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Scenarios for ICT-related Education: A Qualitative Meta-analysis

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Abstract

Education is one of the most essential elements of our society, which is why it has been the subject of dozens of foresight studies. What is currently missing however is a clear picture of the possible roles ICT can play in education. Through a qualitative and quantitative analysis of the large number of diverse studies, this article sheds light on the different future perspectives that exist. Based on the meta-analysis we present four new and plausible scenarios that address the main uncertainties regarding the use of ICT in education.

Keywords: Meta-analysis, IT, Education, Scenarios.

Introduction

Since the invention of integrated circuit by Jack Kilby in 1958, digital developments have taken place at great speed, creating new possibilities as well as new uncertainties. It is uncertain for instance, what the effects of digital technology are on young children during education (UNESCO, 2014), and there is no tried and tested way for teachers to communicate digitally with students effectively (Flecknoe, 2010, p.277). As far as the education system is concerned, the long term especially poses uncertainties. Davidson states for instance, regarding new professions in the future, that "65% of the kids attending primary school in 2011 will end up getting jobs that at the moment do not yet exist" (2011). And it remains to be seen whether we will still learn the same things in the future. A study by Hart Research Associates shows that most of the 318 employers they interviewed think that skills will be more important than diplomas. As the researchers write, "an applicant's ability to show critical thinking, clear communication and the ability to solve complex problems is more important than a Bachelor's degree" (2013, p.4).

Yet, the existing European education system addresses such new needs insufficiently, as becomes clear from the 'Europe 2020 Strategy', which states that "a fundamental transformation from education and training is needed to develop new skills and competencies and keep Europe competitive" (Redecker et al., 2010, p.2). Education faces a major challenge: how can we educate people in such a way that they are prepared for uncertain futures? And what role does IT play in those?

To answer those questions, dozens of futures studies were carried out in recent years by various organizations (Sociaal-Economische Raad, 2015; Nationale Denktank, 2016; Prince, 2014, Redecker et al., 2010, and others). However, no clear overview is available of education-oriented foresight studies, which would be useful to develop an overarching vision. What are the trends that the various foresight studies distinguish? How do these studies relate to each other? And what possible options do the foresight studies identify in terms of policy formation? At the moment, there is no overview that describes the similarities and differences. The aim of this study is to fill that gap and focus on what is perhaps the most important development in education in the last three decades: the role of Information and Communication Technology (ICT).

Despite the potential, education is still considered to be lagging behind with regard to the implementation and use of ICT (Mundy, Kupczynski, & Kee, 2012). Simultaneously, the integration of ICT in education is seen to be necessary because of society's increasing demands for ICT expertise (De Boer et al., 2002; VSNU, 2017). Research among experts lists the following reasons for this state of affairs: insufficient training, not enough motivation to change and a lack of government support (including financial support) (Snijders, 2018). For now, in education, where personal contact and interaction between teacher and student is very important, ICT plays a limited role. This is remarkable if we compare this with the frequently mentioned possibilities of ICT, like a life-long learning, time- and location-independent learning, personalization, shifting student-teacher relations and automation (Turkenburg & Herweijer, 2016; Nationale Denktank, 2016; Sociaal-Economische Raad, 2015). Having said that, there are many uncertainties regarding the use of ICT as well: "it is not yet exactly clear which particular solutions are most effective and efficient" (De Boer et al., 2002, p.24).

In this article, we conduct a meta-analysis of futures studies about education and ICT, and translate them to education scenarios. The aim is to provide a clear insight into possible future roles of ICT in education by developing scenarios based on existing futures research.

Method

Qualitative Meta-analysis for Futures Research

To develop future visions about education and ICT, a *qualitative* meta-analysis was carried out. A meta-analysis is a quantitative, statistical method (Gupta & Agrawal, 2012, p.1470). Schreiber, Crooks & Stern (1997) first described a qualitative meta-analysis as the "aggregating of a group of studies for the purposes of discovering the essential elements and translating the results into an end product that transforms the original results into a new conceptualization" (p.314). Since then, this research method has been employed in particular in sociology, anthropology and education (Timulak, 2009, p.592). Van't Klooster and Van der Duin (2016) developed a meta-analysis methodology specifically for futures studies that consists of a literature study and an analysis of the results through clustering. They list three reasons why a qualitative meta-analysis is a suitable method for analyzing studies: it is efficient, it is recognizable for users and decision-makers, and it makes it possible to compare futures studies. Their meta-analysis for futures research consists of seven different steps through which existing futures research is 'recycled' to new futures research. An adapted version of this methodology is listed below, in which three steps (6,7,8) were added specifically to demonstrate how we moved from a meta-analysis to scenarios (as made explicit by Rouwette and Franco, 2015). The steps are followed by an indication of their concrete application in this foresight study.

Table 1. *Methodological steps and application in this study*

Step	Methodological steps	Application in this study
1	Determine the goal of the future study. Goals can be placed on a continuum from narrow to broad. The breadth of a meta-analysis affects the number and diversity of studies that are included in the analysis.	In this study, we only included futures studies in which the goal (or one of the goals) was to examine future developments in the area of ICT in education.
2	Compiling a longlist of future studies.	In this study, we looked for studies on the basis of keywords that were deduced from the main and sub-questions. The keywords were: ICT, Technology, Education, Learning, Teaching, Schooling, Foresight Study, Trends and Scenarios. We looked in Dutch and English to identify both national and international studies. A number of experts then checked to see whether relevant studies were missing. The complete list of the publications we found is included in appendix 1.
3	Selection and narrowing down of publications to a shortlist.	To make sure that the *longlist* of publications from step 2 was manageable, a *shortlist* was on the basis of three different characteristics: - Studies that focus on the role of ICT in education. - Studies that are the most cited - Studies that were published since 1998.
4	Structuring the shortlist. The shortlist will have to be structured further to make analysis possible.	In this study, the shortlist was structured and clustered by the type of domain and theme, such as 'the general future of education', or 'blended learning'.
5	Studying and coding the selected publications. In this step, the collected material is studied and analyzed.	In this study, special text-mining software (Atlas.ti and R) was used to code the text based on a number of keywords, after which manual analysis was possible. The coded futures studies were scanned for future trends and development related to the role of ICT in education.
6	Clustering findings and defining FDSC's.	Because step five resulted in a long list with trends, it was important to cluster the trends into more general developments, or Forces Driving Structural Change (FDSC).
7	Assessment of FDSC's: expert survey	A survey was conducted about the impact and level of uncertainty of the findings. Based on the FDSC's with the highest impact and level of uncertainty, a framework for four scenarios involving education and ICT was created.
8	Writing scenarios	Combining the two FDSC's made it possible to build up four different and plausible scenarios.
9	Evaluation and retrospective.	The results of the scenarios were linked to the research questions from paragraph 1.

Operationalization

The search on the basis of the selected keywords (in the title and in the abstract) yielded fifty potential publications. Of those fifty publications, eleven were omitted because of an insufficient focus on the role of ICT and technology in education, because they failed to involve education sufficiently in the developments of ICT and technology, or because of a lack of long-term trends. The remaining studies (see Appendix 1 for this shortlist) were characterized per (educational) domain: technology (14), education in general (10), higher education (5), combination of technology and higher education (5), training of teachers (2), primary/secondary education (1), mobile learning (1) and blended learning (1).

Next, these studies were coded in the qualitative data analysis software ATLAS.ti by labeling the trends, causes and effects with keywords, which resulted in a list with 71 unique codes, which were combined into 14 *code families*, with the possibility of using a code in several code families. Finally, the programming language R was used to apply *data cleaning* and quantitative word frequency analysis, whereby the results of the qualitative analysis could be supported or refuted with data from the qualitative text analysis. That way, the quantitative analysis could indicate in what percentage of the studies a certain term was used and how often it was used per study.

The results of the meta-analysis were used to create scenarios about education and ICT. Scenarios assume that the future cannot be predicted and offer various possible visions of the future. Scenarios have to be distinguished from other approaches like prognosis, prediction, projection and speculation, which assume a lower level of uncertainty about the future (Rouwette & Franco, 2015). In accordance with the steps of the meta-analysis, content-related keywords were used to characterize the main visions of the different futures.

Survey

To get from literature analysis to scenarios a survey was conducted about the impact and level of uncertainty of the findings. This online survey was e-mailed to 24 education experts who were part of an expert network on the 'Future of learning' which was organized by the Netherlands Study Center for Technology Trends. To avoid discussion on the influence of existing systems and rules and collect perspectives on the long-term future, the survey used the year 2050 as a time horizon. Of the expert group, eleven members started the survey and nine of them completed the survey, of which the results were combined into a single data set. Next, the programming language R was used to create a *stacked bar plot* to visualize which questions the experts had different opinions on, making it possible to measure the level of uncertainty of a development. Finally, the questions were combined into a single score with regard to influence, to make it possible to say something about the impact of the development, by plotting the items with Likert scores of -2 to +2, respectively.

Results Literature Study

This paragraph discusses the results of the literature study on the basis of the meta-analysis. By means of a quantitative word frequency analysis six educational trends were selected. There may be some overlap among the results, because the trends influence each other, but on the basis of the text codes in ATLAS.ti, this is the most logical division.

From Knowledge to Skills

Most futures studies detect a shift from knowledge towards skills, which is a trend that has been described in futures studies for the last few decades. As early as 1981, the American education commission envisaged a learning society and stated that educational reform was needed to realize that ideal (Selwyn, 2016). The commission wrote that there was a pressing need for new basic

knowledge (like mathematics, social sciences and computer sciences), but also that a strong focus was needed on new skills, like understanding technology, critical thinking, applied learning and communication skills.

The call for new skills has since become louder and a popular question at the moment is which 21st century skills we will need in the coming decades. According to the World Economic Forum (WEF), now more than ever before, there is a growing gap between what people are learning and what they will need in the future (2016). There is a shift underway from a knowledge-oriented education system towards a skill-based system. The WEF and other organizations point to EduTech as a way to respond to that shift in a cost-effective way. ICT such as Artificial Intelligence, Virtual Reality, MOOC's and Learning Analytics are often assessed as catalyzers which make it possible to create a more interactive learning experience that focuses on skills.

Personalization

One of the developments that is mentioned most often in the futures studies is personalization. In the qualitative analysis, 25 studies were characterized for recognizing a trend towards personalization, and the quantitative analysis showed that 30 studies described personalization 451 times. Personalization means that students can tailor their education to their personal needs. The origin of this trend is the demand by students for more enjoyable and more interesting education that would provide a better match for the jobs the students want to have in the future (Van der Zwaan, 2016). A tailored approach could make education more valuable by matching knowledge and skills to the needs and interests of students (Williams, 2008). ICT could contribute by providing adaptive learning systems that keep track of what people learned (and what they know) over a longer period of time. Different types of personalized systems can be distinguished, like intelligent tutors, adaptive learning environments and learning management systems that personalize the learning process through data-driven technology, machine learning, analytics and artificial intelligence. A perceived benefit of technological personalization is that the systems can take into account students who deviate from the average, either because they are behind or ahead of their peers. ICT could help make a distinction in learning styles, learning pace and the management of the learning process, and in a broader sense take differentiation in learning groups into account.

Providing an open, modular system would allow people to enter the educational arena when they want to, where they want, and it could help facilitate what they want to learn and the preferred level. This would lead to a more inclusive system, especially when we look at the less fortunate in society (Aktaruzzaman, Shamim & Clement, 2011; OECD, 2016; Oliver, 2002; Punie, 2007; Redecker et al., 2010). According to the OECD, for example, an open education system can (could) provide immigrants and developing countries with tools for learning knowledge and skills, to which they had no access before (OECD, 2016). Of course, an open education system does not by itself give access but policies need to be developed to make that possible.

Networking

Another trend is the *networking* of education, in which networks are seen as collaboration between educational institutes and between students. In the qualitative analysis, the code 'network' was used 40 times, making it the second largest code family. It is expected that this networking is not a free choice for educational institutes, but a forced development "caused by increasing international competition on the education market" (Van Staalduinen, 2004). The reason that this kind of networking is seen by many as a positive development is because it "increase[s] the chances of learners' experiencing high quality educational experiences based on shared understanding of learners' histories and prior understanding" (Facer & Sandford, 2010).

In concrete terms, that may mean that students take courses at several different institutes, depending on the institutes' expertise (Facer & Sandford, 2010; Glenn & D'Agostino, 2008; Oliver,

2002; Oyaid, 2009). In addition, instant messaging and social media will increasingly be integrated into teaching material to stimulate motivation and communication of students (Attwell, 2007). Working together is seen as essential to improve the quality of education and tailor the learning material more closely to certain student groups (Bottino, 2004; Delors, 1998; Jones, 2003). In addition, working together can lead to a shared cultural understanding and advanced knowledge of other cultures, because students will get used to working together with international students (Bonk, Kim & Zeng, 2006a) provided that that is also being encouraged by the teaching context. Just having connections between cultures does not automatically lead to developing intercultural skills.

For education institutes, networking could lead to developments such as 'collaborative agreements' between researchers (De Boer et al., 2002), online training for teachers at an international level (Bonk, Kim, & Zeng, 2006), the exchange of teachers (Delors, 1998) and a sharing of web-based material and data (Miller, 2003; OECD, 2004; Oyaid, 2009). This may turn education institutes into a *global campus* where physical and virtual collaboration with other education institutes co-exist (Collis & Wende, 2002; Valcke, 2004).

ICT is seen as the factor that makes networking possible (Oyaid, 2009). Already, technological developments in the field of data analytics (like *big data* and *data repositories*) have a major impact on education and research, and that is a process that will continue (Van der Zwaan, 2016). As a result, Facer and Stanford expect that people (in technologically advanced societies) expect that they will always be able to connect to each other via ICT and have digital access to data, people, knowledge and tools (Facer & Sanford, 2010). Now, in 2018, we can state that this expectation has come true for the larger part.

Time- and Location-independent Learning

Another development is that of time- and location-independent learning. The term 'life-long learning' is mentioned 465 times and appears in three-quarters of the documents. In addition, in the qualitative analysis, the concept of location independence is mentioned specifically in 17 different studies. These concepts were merged because, in literature, they are often linked and both refer to increased flexibility of learning.

The concept is not new, as institutes have been offering long distance courses for years and a lot of research has been done to determine how to do so in the most effective and efficient possible way. However, researchers state that the use of ICT holds a promise to bring time- and location-independent learning from a 'select few' to the masses (Oliver, 2002). Although, with *massive open online courses* (MOOC) and other developments, we see the increase of time- and location-independent learning already, the current education system has not embraced the concept fully. Generally speaking, most experts appear to agree that face-to-face and online learning will continue to coexist (De Boer et al., 2002; Facer & Sandford, 2010; Vincent-Lancrin, 2004). This form of *blended learning* (26% of the studies, 146 times) will be facilitated by ICT, which will make it possible to learn at any age. This will take place in part online and in part face-to-face, for specific interactions and for essential interaction with peers and fellow students (Facer & Sandford 2010; Van der Zwaan, 2016). However, the further we look into the future, expectations are that the face-to-face element will continue to decline (Salmon, 2014).

Personal ICT devices are expected to be an important enabler of this type of learning and their use in blended learning are expected to increase in the next two decades (Bonk, Kim, & Zeng, 2006a). Interaction through personal devices will be seen as a natural daily activity (Melhuish & Falloon, 2010).

Automation of teaching functions

ICT may change the role of the actors who are currently providing education. Although various popular reports predict that the role of the teacher will disappear completely, in most foresight

studies the teacher is considered to be an important factor for the education of the future (UNESCO, 2015). What is predicted however is that the current role of the teacher is not suitable for the future. Wheeler (in Oyaid, 2009) lists four reasons why the use of ICT in education will change the role and status of teachers (of which the first three in our view already have happened in developed countries):

1. ICT will make certain teaching instruments, like the blackboard, redundant.
2. ICT will change the way of assigning scores.
3. Teachers have to adapt to the change in education: from transferring knowledge towards organizing learning.
4. Teachers need to match the characteristics of the human brain more closely.

The expectation held by various studies is that these changes through ICT will lead to a situation where the teachers is seen as a 'facilitator' of learning and as a mentor to the student (Aktaruzzaman, Shamin & Clement, 2011; Bonk, Kim, & Zeng, 2006a; Facer & Sandford, 2010; Kim & Bonk, 2006b; Molebash, 1999; Oliver, 2002; Oyaid, 2009; Redecker et al., 2010; Salmon, 2014; UNESCO, 2015). This means a shift away from the current *teacher*-oriented approach towards a more *student*-oriented approach. The use of ICT will make students more responsible for their own learning activities (Oliver, 2002). The position of the teacher will change from that of a central authority towards that of a decentralized facilitator. The teacher will use ICT to support students on their learning path (Oyaid, 2009).

The expectation is that, by means of ICT, the traditional approach to teaching is only one of the many ways in which teachers will transfer knowledge and there will be a constant shift between the various approaches (Jones, 2003). For instance, a survey conducted by Glenn and D'Agostino (2008) shows that 60% of the participants predicts that teachers will teach in more than one medium. To keep up with all these changes, teachers will have to maintain their skills continuously, through life-long learning of their own, not only with regard to their specialist subject, but also when it comes to technology (Delors, 1998; Kim & Bonk, 2006). An important condition for this is the support from educational institutes and the willingness of teachers themselves.

Availability of ICT on the Basis of Costs

When we examine the role of ICT in education, we also need to look at the changing costs of ICT and their impact on education. The importance of this trend clearly shows in the quantitative analysis, which indicates that costs are mentioned 561 times in 90% of the studies. At first sight, literature appears to foretell that the costs for education institutes will rise as ICT is integrated more in education. For example, 70% of the surveyed universities list costs as their "main concern" when it comes to the implementation of digital technologies (Glenn & D'Agostino, 2008). In addition, institutes focus a great deal on the fixed and purchasing costs of ICT. One of the possible consequences of these high costs being mentioned is that, in the future, small campuses will no longer keep up with the big universities and will therefore have to find other ways to differentiate themselves (Glenn & D'Agostino, 2008).

Upon closer inspection, literature indicates that the implementation of ICT can also lead to cost savings in many ways, for instance through digital information storage instead of physical storage, access to global open data, a more efficient infrastructure and better training (Punie, 2007). The impact of these costs savings increases dependent on the size of the education institute, because of the high degree of scalability of digital learning. A good example of that is the Open University, which is a pioneer in the area of digital learning and the biggest university in Great Britain, as well as the university with the least visited campus (Williams, 2005).

In addition to economies of scale, there are two other reasons why ICT in education is likely to become cheaper in the future. In 15.4% of the examined articles, Moore's Law is seen as an important guideline for faster and cheaper ICT (Facer & Sandford, 2010; Kim & Bonk, 2006b;

Molebash, 1999; Oliver, 2002; Redecker et al., 2010; Turkenburg & Herweijer, 2016). So if ICT is too expensive for smaller education institutes now, that does not necessarily have to be the case in the future. Secondly, mobile technologies, like smartphones and tablets, can play a greater role in the future in terms of saving costs, because they are portable, cheap and available to almost everyone. According to UNESCO, mobile technologies "hold the key to turning today's digital divide into digital dividends bringing equitable and quality education for all" (UNESCO, 2015).

Scenarios: From Data to Future Image

Scenarios are often built by mapping and rating trends and FTDSC's on their level of uncertainty and impact (Nekkers, 2016). On the basis of the results of the survey, the most important contextual trends were selected. By adding the numerical values (-2 to +2) to the respondents answers and then dividing the results by the number of respondents, we were able to calculate an average score for each question. To determine the level of uncertainty, it was decided to look at where the respondents disagree, which was done by analyzing the data in a stacked bar plot using the programming language R. Table 2 shows how all trends were assigned influence and that the respondents scored 'Availability' and 'Personalization' the highest, meaning that according to the respondents these trends will have the biggest and most uncertain impact.

Table 2. *The impact of ICT developments*

Trend	Impact value
Availability	1.666666667
Personalization	1.555555556
Skill-based learning	1.555555556
Informalization	1.333333333
Networking	1
Automation	1

Because personalization and availability are important and have a high level of uncertainty as well, these two contextual trends will serve as driving forces for the scenarios, which results in a scenario framework (see below) with four different scenarios.

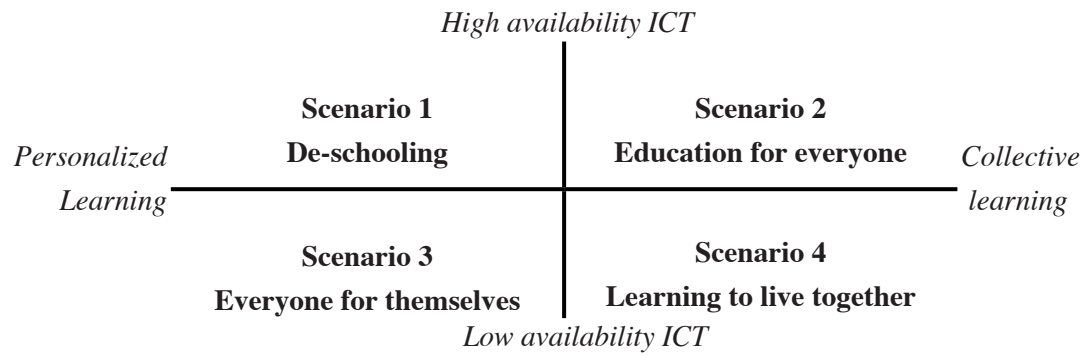

Figure 1. The four ICT & Education scenarios

Scenario 1 'De-schooling'

A lot of ICT – very personalized; scenario with high level of market forces, de-schooling, and a small role for central public institutes and schools.

This scenario outlines a future in which ICT will be a determining factor in the transformation of education. Central public institutes and schools play a less important role. Powerful, cheap ICT makes it possible to connect people and allow them have access to education in small-scale and large-scale networks. There will be new teaching professionals, while classic relations between student and teacher, parent and teacher, and education and community slowly disappear. Thanks to the availability of easily accessible separate courses and self-schooling, students are less and less interested in taking formal education. Employers are also less focused on diplomas and select on the basis of skills and their own test criteria.

The scenario leads to more room for personal ambition and personal supervision, by people as well as by smart software. The choices and knowledge of students are monitored in an advanced student tracking system, making it relatively easy to see in which areas a student either experiences difficulties or excels, for both learning coaches and for students themselves. This personal and flexible approach makes it possible for people for whom it is currently difficult to enter an education institute, like the underprivileged (assuming that they have the skills for access) or people who work full-time, to do so more easily in the future. Thanks to a variety of ICT solutions, these students will be enabled to engage in education in their own time and location. An important element of these ICT solutions is that of the mobile technologies that allow students to learn via intelligent systems. As a result, future education will be more diverse than it is at the moment.

There is a risk that there will be large differences in adaptability between students and between teachers. Some students and teachers will excel due to their interests and the ability to learn about and buy the latest ICT. However, other students, for whom self-schooling and ICT-mediated learning is less simple, will tend to stop learning sooner and enter the job market or drop out. This carries the risk that, in the long term, the labor market will face a shortage of people with theoretical, specialized and abstract knowledge, and that people who find it difficult to adapt will stay further behind.

Scenario 2 'ICT education for everyone'

A lot of ICT – collective; Public-private cooperation, education for everyone scenario.

In this scenario, there is an ICT-enabled leveling effect in education. ICT has become faster and cheaper, which means that schools and universities have increasingly advanced systems. On the software market, this has led to the existence of several large companies competing with each other to marketize the best educational software and serious games. These companies operate on an international level and the intensive cooperation between education institutes has created a need for standardization and uniform software packages. Unlike today's technology, the technology being used will have the ability to carry out powerful simulations, with the technology being constantly connected to high-speed Internet. Thanks to the capacity of the devices involved, people do not need multiple personal ICT devices; the technology is provided by the education institute.

The threat of automation and the replacement of human tasks and functions by smart technology only increases. As such, automation will have a major impact on the organization of education. Students, teachers, parents and managers will have to adapt by mastering technology. For instance, people no longer need to know how to do something, but how an ICT device could do it and how people can be supported in that process. Another factor that plays a role in this is that all this technology will produce a wealth of information, of which we currently see only the beginning, among other things through a network in which all devices will be connected to the Internet. Students and teachers will need many (new) skills to organize and analyze the data generated by those devices, which means that having ICT skills will be crucial as well.

The teacher's task will change from transferring knowledge to *facilitating learning* because information is freely available on the Internet in central databases, and it is in particular the student's task and challenge to find and analyze that information, and to arrive at the right conclusions. The teacher will be a coach in that process, professionally and personally, allowing the student to acquire the necessary 21st century skills. Given the social character of this scenario, the 21st century skills need to be complemented with skills and knowledge related to ethical and social issues.

Scenario 3 'Everyone for Themselves'

Limited access to ICT – personalized; gap between rich and poor, top-quality education and excellence, but only for some

This scenario is about the development and realization of the individual. Personalization and flexibility are the keywords. One-size-fits-all approaches are not accepted and the main purpose of technology is to make sure that the focus is on students and their choices. Learning is informal and learning situations are distributed among different locations, technological platforms and a wide range of activities. People do not have to be at a specific place at a specific time; learning is completely location- and time-independent. There is less stability, less structure, and the boundaries between learning and not learning, different disciplines, and online and offline are things of the past. There are few physical classrooms left and everyone is connected to each other virtually.

ICT has become increasingly complex and advanced, which increases the costs and limits availability. As a result, technology companies compete to develop the best systems and sell them to students via new business models (including premium models and membership fees). This scenario also sees a growing gap between rich and poor. Wealthy people have access to advanced technology such as artificial intelligence, biotechnology and other advanced systems with which our cognitive functions can be improved, while less wealthy people increasingly lose ground.

Scenario 4 'Learning to Live Together'

Little access to ICT – collective learning; solidarity important, highly centralized and government-managed, distrust technology and price ICT high

In this final scenario, the focus is on the social importance of learning. The central education system is seen as the main platform for promoting citizenship and it has a binding function in an increasingly diverse and fragmented society. More public money is invested in education and social organizations and government work closely together. Schools are organized locally and have a central place in society, and there are powerful national policy programs that provide social and digital infrastructure, especially in weaker communities. Schools have become meeting points in society where people come to meet not only people their age, but all kinds of other people and social groups. Instead of being individual knowledge carriers, teachers in this scenario work together in teams and have supervisory and coaching tasks, and they establish and facilitate networks between students and institutions. Teachers are seen as co-learners who play specific roles within the democratic learning networks. They are connectors and moderators who know how they can set up and facilitate learning communities. The curriculum focuses on citizenship, social cohesion, battling segregation and inequality, as well as social manners and human values. Learning is not limited to knowledge, but includes a strong focus on social and cultural skills. In this scenario, ICT is not the goal, and there is distrust regarding long distance learning and the use of mediating technology in classes. To purchase and develop expensive technology, education institutes cluster together to realize economies of scale. Technological innovation and implementation is a process that takes a lot of time, which is fueled by a distrust of markets and technological solutions to social problems. There is less of a focus on excellence and high performance, and education is more value-driven towards values such as solidarity and inclusion.

Conclusion

In this foresight study we did an international meta-analysis of futures studies about education and ICT, and translated the outcomes into four education scenarios. The literature analysis was carried out systematically among a relatively large number of articles (n = 50). From the meta-analysis, we identified six important educational trends: a shift from knowledge towards skills, personalization, networking, informalization, automation and availability of ICT. A survey among a panel of experts showed that all the trends in question have an impact on education, The availability of ICT and personalization had the highest levels of uncertainty, which made us decide to use those two trends as 'forces that drive structural change' to set up four scenarios about the role of ICT in education. The scenarios were on the axis 'high availability of ICT versus low availability of ICT' and 'personalized learning versus collective learning'. In the four scenarios, we see how the different ways in which ICT is implemented can lead to educational shifts, such as an increased role of private parties, an ensuing power imbalance between the state and private sector, and a shift in the role of teachers. In addition, we see a possible change to a reorientation of the values that underpin our current education towards more economic goals, but also, in the opposite direction, to a situation in which individual happiness or societal relevance become focus points. Our reason for setting up the scenarios was that it is necessary to review education in the light of the digitization and technological development of society. Although it is hard to predict which way technology will develop and the way societies deal with technology does not follow general rules, there is a need for a discussion about the possible opportunities and consequences of technological development with regard to how we organize education. By setting up new future scenarios, we gain insight into the various ways of thinking and can then propose alternatives, focus the debate and inform future-oriented policy.

The scenarios also help us formulate and evaluate policy to map different visions, possible blind angles and backgrounds of various stakeholders (See Hermes & Zonneveld, 2015). The way the scenarios function is important because it provides insight into how stakeholders who favor specific scenarios look at reality. After all, scenarios are stories and, as such, perspectives on reality. Everything that falls inside the focus of a scenario can be clearly observed. Whatever lies beyond its boundaries, remains invisible.

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Appendix 1. Shortlist of Publications Used in the Meta-analysis

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