is bivalent: either one has solved the equation or spelled the word correctly, or not. The problem of measuring social competences, innovative competences, "an entrepreneurial mindset", creativity, "critical thinking" and other fuzzy and abstract competences touted under the banner of 21st century skills are difficult to provide evidence for. They are open to interpretation and mean different things, according to who you ask. *Not* to use digital technologies could very well be entrepreneurial or innovative or creative in some contexts. One example of an attempt to attack this problem is the PISA test that claims to measure "real-life" competences. It does so by making students take a survey (implying that taking surveys is a real life competence). For PISA to succeed in the venture, requires consensus on what a real life competence is, a setup that could monitor students "in

real life", and very clear definitions of what to look for, in order to quantify, index and make them relatable to real-life competences in other contexts. In that light, it is stunning that Mr. Schleicher - in his hunt for evidence - throws so many new items on the table in his foreword to "Students, Computers and Learning". This complicates the matter immensely: each potential is a new parameter - and it would require a substantial expansion of the PISA-test (and affiliated surveys) to investigate these potentials. Methodologically it would seem more reasonable to revert to simpler issues, e.g. that digital devices can support the acquisition of basic math skills, before moving on.

The third problem with measuring the effect of educational ICT is that it is not a valid analytical object. It means too many things: even though it can be isolated to individual devices (an iPad used in a middle-school setting for example), the content of a device can differ from moment to moment (pupils may shift between reading Shakespeare and watching YouTube from minute to minute), the learning materials on it have different pedagogical aims, and used for so many different things that - even where evidence is produced - it would be hard to pinpoint what exactly it was about the iPad that caused the effect. This puts the whole work with this thesis in an eerie light. Have we been asking the wrong question all along? The answer is yes, but the question has a pragmatic source: it departs from observations of written practice in policy, where it is normal to ask the question.

The fourth problem is philosophical in nature: is a machine categorically different from a human? One could imagine a setup such as Larsen's above that dealt with the problems we have just listed. It could reach the conclusion that "there is evidence for heightened learning attainment in a very specific mathematical problem in situations X among students with attributes Y, using a single-use iPad. In other contexts that look exactly like the original setup, similar results are obtained". This could lead to the conclusion that it is the iPad that is the causal factor, and not the person who has designed its didactic interface. This in turn, leads to the natural question: could another human not achieve the same result (without an iPad). A teacher for example?

A fifth problem concerns the notion of "externalities", i.e. the resources needed to uphold a setup that could provide meaningful evidence. Is it worth it? Are costs numerated properly?

Are costs associated with maintaining infrastructure and downtime taken into account? Are we aware of the financial risks associated with buying infrastructure from entities that might become monopolies? And do such discussions in themselves not steal resources from pedagogical activities?

A sixth problem relates to notions of learning, "learning output" and the attempt to translate intra-psychic processes into metrics. Measuring "learning" is measuring something, but does it measure *enough*? A convincing argument of the contrary comes from phenomenology and fields like "4E cognition" (Fuchs, 2018). These schools of thought claim that cognition is not (only) a cerebral act - cognition is distributed across embodied, enacted, embedded and extended domains. This has many implications for how we should pursue science that I will not address here, but that I urge you to consult.

A seventh problem is the notion of digital competences. In the corpus there is a shared observation that a revolution is going on, and a techno-determinist view that the future will be increasingly digital. The digital revolution creates a new cognitive environment. This argument, understood as a unified argument, postulates that there are digital invariants (i.e. the computers and the software used in schools have some of the same features as the computers in the workplace), *and* that change is happening at a maddening pace. A general idea of radical transformation would, logically, include computers themselves. In other words, how can we predict the future in a world that is changing at a maddening pace? Should this not be an argument for not digitizing education, as the project is doomed for obsolescence?

An eighth problem: The technological revolution is often described as a force coming from the outside, a fate that we have to embrace, a reality we have to adapt to. The determinist view does not factor in how institutions are co-constructors of this reality, that institutions are active agents, and that they make the reality more digital, through sheer funding, but also by creating legislative frameworks that encourage or reward the application of educational ICT.

As might have become clear to the reader, the answer to whether evidence can be provided for the beneficial effects of educational ICT is a dry "**no**". This is an empiric, pragmatic (the result of a corpus analysis), methodological and a philosophical "no". But does this mean that

digital technologies cannot provide value in education, that they are not interesting, that we should shut the whole program down? Not at all, please jump ahead to the section on "implication and recommendations" (next chapter). We need to get reflections on the limitations of this work out of the way first.

### 6.6. Discussion of the realist-anti/realist analytical prism

As we have seen, there are many methods, schools of thought and approaches to analyzing the field. To simplify matters, I constructed an analytical prism that consisted of a simple binary pair, namely the realist-anti-realist paradigms. I argued that this analytical tool was useful to understand how evidence is used, based on a well-known and familiar tension between the "hard sciences" and the social/humanistic sciences. It is an approach that greatly reduced the complexity - comprised of the number of actors, semantic practices, reports, commercial products etc. But is it a reductionist analysis? To reduce the problem of evidence to this simple pair is indeed reductionist, especially if we fall into the trap of recommending that evidence-practices should seek absolute purity, or if we maintain that the two paradigms are mutually exclusive. In a sense, the criticism of political report writing has been going on in stereo: either the reports can be criticized for lack of rigor in their use of realist, scientific methods. On the other hand, many of the problems created, may stem from the lack of understanding of the cultural and contextual aspects of how evidence is used discursively (on the political level), and how the data used to produce evidence, has evacuated cultural, social and psychological aspects. My paradoxical suggestion for solving this problem conceptually, is to reduce it even further, i.e. by reducing the analytical perspective to the gap between the two paradigms. The philosopher Yuk Hui, in an interview from 2014, states it more precisely than I can myself:

*"This gap between two cultures seems to be fully legitimated as common sense: in humanities, people are glad to admit that they don't know technology, as if it is such a natural thing; and in the field of technology, people tend to think philosophy is too far away from their lives, and they tend to read pop sociology books like 'Tipping Point'. But in fact, there are no two cultures, but only one, which is the gap itself."* (Interview with Yuk Hui, Dawes, 2011)

A way forward is to recommend reflexivity on how the tensions between realism and anti-

realism should be understood as the focus of investigations, both in those who seek out to produce evidence, and those who seek to analyse their epistemic and scientific practice. It is not a tension we can be absolved from. Evaluation, science and knowledge practices should be understood as a unified concept of "being-in-the-gap."

## Limitations

This leads to some comments on limitations of this work. As I describe in the post-script, the study was initially bound to a quantitative ideal (the big data corpus analysis), and has tried to pursue the same goal, but on a smaller and more qualitative, hermeneutic scale. This means that the quantity of selected reports has been scaled down dramatically. I maintain that findings in them are representative, and that the analysis has predictive power. Reports published after 2015 reproduce the argument structure: we have to adapt to a new reality + the potential is big + we need to fix the support factors-problem in order to reap the benefits. But a purely quantitative or a purely qualitative focus might have revealed other and more interesting findings. I suggested above that the work in one sense fails miserably, as it asks a question that structurally cannot be answered. It becomes too easy to problematize, and deflects attention from what seems more important to clarify. This is a recurrent problem in research: It is not interesting to conclude that people or policies are wrong, but more interesting to investigate why people or institutions act on certain beliefs (and the impact on reality of such beliefs)[29]. This continues to be a blind spot for me: what is it about digital technologies that appeal so much to political institutions? I understand the compelling visions and the cultural revolution that the Internet promised in the mid '90s, but we are no way nearer understanding the concrete political practices over time: the redundancy, ignoring previous findings, the increasing distance to longstanding discussions in academia. This is especially true when it concerns the real-life impact of political publications - a question that has been troubling me persistently: do people read them? Are they used to legitimize decisions? Or are other factors at play? Only an ethnographic analysis could shed light on this.

Another limitation is the quality or the value of the comparative analysis. Denmark is one of the leading digital nations, and there is a high degree of compatibility between the arguments formulated by international institutions and the arguments formulated in Danish policy papers - especially the further we move away from 1983. The expectation was that a comparative analysis would yield more interesting differences or tensions. Maybe some will find it interesting that there is an affinity between leading digitization-indexes and the adoption of policies crafted in international institutions, but it

[29] Echoing Adam Greenfield: "The meaningful question isn't whether these technologies work as advertised. It's whether someone believes that they do, and acts on that belief" (quoted in Selwyn, 2019)

comes as no surprise. My prediction is that Denmark will adopt different (critical) variations of digital literacy as fast as it adopted the project of digitization, and that technology criticism will be welcomed institutionally. Paradoxically this could confirm the value of being a fast-mover. If the prediction turns out to be true, it might be caused by the fact that Denmark is the country with the longest track record of no effects, and the most intense adoption of technological solutions, in a way that creates negative experiences enough to provide the fertile breeding ground for a backlash that will balance the matter.

A third limitation is the lack of material analysis. It would improve the quality of the study, if an analysis of the most commonly used digital learning materials were included. It would provide clear examples of where exactly the different pedagogical elements are visible in the interface - but also how the milieu of different pedagogical outlooks eventually make the data "messy", and potentially invalidating evidential studies.

## 6.7. Conclusion

This dissertation has been engaged in the research problem of providing evidence for the positive effects of educational ICT. The quotes in appendix 2 provided the starting point of the investigation, and worked with the thesis that it is not possible to provide such evidence. The analysis consisted of approaching research literature distinguished by their affinity to either a realist or an anti-realist tradition. We analyzed a corpus of empirical literature to see how the evidence problem is treated in the wild or in written practice, and how this practice developed over time.

The investigation started out with documenting that a number of studies (much larger than this one) have reached the conclusion that benefits remain elusive, that there is little scientific evidence, that significant effects cannot be found and so on. The dissertation then reviewed different schools of thought that directly or indirectly relate to the question of evidence. The review also served as an introduction to different methods used to study the field. We then proceeded to review a corpus of texts that spanned the entire period to investigate arguments, epistemic sources for the arguments, and whether the evidence problem appears, how it is addressed and how it is interpreted. The analysis confirmed that the evidence problem is indeed acknowledged by policy writers (or by researchers commissioned by political institutions to assess the situation) throughout the period. Some of the reports spend more time imagining potential benefits than delving on the issue than others. Some reports draw conclusions on the lack of evidence: the issue should be investigated more thoroughly before larger investments are made. The value of this study has been to isolate the different arguments and reveal that a disparity of reports share many of the same arguments. This is helpful in decoding the debate moving forwards.

### Is policy realist or anti-realist?

Throughout the dissertation I have related various phenomena to realist or anti-realist schools of thought. But what about policy itself? Do political institutions adhere to scientific realism or are they formed by more continental approaches? In our corpus, there is a mixture of evidential practice and excitement about sociocultural theories (though rarely mentioned directly as such). The political project may have ended up creating a data-behavioral project,

but it has been inspired by cultural theories of learning: we learn differently (there are multiple subject-types among learners). Technology is described more as an environmental or a cultural reality than a technical or a functional one. It allegedly fosters collaboration between cultures and peers. Policy uses a host of terms that strict scientific realism avoids like the plague: innovation, playfulness, engagement and so on.

The more puzzling aspect however is the marriage of evidence and potential. The two should be categorically incommensurable. Evidence is based on observations made in the past. Potential relates to the future. It is a concept used to denote fate, possibility or choice (Taussig, Hoeyer, & Helmreich, 2013), in other words a conceptual category that cannot contain any data, as it simply has not happened yet. Despite this, and this is the truly new phenomenon in the history of policy, attempts are made at providing *evidence for a potential*. The network readiness index is an example of this. Mr. Schleicher's dismissal of bad evidence, in favor of the potentials is another example. But logically, this is an absurd project. The only true scientifically valid approach, be it quantitative or qualitative, is to analyze empirical material in the past, to determine truths locally or globally, in order to observe effects, or to provide explanations for reasons behind the effects. The turn towards the future can never be anything else than speculation: it is impossible to say whether the future will be more digital, or whether students will be active participants because a technology offers the possibility.

It is very strange. The crux of the problem seems to be that policy's closest ally (RCT-studies) is the worst at producing convincing evidence, and that its' anti-realist counterpart provides plenty of proof, in the form of accounts of how subjects experience the value of digital technology. But this evidence can not be scaled independently of subjective goodwill , and unless one sacrifices cultural conditions, individual freedom and respect for differences in context. The solution seems gradually to become, instead of accepting this basic tension in the sciences as well as in cultures of assessment, to turn towards an imagined future where data will provide the evidence for the benefits of an ideal digital environment in which the constructivist subject can thrive.

## 7. Practical implications: digital literacy or towards better evidence?

In the introduction I mentioned that the dissertation should be read as a contribution to "digital literacy". Digital literacy, as the European Union proposed, is a five-point model, comprised of the following:

1: Information and data literacy
2: Communication and collaboration
3: Digital content creation
4: Safety
5: Problem solving

The model I propose, is a self-reflexive critical alternative, and one that altogether abandons the evidence-project. But it takes digital phenomena seriously. It echoes many of the points made by Holger Pötzsch (Pötzsch & Tromsø, 2019) in a recent article. Pötzsch makes the simple point that "critical reflection upon (possibly unintended) consequences of digital technologies does not require the acquisition of costly new products." (p. 223) He also notes "critical mindsets can best be achieved by the traditional humanities with their historicizing, multi-perspectival, and interpretative approaches" (p. 223). These methods, is Pötzsch's view, "facilitate reflective critique aimed at *Bildung* in a Humboldtian understanding where the individual gradually matures through self-reflective engagement with itself and its surroundings." (ibid.) This approach is suggested as an alternative to the current focus on building digital competences "with an eye on labor-market qualification and the acquisition of quantifiable human capital". (ibid.)

If we include these comments with the findings in this work, a critical, self-reflexive model would look like the one below. Understand this as an alternative to the Digcomp2.0 framework.

## 7.1. Critical digital Literacy

### 1: Policy - literacy

It is important to be able to judge the relevance of arguments for digitizing. This includes being able to discern the political sources and the history of digital advocacy. The context of the "digital demand" itself must be understood, before the student can situate his own values and perspectives into it, in order to subsequently contribute to their value. It places collective, self-reflexive thinking as the foundation of learning. How do they negotiate Yuk Hui's gap, mentioned above?

### 2: Communication and collaboration

Students should be able to analyze to what extent different technological tools afford the way thought is structured. They should also be able to relate these to classic technologies such as reading books and writing on paper. Collaboration - regardless of media - should be understood in light of the psychological, cognitive and phenomenological structures that subjects contribute to collaboration - or that precede their dissemination.

### 3: Analog content creation

To create and edit analogue content. To improve and integrate information through solitary contemplation - before it is mechanized or distributed. This serves the aim of creating understanding for the fact that digital media build on a legacy of thinking and visual, linguistic, auditory "languages" that constitute major - if not all - parts of "the digital".

### 4: Safety

To understand the business-models around digital platforms, mobile applications and the internet, in order to avoid their negative consequences. To learn how to achieve results in the world in non-commercial forms. This serves the aim of creating awareness of the business models that often are linked to the (sometimes philanthropic) discourse guiding our perception of technologies.

### 5. Problem solving

Understanding how all the problems that are associated with digital technologies can be solved by non-digital means. This includes issues such as inequality, environmental footprints and novel forms of management and control. This serves the aim of driving home the point that human actors and social dynamics drive and define technology.

### 6. Evidence

To work with a more fine-grained evidence-model, the suggestion is to adopt John Krejsler's (Krejsler, 2019, my translation) proposal for a nuanced evidence-model:

a) To distinguish between *evidence-based* and *evidence-informed* knowledge, in order to understand the distinction between "hard" and "soft" evidence-problems.

b) To distinguish between *global* and *local* evidence forms. This means being able to distinguish between global evidence, which is universally valid for everybody within a well-defined intervention group, and local forms of evidence, that focuses on the particular in a specific context.

c) To distinguish between *external* and *internal* evidence-forms that aim to visualize the power-relations that determine who owns the right to define and produce legitimate knowledge about what works in specific social domains and contexts.

This alternative to the Digcomp2 model could be visualized in the following way:

| 7.2. A hermeneutical approach to educational ICT<br>A model for critical, self-reflective digital literacy - an alternative to the DigComp2 framework | | | |
|---|---|---|---|
| | **Title** | **Content** | **Intention** |
| 1 | Policy-literacy | Identification of the political reason behind the contingent, educational context with a focus on how digital technologies claim to support it. Identification of "the gap". | Creating awareness of how educational issues are framed. |
| 2 | Communication and collaboration | Analysis of the social theories and theories of communication embedded in technology. The social and communicative affordances in technology. | Developing an analytical framework to dissect & manipulate technologies. To gain an understanding of affordances in communication technologies. |
| 3 | Analog content creation | Identification of the legacy of crafts, schools of thought and theories of modality that are integrated into digital technologies. | Gaining awareness of how digital technologies appropriate the past. |
| 4 | Safety | Analysis of the business-models in educational technology, and how they are supported algorithmically. | Self-protection & awareness of prerequisites for competing on the market. |
| 5 | Problem-solving | Analysis of root causes & social dynamics behind the problems that we observe. | Identification of human actors in order to engage critically with their theories and perspectives. |
| 6 | Evidence | Learning to distinguish between evidence-based & evidence-informed/global & local evidence/external & internal evidence | Learning to justify and qualify the effect of social interventions. |

This model is tentative, untried and does not (yet) exist in a didactic form. In the table no distinctions are made between age-groups or pre-existing competences, skills or abilities. The novelty of the model consists of a focus on the digital milieu in educational settings, a focus on political intentions, background assumptions and the dynamics that the actors who design and control the digital milieus cause. Finally, it acknowledges that the price for public funding

is to justify. Instead of rejecting evidence, to nuance how evidence can be used to justify interventions in more precise terms than seems to be the case today.

## 8. Further studies and perspectives

More research is needed. But not into whether universal evidence can be provided. The methodological problems are insurmountable, the effect and value of learning processes, and the prosthetic support of them, cannot be grasped by a realist approach, and the question is not dissociable from cultural and historical contexts. This is not a blanket-dismissal of evidence: it can of course be produced in many aspects pertaining to the educational field, but not to *learning* as a universal parameter that can be described in bivalent terms.

I do recommend however, based on insights in the present work, and the acquaintance of recent theory that has emerged during the work with it, to pursue the following paths:

### Political report-writing as an embodied, collective, performance of cultural practices

In conversations with professionals who have been engaged with the writing and publication of policy papers, I have been told that I have read policy papers with a wrong framing: it is not necessarily the content of a report, its internal consistency, the value of its information and the interpretations of it, that matters. Reports are semiotic-material actors (Jensen & Lauritsen, 2005). Reading hermeneutically "against the text", i.e. to uncover hidden, forgotten, and/or repressed meanings and make such underlying themes explicit is less interesting "than it is to see where it goes and what it does." Lauritsen and Jensen call this approach “reading with the text.” (do.). While I think that the present work fills a gap, by making the political arguments for educational ICT categorically and historically more accessible, I agree that it misses some important points. As I envision it, two forms of analyses - that read with the text - could be pursued in the field of policy writing. One question that has kept popping up in my hermeneutic praxis, is how exactly these texts are commissioned, written, produced, *who the authors are* (their professional background and educational training), which tools they use, their affective state while writing it, during or after its completion. On which criteria is the success of a good report measured? How many people are concretely involved? How are changes negotiated (for a fascinating account of such a process, see http://edfutures.net/We_were_consulted).

The other approach would be to follow how the target group uses reports performatively.

How they are read, referenced and drawn forth in practical contexts. As an avid reader, I am consistently surprised by the fact that interactions with texts so seldom are hermeneutic (sitting at desk reading linearly, with the intention of understanding its meaning), and more often used to say something about the person who carries it around, who links to it on social media etc.

### Post-phenomenology

Related to these approaches would be to study the technological mediation of knowledge in the interfaces used in milieus that justify interventions in the educational area. Recently, many persuasive cases of algorithmic bias and algorithmic intentionality (and their epistemological effects) - have been studied. The banal example would be to study the use of Google (are policy authors more susceptible to use sources on the first page of displayed results?). Are the results that they claim constitute as valid knowledge in fact delivered on the basis of profiling? Does the technological milieu afford an increased production of policy papers?

### Marxist critique

"The underlying logics of capitalism [are] a veritable “elephant in the room” in thinking about technology-use in schools. " writes Holgert Pötzch who we mentioned just earlier (Pötzsch & Tromsø, 2019). There are a number of other studies of digital phenomena written from this perspective that could be applied to educational ICT. To what extent are politicians focus on educational ICT scripted by commercial interests? I have mentioned Antonio Casilli's concept of micro-labor. His analysis deserves to be deployed on educational ICT. How much value is extracted through the digital labor of actors in the educational system? To what extent is the data produced on collaborative platforms used for profiling? To what extent are concepts like innovation and experimentation used to shift the burden (and expense) of feedback on software-development to the users?

### Self-reflective AI

The technological systems that already are in place to collect data and analyze it, could be used to collect data and build databases of the knowledge base of institutional thinking itself. This data could be used to challenge the policy writer algorithmically, through prompts to

avoid redundancy, clichés and tropes on the basis of an extensive corpus analysis. Such a project could aim to raise policy writers' bar, by encouraging them to speculate on potential benefits on the back of known, persistent problems. It could also be deployed to visualize past epistemic practices, to encourage the writer to steer away from articles, reports and sources that were the epistemic basis of interventions that subsequently could not be justified evidentially.

### Digital Studies

Finally, I will mention how this dissertation, the proposed studies above, and maybe the concept of digital literacy itself, should join the French philosopher Bernard Stiegler's "Digital Studies"-program (Stiegler, 2014). Digital Studies is proposed as a "research-protocol", to investigate the epistemic practices of professionals. Studies like this one, moves the focus from the effects of the digital milieu on epistemic practices of visible professions like teachers and health professionals, to the professionals who contribute to the political act of building and maintaining the discourse. It is similar to the post-phenomenological project.

## 9. Postscript: Mutations

This dissertation is the product of four years of work with the project of working theoretically with the meaning and values of using digital technology in education. The research project has undergone a series of (frustrating) transformations, before arriving at the result in front of you.

### Teaching creativity through computers.

The ambition was initially to study the effect of educational ICT on *creativity*, or to test the salience of claims like "the computer is a bicycle for the mind" (Popova, 2011), i.e. notions of technology's ability to boost or accelerate creativity in students. This lead to the insight that institutional interest in *creativity* (often appearing under the banner of "21st century skills") is typically embedded in an innovation-discourse. Or used as a synonym for innovation. Arguments for the creative power of computers, are often linked to the engaging, personalized, differentiated, multimodal and game-like nature of software, and to their connection to children's natural life world (or preferred digital milieu). Another argument is the democratic argument: the access to cameras, sound-recorders, editing tools and the relative ease with which it is possible to publish media productions have been described as a threat to traditional gatekeepers, but also as the creation of a more meritocratic marketplace for creative professionals. Finally, arguments pertaining to the potential to simulate, test and iterate ideas (often sold as "design thinking") at a much higher speed than what was previously possible, are commonplace.

It very quickly proved impossible to study ICT's effect on creativity as a functional process, and creativity and innovation are notoriously difficult to study in themselves. The empiric nature of creativity and innovation (how does it exist as a discernible entity in the world, is it something going on in neuronal processes, is it the *result* of mental activity, of social processes, or should it be understood as a conceptual framework to stimulate preferred activities?) was too big a challenge. Besides that, they are terms used relative to something else that is perceived as non-creative or non-innovative, and this of course, is highly contingent, and loaded with background assumptions that require hard work to unpack. Add learning to that (how does one teach creativity), and then add "computers" to the mix (what is

meant by computers? Do we mean software or hardware, or a certain combination of the two?). Such questions triple the complexity. This explains the relative few number of studies claiming to be able to say anything of interest about the effects of "using computers to teach creativity".

One way to get a grasp on the problem-area, is the field of "Innovation Studies" (Fagerberg, R. Martin, & Andersen, 2013), which is a study of the knowledge base for the field of innovation. The article's focus is straightforward: the literature cited in the field of innovation. It is in essence a bibliometric study, constructing "a database of references in scholarly surveys of various aspects of innovation, published in 'handbooks'." (p. 3)

### The knowledge base of educational ICT

This caused me to pursue a path that simplified the project somewhat (dropping innovation and creativity, and restricting it to the question of how computers improve learning *tout court*), but by investigating educational ICT's effects through an analysis of the knowledge base in a corpus of representative texts. Instead of adopting Fagerberg et als. empirical strategy of analyzing *scholarly* literature, the project became to analyze political documents. The simple reason for this was that political reports - at the time - seemed understudied, and exert more influence over how the reality of education is managed, planned, and imagined than academic studies do. I also believed, naively, that these reports would point to relevant literature that convincingly "proved" the beneficial effects of ICT on learning attainment (with the first question still lingering in the background - "because they inspire more creativity").

### Big Data analysis

As it turned out, the production of political literature is intensive and voluminous, in which a substantial number of private and public actors participate, nationally and internationally. The task became the arduous one of building a corpus (meeting the criteria formulated by Bowen (Bowen, 2009), such as identifying overarching themes and common tropes.
The first intuition was to focus on one or two influential reports (from OECD), but an acquaintance (a big data specialist) encouraged me to collect as large a number of documents as possible in order to carry out a big-data semantic analysis. I proceeded to do this through extensive searches in popular search engines, in the institutions' own databases, and with the

help of libraries. The imagined advantage of this method was that an algorithm would be able to reveal interesting correlations, visualize semantic clusters, and generate quantitative reports on the number of reports published yearly, the most active institutions, the most cited reports and many more questions that the analysis promised to answer. On my friends suggestion, I formulated a series of questions, which he would help me transform into corpus queries. This resulted in the following document, a wish list for the algorithmic genie:

**Bibliometric analysis**
What is the knowledge base, bibliometrically (I naively thought that citation-practices were standardized in political literature, and could be identified algorithmically, in a jiffy)

**Influence:**
What is the distribution - in citation-practice - between peer-reviewed articles and reports from consultancies, think-tanks and transnational lobby-organizations?

**Chronology and naming conventions:**
Distribution in the corpus of year of publication, institutions, naming conventions (aka. "white papers", "vision papers" etc), geographical distribution.

**Concrete technologies**
Distribution and occurrence of mentions of concrete technologies, i.e. occurrences of terms like "ipad, apple, smartboard, IBM, 3d printer" etc.

**Epochalism**
Distribution of terms that describe our time as unique, using words like "revolution, disruption, unprecedented change" etc.

**Obsolescence**
Linkrot: how many of the links in the report are still functional (to quantify the obsolescence of the knowledge foundation).

**Risk-awareness**
Words denoting problems like "critique, problems, risk, despite".

**Potential**
The occurrence of the term potential, and the historical development of its use.

**Optimism and pessimism**

Which are the most optimist institutions, which are the most pessimist?

**Semantic practice**

Definitions: what is meant by digital, computers etc.

At the time I was inspired by the work of Boltanski/Thevenot (Boltanski & Thevenot, 1994) and Boltanski/Chiapello (Boltanski & Chiapello, 1999), based on a corpus analysis of French management-literature in the 70s and 80s, and I imagined it would be fruitful to examine whether semantic, machine-assisted searches could map the distribution of words belonging to Boltanskian polities (aka value regimes), to find out what values the different institutions attached to educational ICT. This resulted in the article "The digital: a monstrous composite?" (with Søren Riis), which has been reviewed, and is under publication.

After two Ph.D. courses in data-driven corpus analysis, I toyed with the idea of using methods like "topic modelling" and "stratified random sampling". With the benefit of hindsight, I can now see that each question above merits its own dissertation, each question requiring considerable resources. The project was stopped in its tracks two times:

- The programmer who offered to assist me was too busy to meet.
- The second was arriving at the Media Lab in Paris with a USB-stick (and a mock up of an interface, see figure 7) containing hundreds of PDF-files, and the questions mentioned above, hoping that the staff and researchers there would be able to assist me, or that I would learn to master the art of machine assisted corpus analysis. I was quickly told that there is no standard citation praxis that could automate the bibliometric analysis. Some of the PDF-files were unreadable by the software. The only path forward was to manually tag all the documents in NVIVO (qualitative software) e.g. This crushed an illusion that big-data analysis and semantic analysis, quickly and easily, could give invaluable insights to the knowledge foundation of political institutions, on the subject of the value of educational ICT.

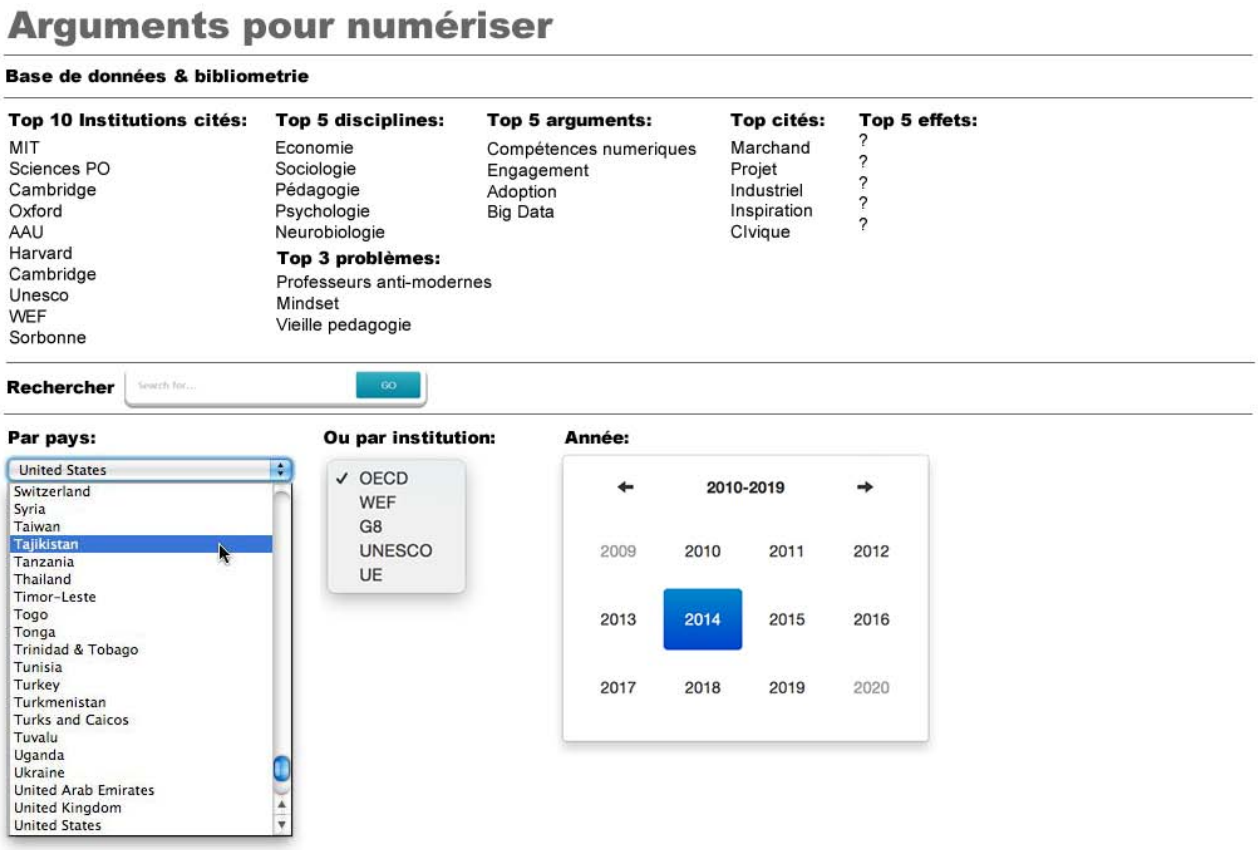


Figure 6 - wireframe of a database of political justifications

I also made a mock-up of how an online database that collected political reports, could list most cited institutions, top scientific domains represented, top arguments and offered the possibility of searching for reports geographically or by year. One of the members of Media Lab, Mathieu Jacomy, told me that such a database surely already existed. I couldn't find it. The nail in the coffin, was the insight, that to mark up the PDF's required carefully reading the entire corpus - and re-reading it, if new questions arose (and thus new categorizations had to be made). Just reading the corpus documents, gave insights and fed new intuitions, and it seemed silly to insist on quantifying it - with all the fuzziness associated to semantic analysis - when so many interesting thoughts presented themselves, by a classical hermeneutic approach.

Today I am perplexed by the hype surrounding big-data semantic analysis, knowing how much work is required, the experience that each search demands an a priori theory (to know what to look for), but even more perplexed by the fact that there is no large, international project dedicated to making publications of this nature systematically accessible. The practice of political publishing is unstructured in the domain (technically there is no agreed upon document ontology between institutions that publish political reports), and that big-data analysis funds are not allocated to the analysis of the foundations of political knowledge, systematically, and tracked over time, in order to document persistent problems. This could take the shape of database of invariant or current problems, in order to reduce redundancy. Many political reports have a tendency of recirculating certain tropes - without knowing or acknowledging that they have been repeated ad nauseam elsewhere. Such a project, however, might risk falling prey to a representational fallacy (the idea that if such information were made accessible, political practices would change), and it could very easily underestimate the performative or the cultural function of political report writing.

### Technology-assessment?

Another path that I pursued was the project of invoking the tradition of Technology Assessment (TA), but applied to educational technology.

In "*Technology assessment for responsible innovation*" (Van Den Hoven, Doorn, Swierstra, Koops, & Romijn, 2014), Armin Grunwald outlines the roots and concepts of TA and introduces the different goals of theoretical TA, since its inception: "*adding reflexivity to technology governance*", "*preventing disasters or undertaking compensatory measures*", "*maximizing the technology's positive contributions and minimize its negative consequences*" or more basically: just "*getting things right from the beginning*". There are differing, competing (or complementary) proposals for such approaches, concepts or methods be it from TA, "responsible innovation" or "constructive TA" (Schot & Rip, 1997). Grunwald describes how TA in the 1970s emerged as a "*science-based and policy advicing activity*" (Bimber, 1996, in Grunwald 2014). At its early stages TA was developed as an early-warning function supposed to equip political actors with the means to "*compensate for or prevent anticipated negative effects of technology*" and emerged from broader debates in society and science on issues of "*risks and chances, potentials and side effects, control and responsibility*".

Newer developments in TA, are - again according to Grunwald - conceptualized as "Responsible innovation" and/or "Responsible development" and have the same ethical concerns as the latter (gauging potential benefits of technology from the viewpoint of societal values, as opposed to pure market criteria), but situated closer to innovation processes, i.e. in the research and development (R&D) phase of technological innovation. Grunwald describes how "*Science institutions, including research funding agencies, have started taking a pro-active role in promoting integrative research and development*." I adhered to the proposition that TA responds to social challenges of the greatest importance, notably in fields like energy, traffic infrastructure and bio-technology, where the stakes are high, and risks potentially catastrophic, for many people. The negative impact of developments where TA has not been applied or has failed to meets its criteria, is also a sad, empirical fact: the list of preventable disasters is long.

Does educational technology deserve the same scrutiny? Are potential negative effects comparable to, say the risks associated to nuclear power plants, emerging genetic technology or pharmaceutical innovations? It might seem overly dramatic to make such comparisons but, in some respects this work could be categorized as a variant of Technology Assessment, especially when it comes to integrating negative findings of digital technologies on children and youth, in relation to learning.

### The influence of the work with this thesis on a national political debate

To complicate matters further my work with this thesis landed me in a hot debate about educational technology (which is still raging). In June 2017 I was invited to write an op-ed for the Danish website "Altinget". It is a Danish news outlet concerned with political issues, and whose target group are politicians and political reporters. It was titled "*Researcher: iPads in primary schools do not create the programmers of the future*" (the title was worded by the editor, not me). It struck a chord, and attracted the attention of countless media-outlets in radio, TV, print and online-media. It also led to the publication of the book "*Kritik af den digitale fornuft*" (Translation: "A critique of digital reason - in education", Balslev, 2018), an essay on the use of digital technologies in education. It attempts a synthesis of a large number of reports that conclude - through different methods - that evidence of the impact of

educational effect on higher learning attainment is scarce. It also offered me the chance to follow policy-work closely, participating in an advisory group for the Danish Minister of Education Merete Riisager, and her plan to create a new subject for primary school: "Teknologiforståelse" aka. digital literacy. The task consisted of meeting with professors, industry professionals and political clerks, to assist the ministry with knowledge and comments to the group writing the actual proposal. These events brought me closer to the machine room of policy making. Besides the appearances for the Minister I was invited to participate in other expert-groups: a group invited to discuss a Horizon 2020 funded project on the future of AI, and a group of experts participating in the production of the report "Education for a digital age" (for the two unions "Dansk Magister Forening" and "Dansk IT"). This very nearly tipped everything towards a full-blown (auto)ethnographic study of how political documents are negotiated, assembled and produced. It would ideally take the shape of a post-phenomenological analysis of the impact of the technologies used for communication and co-operation. E-mails and communication platforms have an influence on how reports are being produced, on the background of talks, meetings and summaries and consequently, how they are interpreted, translated (or aspects of them ignored). One important aspect of this would have been, to chart how the no-evidence findings I made (and communicated in the media), are repaired by professionals with stakes in the industry. It amazed me that - on the background of the history and the number of people making the same observation in the literature that I uncovered - that it was such a surprise to the public, and in many instances I found it fascinating how this fact was negotiated, agreed upon or countered. I often witnessed that an interpretation of what I was *really* trying to say (I attribute this to my history as a digital entrepreneur), was that "we still haven't got it right, we need to spend more funds, research more") whereas the discussion I wanted to start was whether digital learning technologies deserve the attention they are getting. Instead of debating whether iPads should be distributed in kindergartens, the conversation should be about what is necessary, and what kinds of knowledge and competences are important to live sanely with digital technologies - for better or worse.

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## Appendix 1: Extensive corpus

Below, I have listed the entirety of the publications that I have found through desk-research and that in some form or another relate to educational ICT (178 in total). They are listed in chronological order. I have not included them in the list of references (besides the ones I have included in the corpus). Consider it a gross-corpus, the preliminary attempt at a literature review of political reports. This search focused on political institutions, and reports by consultancies and think tanks commissioned by political institutions. Some of the institutions are municipalities, some are written by expert-groups - others by anonymous clerks in Ministries or within overnments. It is by no means exhaustive. It is doubtful that it is possible to make a comprehensive list; especially publications in the '80s and '90s have been hard to find copies of, existing only as paper copies. There is also a very large corpus of online-publications (in the form of press releases, news, interviews) that would be relevant to include. It is a result of searches made on the variety of acronyms and terms described in the introduction.

The list is included to give you an impression of the variety and the quantity of literature, the many different formats they are published in and the variety of names they are given: reports, reviews, white papers, action plans, strategies, economy papers, "inspiration-catalogues", recommendations, analysis reports, presentations etc. The list also includes instances of reports from the UK, U.S. and France - found serendipitously. In some of the publications, educational ICT is a component of more general political or economic themes; in others they play the main role. The files can be downloaded in a zipped folder from www.jesperbalslev.dk/educational-ict-gross-corpus for those of you who want to attempt a big data semantic analysis, to answer the questions that I ask in the introduction.

***References, extensive corpus***

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# Appendix 2: Documentation of problems related to evidence of positive effects of educational ICT (in policy papers)

## 2015

"Although educational technology is expected to contribute to improving education in the EU, compelling evidence of the benefits of technology on education remains elusive." (Pastor & Quirós, 2015, abstract)

## 2014

"Learning increasingly takes place in an environment which is constantly evolving to respond to the personal needs of each learner. The emergence of Open Educational Resources and Massive Open Online Courses is expected to offer multiple advantages in terms of increased access to education, reduced costs and flexible timetables, to name just a few. However, there is little scientific evidence to prove the efficiency of these new models. Some critics even argue that they may well be just another attempt to further commercialise higher education." (Katsarova, 2014, p.1)

"Research from the OECD indicates that there is not enough empirical evidence to support the idea that students' use of technology and digital media is transforming both the way in which they learn and their expectations about teaching and learning. Surprisingly, it demonstrates that a majority of students do not wish technology to bring a radical transformation in teaching and learning. Teachers are not adequately prepared for the digital revolution either: an EU-wide survey shows that while 70% of teachers recognise the importance of ICT-supported methods, only 20% of students are taught by digitally confident teachers." (ibid., p.3)

"It is generally believed that ICTs can empower teachers and learners and that their overall impact is positive. There is, however, little scientific evidence of the concrete contribution of ICTs to the learning process. ICTs' impact remains difficult to measure, because of the lack of appropriate indicators, and therefore open to debate. Evidence is quite often derived from

opinion-based studies interpreting perceived,9 not actual, impact. Some experts describe them as tools to support and improve existing learning processes rather than having any transformative potential. Studies tend to find small positive educational outcomes without ascertaining the causality of the link (i.e. it may be that more effective schools and teachers are more likely to use ICT and digital technologies effectively). Moreover, the cost advantage of digital learning is disputed. A recent comparative study (2012) suggested that the idea that online learning is less expensive is based more on intuition than on fact, since most existing studies lack rigorous control and use self-reported data." (ibid. p.3)

### 2013

"A PC with the right software can revolutionize the learning process. It can also just be an expensive notepad. A lot points to the latter being the case. IT is being used in education, but has not had a revolutionary effect. And in regards to IT-competences, Danish youngsters between 16 and 25 are placed below average in the international PIAAC-study" (Produktivitetskommissionen, 2013, p. 94)

"In Kirkwood and Price (2012a) it is concluded that an increased use of technology in itself does very little – if anything at all – to strengthen students' learning". (Kvalitetsudvalget, 2015, p. 127)

### 2012

"...the existing knowledge base is quite scattered and limited in scope: it covers only some of the important aspects related to the inputs (how many devices have been sent to schools, for example); it provides only very limited information about the processes (how many students per device, for example); and it is rather confusing, if not biased, in relation to the outcomes (the effects of technology use on student performance)." (World Economic Forum, 2012, p. 139)

"Yet the reality is that even the most well known international sources for education indicators lack basic information about technology policies in education." (p. 136)

"There are also technical issues related to measurement. To begin with, it is worth considering that there are no well-established monitoring systems of teaching and learning practices. In other words, when it comes to analyzing predominant classroom practices, most educational systems are totally blind." (p. 137)

"In the domain of technology policies in education, a very simple question is quite often posed: does technology- supported education make a difference? Or, more generally, does technology lead to better student results? When looking for a response in the existing knowledge base about the effects of technology in education, a striking fact seems to emerge: there is no conclusive evidence. This has been known for some years as the "non-significance phenomenon," leading to the overall conclusion that, in education, technology makes no difference because the investments made have not translated into improved educational productivity, thus reasserting Solow's productivity paradox in the education sector." (p. 139)

"Taken together, the correlational and experimental evidence does not offer a convincing case for the general impact of digital technology on learning outcomes." (Higgins, Xiao, & Katsipataki, 2012, p. 3)

### 2011

"Although there is no consensus as yet regarding the actual benefits of technology in ensuring quality learning, ICT are increasingly seen as an integral part of modern education systems." (UNESCO, 2011, preface)

### 2010

"Despite the fact that education systems have been heavily investing in technology since the early 1980s, international indicators on technology uptake and use in education are missing." (Scheuermann, Pedro, & OECD, 2010, p. 5)

### 2009

"Balanskat et al. (2006) reviewed several studies on the impact of ICT on schools in Europe.

They conclude that the evidence is scarce and comparability is limited." (Scheuermann & Pedr, 2009, p. 74)

### 2008

"...although ICT has the potential to develop a “learning continuum” that would support lifelong learning and embrace formal, informal and workplace learning, this has not yet been realised" (*COMMISSION STAFF WORKING DOCUMENT: The use of ICT to support innovation and lifelong learning for all - A report on progress*, 2008)

### 2005

"The positive impact of ICT use in education has not been proven. In general, and despite thousands of impact studies, the impact of ICT use on student achievement remains difficult to measure and open to much reasonable debate." (Trucano, 2005, p.6.)

### 2002

“Now, the bad news: while new digital technologies make a learning revolution possible, they certainly do not guarantee it. Early results are not encouraging. In most places where new technologies are being used in education today, the technologies are used simply to reinforce outmoded approaches to learning.” (Kirkman, Cornelius, Sachs, & Schwab, 2002, p. 32)

"...the existing knowledge base is quite scattered and limited in scope: it covers only some of the important aspects related to the inputs (how many devices have been sent to schools, for example); it provides only very limited information about the processes (how many students per device, for example); and it is rather confusing, if not biased, in relation to the outcomes (the effects of technology use on student performance)."

“However, research on the effect of ICTs on academic achievement continues to be open to criticism (as with all other areas of education). Critics deny positive findings as the result of flawed studies, while supporters promote positive results, without sufficiently evaluating the quality of their studies.” (Haddad & Jurich, 2002, p.39)

### 1987

"But there have also been evaluations in the U.S. of LOGO (problem-solving) applications. Unlike the CAl evaluations, which show a clear trend, the LOGO studies show mixed results. Some suggest significant gains in problem-solving, skills including gains in divergent and reflective thinking. But a major two-year study of LOGO found no significant effect on cognitive skills. Neither do any studies sustain Papert's claim that learning with LOGO-type programs will create new conceptual skills in children." (Daley, Loop, & Carnoy, 1987, p.4)

## Appendix 3 - The bibliography of "Vision and reality" (Daley et al., 1987)


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