Which elements of digital competence should be acquired at school?

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1. Introduction

Digital competence is not yet a stable concept (see also the answer "What is digital competence" about defining the concept) but emerging from various backgrounds. We had to consider what issues to include in the definition of *digital competence*. Studies about the curriculum do not necessarily explicitly use the term "digital competence" but discuss, for example, about "digital literacy", "media literacy" or "ICT skills". For this reason, the original author's concept is mentioned when reviewing the results, if relevant, to make it clear which term and which elements of digital competence have been investigated in the referred article.

First of all, there is no clear answer to this question. Instead of defining which elements to teach about digital competence, several articles discuss about what kind of digital skills (or competence) can be acquired when emphasizing and increasing the use of digital technologies in the curriculum, or the changes required in the curriculum to teach necessary digital competences. Moreover, there is also discussion about digital competence itself: is it a set of skills and attitudes, that can be cut up into small entities to be placed as parts in the existing curriculum, or is it something deeper that changes also the broader content and practices of education (e.g., Erstad, 2010; Hague & Williamson, 2009).

In several papers, the content of digital competence and the practices of teaching digital competence were combined (e.g., Erstad, 2010; Luce-Kapler, 2007; Walsh, 2007). For the review about teaching practices, see the answer "Which pedagogical practices and methods best support learning digital competences?"

Several articles discussed learning *new literacies* or *information literacy / digital literacy* which had media education as a background discipline and which connected the topic to such subjects as languages or visual arts. There were less articles about other disciplines or the curriculum in general.

One possible subsequent question could be "Why should some elements of digital competence be acquired at school?" This question would lead to such answers as the need to decrease the digital divide by teaching elements of digital competence in school for everybody (see e.g., Hague & Williamson, 2009; OECD 2010; Erstad, 2010). We will not, however, continue in this direction, because, although this is of major importance, it is not the goal of this paper.

2. Digital competence taught in school

What contents should be taught in school?

This question is answered often in a very broad way; e.g. in a summary report about PISA studies by OECD (OECD 2010) "education standards need to include the kind of skills and competences that can help students become responsible and performing users of technology and to develop the new competences required in today's economy and society which are enhanced by technology, in

particular those related to knowledge management" (p. 14). In the referred report, these skills were defined to include processes related to knowledge management in network environments. Moreover, it stated that these skills should be gained at school. Such a broad definition leaves open the question about in which specific subject domains or on which school levels the elements of digital competence should be taught.

One of the few papers that provide some answers to the question is Erstad´s (2010). He broadened digital literacy to media literacy and suggested the following aspects of media literacies as part of school-based learning: 1) Basic skills, 2) Media as an object of analysis, 3) Knowledge building in subject-domains, 4) Learning strategies, and 5) Digital Bildung/ Cultural competence. Erstad defined aspects and categories of media literacy by which he tried to operationalise media literacy in school practices, not connecting them to any specific subjects or technologies. Besides this, Erstad emphasized user-generated content creation (Web2.0, editing software) in which students have an active role in knowledge practices. (Media literacy / competence, which Erstad used, is in some definitions the main concept, of which digital competence is one of the sub-contents. See the answer to the question 1. What is digital competence?)

Another study about the role of digital competence in the curriculum was conducted among teachers of informatics oriented subjects in the Czech Republic (Benes, Mudrak, Prochazka, Rambousek, and Stipek, 2008). The respondents answered to a ready-made questionnaire. Teacher respondents considered that the most important units for developing information and technology literacy of elementary school students were 1) word processing, 2) basic user skills, work with operation system, file management, 3) information seeking and communication, and 4) work with spread sheets. As the authors said, the respondents often tended to mark those competences they master themselves, and point out as unimportant the ones in which their IT competence was lower. According to the respondents, the most important higher-level competences were 1) to analyse the obtained information and find the important piece for the given task, 2) use more resources of information in problem solving, 3) to be able to evaluate the various forms of given information. The respondents also gave their opinion about the best order for building the IT competences (at elementary school): First, competences focused on reading and understanding information, second, the visualization of data and information, and third, the transformation of complex knowledge (e.g. the ability to create and use thought maps and notion maps, algorithm design and programming). In addition, at elementary school students should be able to create and edit word processor documents and file tree structures. They should also have the ability to use several information resources, analyze the received information, determine the important parts of the given task, and manage the information load.

Changes needed for the curriculum

In several reviewed articles, an essential conclusion was that there is a need for changes in the curriculum, in structures, in teachers' competence, etc. before schools can provide students with relevant competences and skills. The necessary changes mentioned in articles used were the following:

 1. A general change in the curriculum, not related to any specific subject

This was emphasized by Erstad (2010) and Hague & Williamson (2009). Erstad regarded knowledge building in subject-domains essential. New technologies change fundamental issues within school subjects (e.g. calculators in mathematics). Knowledge is interconnected with the cultural tools we have, and not only with "content", and tools change over time. It is important to have knowledge-building skills, not specific technology skills. Based on his own study using project work, Erstad explained that digital media was both a resource for students' learning, as well as a tool for reflection on information

sources, their collaboration within and between schools, and content creation – all of which were not related to some limited subjects of the curriculum.

2. Changes in subjects of (media) literature and writing

It is natural that there should be changes in literacy-related subjects because literacy / digital literacy / media literacy are the core contents of digital competence. The content of literature and writing needs to consist of "something" of the new features of digital technology. As an example, Hague and Williamson (2009) referred to Bazalgette (2008) who suggests that literacy should be redefined for the 21st century. In their review, Hague and Williamson presented one perspective on literature "as a combination of the operational cultural, critical, creative and collaborative forms of important components of what it means to be an effective digital participant". The authors also present other perspectives on literacy, such as media literacy and multi literacies, in which digital skills are also included, as well as digital literacy as a kind of "concluding concept" which is a combination of social awareness, critical thinking and knowledge of digital tools. Their definition of new literacies involve social skills developed through collaboration and networking. Regardless of how we define digital literature, changes are needed in the existing literature curriculum. (For more discussion about the concepts, see the answer "What is digital competence".)

O'Brien and Scharber (2008) stated that students are engaged in different literary practices inside and outside of school. The possibilities of including digital literacies in the school curriculum relate to bridging the new (outside school practices and contents of digital literacy) with the old (inside school practices and contents of literacy) in ways that will gradually transform how young people express ideas and learn in schools using new digital tools. Walsh (2007) and Luce-Kapler (2007) also emphasized the importance of making school-based literacy practices relevant to students' lives (see the examples below of these studies).

3. Changes in the structures of school, such as scheduling and organizational routines, which, according to O'Brien and Scharber (2008) are challenged by digital literacies' practices.

4. Changes in the assessment practices

In his article, Erstad (2010) described how students' digital competence is evaluated in schools in different countries. Several of the studies he used for reference purposes showed a clear connection between students' digital competence and their parents' socio-economic status. Schools have not been able to bridge this gap.

In describing the gap between outside and inside of school' digital literacy practices O'Brien and Scharber (2008) wrote about the gap in official standards and assessments. Students' outside "texts" are multimodal digital ones but the assessments are almost exclusively based on printed texts.

Examples of results following curriculum changes

Based on the results of reviewing articles concerning the curriculum and digital competence, it is evident that the issue is more relevant for the curriculum of some subject domains than for others. Such domains are especially literacy but also arts more broadly. Merchant (2009a; 2009b), for example, has written about this change within literacy. He suggests that the central concern of digital literacy is reading and writing with new technologies recognizing that on-screen texts combine writing with other modes of representation. (See also the answer to the question "What is digital competence?") In these subjects the *content* is changed because of digital technologies, and for this reason a change in the curriculum is also necessary.

Because of our emphasis on *digital competence* we present only two examples of the changes within the literacy curriculum.

The first example is an action research based case study of a literacy workshop in which the traditional content was replaced by a multiliteracies curriculum emphasizing 'multimodal design' (Walsh, 2007). The aim was to incorporate and extend the use of digital technologies from students' out-of-school repertoires of practice. Walsh reported changes 1) in his own understanding: he (the teacher) became better acquainted with the concept of multimodality and possibilities to include texts from youth digital culture into his own teaching, 2) a shift of focus from literacy instruction, in which students imitated literacy practices the teacher had modeled, to students becoming inventors / designers of new genres. Walsh emphasized authentic settings which resemble some of the changing work contexts and which make the literacy practices relevant to students' lives.

The other example is a review about empirical studies of digital practices within new literacy studies. The author had collected results of learning outcomes after integrating new digital media into official literacy curricula (Mills, 2010). In the review, the content of literacy studies was broadened to digital media, and this new literacy was connected, e.g., to popular culture, recreational contexts, or digital art. The results were promising; e.g., some of the studies integrated students' existing cultural resources using digital and popular media, accomplishing both conventional and innovative curricular goals.

ICT / digital literacy in curriculum: a separate subject or integrated in several subjects?

An interesting change has happened during the last ten years: while the question "Should ICT be a separate subject or integrated in other subjects" was a burning question 10-15 years ago, none of the recently published papers reviewed discussed this issue – it appears to be so self-evident that digital technology should be integrated in all subjects and in all learning and teaching processes. The dominant opinion in the articles was that the best way to support students' digital competence is to use technology in various school subjects and for various purposes. Allen (2007) stated that there should be a school-wide consensus on goals, methods, and responsibilities about the acquisition of information literacy skills. Based on a survey targeted to teachers in Czech Republic, Benes, Mudrak, Prochazka, Rambousek and Stipek (2008) reported that teachers favor the approach that information education is not limited to the information technology subject itself, but the development of information technology competences should be supported by the wide usage of ICT in other subjects not directly focused on informatics, and also in various educational information activities that are not directly linked to these subjects. The improvement of digital competencies or related skills can be an important additional goal or side-effect in settings where technology is used in education for other purposes, mainly learning of some subject domain content.

In her research-based paper, Labbo (2006) stated that new literacies are learnt best when computer technologies are integrated throughout the day and across the curriculum. She regarded the most important consideration driving the need for a transformed, computer-related pedagogy is the fact that reading from the screen is so different from reading from the paper page. This improves visual literacies, which include the ability to interpret, recognize, critically evaluate, and utilize visual graphics.

Mitchell and Dunbar (2006) investigated the role of computers within the nursery sector as the potential way of introducing young children to computers. Their results indicate that the programs that were in use appeared to provide the children with a range of enjoyable and purposeful learning tasks that enabled the promotion of emergent ICT skills. In addition, in several papers the level of digital competence today was discussed: the high level of digital skills / competence among the young is so obvious and acquired in informal settings that there seemed to be no role for school to teach technology skills separately. This claim of children's high level digital competence is not necessarily true but problematic and often over-generalized, as can be concluded on the bases of several studies; the issue is discussed, e.g., by Erstad, 2010 and Buckingham, 2007.)

According to Buckingham (2007), we need a broader re-conceptualization of what we mean by literacy in a world that is increasingly dominated by electronic media and we should not just simply add media or digital literacy to the curriculum menu or hive off the information and communication technology into a separate subject, dominated by the practice of de-contextualized skills that most students find merely redundant. Children and teenagers acquire forms of digital media literacy outside school simply by using these media. The role for school is to offer such experiences, perspectives and knowledge that they might not encounter in the informal settings.

3. Summary

There is no clear answer to this question, and the topic is only seldom discussed in research studies; digital competence is not divided to sub-competences for various subjects for the curriculum. In general, digital competence is best taught – and learned – in various subjects; not as a separate topic in ICT subjects. For learning adequate digital competence in school, several changes were mentioned: in the curriculum, in some specific subjects (especially in media literature and writing), in school structures, and in assessment practices.

4. Method for answering the question

Elaborating the question

The question "Which elements of digital competence should be acquired at school?" was formulated based on several authentic questions, which focused on questions related to the curriculum and digital skills (such as " Which ICT skills should be acquired at school?" and "Is the current curriculum suitable for developing digital competence, and to what extent?") or even a quite detailed one: "What role should social media have in school"?

Before answering the question, we elaborated it from the curriculum' point of view, and considered the sub-question: Should digital competence be taught as a subject of its own or integrated into other subjects? Both these questions are based on decisions about the curriculum, both in a broad and general sense and for each subject.

Search procedures

The searches were conducted using EBSCOhost, which is an on-line retrieval system of scientific articles related to educational, psychological and behavioral sciences. The searches were targeted to two databases in the system: Academic Search Complete and Education Research Complete. The results from these databases were narrowed down by the following restrictions: Articles were to be peer reviewed, in English, published in between 2005-2010 (originally in between 2000-2010, but due to vast amounts of irrelevant hits this was further restricted) and finally the full text was to be available through EBSCOhost with the rights purchased by the University of Helsinki.

The search words used in the process were mainly derived from the vocabulary of the questions and their synonyms. In addition to these, some terms were added using the professional knowledge of the researchers involved in the process.

The process was started with a more general search shared with all the questions related to Digital Competence. This was conducted to roughly estimate the workload and adjust parameters for the search. The search words used in the general search were:

- digital competence* (all text)
- digital skill* (all text)
- digital literac* (all text) AND education (subject terms) AND school (subject terms)
- ICT skill* (all text) AND education (subject terms) AND school (subject terms)
- ICT competenc* (all text) AND education (subject terms) AND school (subject terms)
- ICT literac* (all text) AND education (subject terms) AND school (subject terms)

In addition the following searches were conducted especially for this theme:

- digital literac* (all text) and curriculum (subject terms)
- ICT literac* (all text) and curriculum (subject terms)
- ICT skill* (all text) and curriculum (subject terms)
- ICT competenc* (all text) and curriculum (subject terms)

(The term indicated between the parentheses describes which parts of the database the search words were directed to.)

In addition to the searches into the databases, a manual search of theme related scientific journals, covering one year of publications, was conducted in the University of Helsinki Minerva-library at the campus of cognitive sciences. More articles were also found through the reference listings of articles that came up in the searches. Some of the reference articles were also familiar to the researchers from previous experiences with the field of study.

All in all 8 research papers and 2 books were used in composing the answer.

5. References

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