Knowing what, Knowing how, or Knowing where? How Technology challenge Concepts of Knowledge

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Abstract. When bringing innovative technology into school education it has been challenging to get full benefits from the technology. Instead of seeking new ways of teaching we tend to adapt the use of technology to traditional ways of teaching. This can relate to the fact that we lack theoretical concepts that help us rethink and revise our practices. In Norwegian curriculum we see different learning discourses represented, that makes it difficult to change our concept of knowledge. It is therefore time to look for new ways of understanding the concept of knowledge, to be able to build new perspective on learning and teaching that opens for a more innovate way of using technology in education. George Siemens' connectivism gives interesting contributions to this transformative process, and may inspire to new concepts of knowledge.

Keywords: Knowledge paradigms, didactics, technology in education, George Siemens, connectivism, knowledge-flowing circles, knowledge networks

1. Introduction. How do New Technologies challenge the Concepts of Knowledge?

The Norwegian national curriculum has recently been revised and in the preparation of the new curriculum from 2020, it has been pointed at the necessity of defining new perspectives on using technology. However, it can seem that the concept of knowledge in the curriculum is not adapting the new possibilities that innovative technologies bring to education.

The paper will present some challenges about how we understand knowledge today and argue that we need a new concept of knowledge that can capture the benefits of using innovative technology in future education. The paper is based on a theoretical investigation connected with a larger study that aims to answer questions about how students work and learning change when they use innovative technology in compulsory school in Norway, where questioning the concept of knowledge in school has been an important part of the study's theoretical investigation.

To understand education in light of innovative technologies it is necessary to see how new technologies challenge the concepts of knowledge itself. The way we understand knowledge and knowing will guide how we teach and understand students' learning in all pedagogical institutions. This paper will briefly present some challenges in the concept of knowledge, based on the Norwegian experience and present some perspectives on how the concept of knowledge must change in light of innovative technology and learning.

The research question for this part of the study has been: How do new technologies challenge the concept of knowledge, in order to discuss the need of revising what we understand by knowledge when using innovative technologies in school.

2. Method.

The study is part of a larger case study of how students use technologies at school. This part of the study is a document and literature review where the main objective is to discover the meaning of knowledge in Norwegian curriculum, to be able to discuss the necessity to develop a concept of knowledge that captures the changes that innovative technology brings to education. I have mostly based the review on strategy documents

and curricular research in Norway as well as some general aspects on didactics and knowledge.

3. Results.

It is no exaggeration that the technological revolution has transformed our society. In short time our everyday lives have undergone substantial changes. Keywords are cellphone, pads, computers, internet social media a.s.o. In Norway, already in 2008, 99 % of students in compulsory school had access to internet at home [10]. They use more advanced technology outside school than in school, and participate in different social networks [11, 12], which give them competences that can be of use in school work. They have access to technology that able them to mediate not only learnt material but also expressions of their own unique experiences. And they have the possibility to influence the learning activities in school, by the potential to control their own construction of knowledge, the way they seek new knowledge and understanding, and to control the tools they use to create learning conditions [13]. This raises several questions about the concept of knowledge in school. Can we capture the transformations within a traditional perspective on knowledge or do we need new concepts to get new understandings?

3.1. School knowledge as a persistent traditional concept

Gavriel Salomon point at all the possibilities that technology bring to education that is not exploited because the school keep to a traditional way of understanding learning and teaching [14]. Digital tools work well for drilling basic skills, and a lot of such tools are developed within the behaviourist tradition.
The increasing use of innovative technology in our society bring forward the need of questioning the core concepts of knowledge and learning in school. But the traditional concepts of school knowledge can be very resistant. Swedish Gunilla Svingby formed some very important questions about school knowledge already in the 1980s [4]. She did a short knowledge test of 9 questions from typical school knowledge, on a group of 100 Swedish school leaders. None of them were able to give correct answers to more than half of the questions, and 60% had only 0-2 correct answers [4]. In other words, none of the school leaders were able to master a typical test that were used to test and grade students' learning outcome. Svingby meant that this showed that the belief in school knowledge as a measurable size was exaggerated, and that most knowledge that e.g. teachers have about their subjects are achieved after leaving school [4]. Even if this was more than 40 years ago it is an ongoing discussion about what school knowledge should be, and of the need to measure learning outcome as detailed as possible to control students' learning outcome. The concept of school knowledge seems to be situated in a long tradition which is hard to change.

3.2. The Norwegian curriculum and didactic traditions

The Norwegian compulsory school (13 years, from the age of 6 to 19) build upon a European critical-constructive didactic tradition [1], which is concerned about how education contribute to the upbringing of autonomous, independent and responsible individuals to participate in a future democratic society. This tradition is founded in the German didactic tradition which has had great impact on Norwegian Education through centuries. The critical-constructive didactics is influenced by Wolfgang Klafki, who tried to integrate two theoretical perspectives on "bildung" [1]; material bildung and

[1] The German concept of Bildung has no English word but the concept states that education is more than the simple acquisition of knowledge and skills. It has to do with nurturing the

formal bildung into one [1]. The material bildung-theories hold the content as the key to bildung through transferring the cultural heritage to students. The formal bildung-theories were mostly concerned about how the selected content contributed to developing cognitive skills, problem solving and critical thinking, a.s.o. Klafki meant that bildung must be understood not only from a content perspective but also had to consider the impact of the social and cultural context of education. In his critical constructive didactics, the critical element is connected to a continuously, critical investigation of the school curriculum, content, methods, assessments and so on, as well as the schools' role in a broader society context. The constructive element is about the school's responsibility for the general challenges of the society like fostering values like self-determination, solidarity and participation [1].

Britt Ulstrup Engelsen took part in an evaluation of the present Norwegian national curriculum [19] in 2008 [5]. She analyzed knowledge discourses represented in the curriculum, and found that there were different present. The core curriculum, which states some basic principles for Norwegian Education, represents two competing discourses; one concerned with the individual and one that is more social oriented. She found that the core curriculum states that learning is an individual matter but also involves the social situation in which learning takes place [5]. She also finds that the subjects in the curriculum is much oriented towards learning content, even if they have exchanged «knowledge» with «competence». She argues that «competence» can be synonymous with knowledge, skills and attitudes [5] which is similar to the way the concept of knowledge was used in previous curricula. Engelsen [5] shows that there are two strong traditions in Norwegian school, a socio-constructivist perspective in the core curriculum and a behaviourist perspective which shows through the strong emphasize on basic skills [5]. Participating in the PISA-program and other international tests also have contributed to strengthen the behaviouristic traditions because the tests only measure basic skills, not complex competences like problem solving [6].

Hodgson, Rønning and Tomlinson conducted a study to evaluate the connection between teaching and learning, emphasizing on the teachers arguments and practice based on the curriculum, finding a tendency towards being instrumental as strongly evident in our present curriculum from 2006 [3]. Our education is occupied by the need of valuating students' learning and outcome using specific measurable criteria.

The same researchers therefore are concerned that in the eagerness to document measurable learning goals, the main goal of education: knowledge, skills and attitudes that our future generations need to participate in society, will be neglected. This indicates that a behaviouristic learning paradigm has a strong position in the curriculum even within a critical constructive didactics. It seems that the concept of knowledge is influenced by different traditions, which can increase the challenges of changing how we percieve knowledge as phenomenon.

3.3. The development of a national strategy for digitaization in education

In all Norwegian strategies for digitalizations since the first strategy in 1996 to the present strategy from 2017 [7], the focus on how technology has changed our society. To meet the future's challenges students in school need to learn to handle and live with the possibilites and challenges that a more and more digitalized society brings. Communication, knowledge- and information sharing, and the premises to take part in working life and society, change due to the digital and technological development [7]. In the strategies developing 21. century skills has been important. This is e.g. subject specific competences, collaborative skills, critical thinking ethical evaluation skills, citizenship, problem solving, and meta learning skills (learning to learn).

In the national curriculum from 2006 [19], using digital technology first was implemented as a basic skill in all subjects, together with reading, writing, calculating and oral skills. In 2010 a framework for basic skills were added to the curriculum to help teachers define the content of the basic skills. This framework has been revised a couple of times, last in 2017. It states that:

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students, to develop their individuality, subjectivity, independence, or just "becoming and being somebody." [2]

> Digital skills involve being able to use digital tools, media and resources efficiently and responsibly, to solve practical tasks, find and process information, design digital products and communicate content. Digital skills also include developing digital judgement by acquiring knowledge and good strategies for the use of the Internet. Digital skills are a prerequisite for further learning and for active participation in working life and a society in constant change. The development in digital technology has changed many of the conditions for reading, writing and oral forms of expression. Consequently, using digital skills is a natural part of learning both in and across subjects, and their use provides possibilities for acquiring and applying new learning strategies while at the same time requiring new and increased powers of judgment [16].

The framework of the basic skills is a trial to describe how digital skills can benefit students' learning in school. However, the framework does not explicitly say anything clear about a future concept of knowledge.

4. The need of an alternative concept of knowledge. Discussion.

Danish Lars Qvortrup says that the society can be perceived as a hyper complex social system where a lot of different systems influence each other. Qvortrup mentions systems as "the political system", "the educational", "the ethical", "the religious", "the economical" and so on, and says that all these systems have their own mindset that forms the way they understand all the other systems, one by one or as a whole unity [9]. The hyper complex society is related to our modern times. Previous times have hardly had the complexity we see today. This also impacts the educational system which has to adapt to the changes that occurred in the transfer from industrial to knowledge society. But Qvartrup also point that even if we mention knowledge as the foundation of today's society it is not obvious what knowledge is or in what categories knowledge can be differentiated into [9]. This exemplifies the difficulties connected to establish a concept of knowledge that works within the perspective of innovative technology

As stated above it is possible to define at least two different learning traditions and two ways of representing knowledge in the national curriculum; the behaviorist and the socio constructivist (Engelsen). However, it is a question if these perspectives are sufficient for understanding how technology transform education and society. And how this will implicate a new understanding of the concept of knowledge. Innovative technology goes beyond all borders, also geographical, and knowledge and learning must therefore be understood in a global and intercultural perspective rather than situated in a specific cultural context, like the socio-cultural paradigm presupposes. These perspectives are problematic to place within the knowledge discourses represented in the Norwegian curriculum. And it can make problems with exploring both benefits and challenges with technology in educational use.

4.1. George Siemens' connectivism and Knowledge

One of the contributions to develop a new understanding of what knowledge may be in the future, is Georg Siemens. He launches the theory of connectivism as an alternative to the traditional learning theories. Inspired of different theoretical perspectives like network theory, chaos theory and new trends in understanding learning, he says that learning takes place both at an individual level and at an organizational level, and that learning is a continuous process that is mainly informal and not formalized in an educational institution [8].

Siemens [8] argues that knowledge no longer can be understood as a static phenomenon since knowledge is continuously changing. It is not possible to establish a common and universal agreement of what is knowledge anymore. He argues that both behaviourism, cognitivism and constructivism limits the way we perceive knowledge when using technology because none of these perspectives are open to include all the possibilities that new technology provides for learning and knowledge development.

Behaviourism define knowledge as change of behavior, and learning as a phenomenon that cannot be observed directly but shown through stimuli and response. Cognitivism define knowledge as symbolic, cognitive constructions and learning as a question of mental processes where sensing, coding, storing and retrieving information are essential. In a constructivist perspective the learners create knowledge by finding meaning in their experiences. All three perspectives share the concepts of learning and knowledge as something going on inside the learner, not outside, like stored in a computer or distributed in a social network [8]. Siemens writes:

> Many important questions are raised when established learning theories are seen through technology. The natural attempt of theorists is to continue to revise and evolve theories as conditions change. At some point, however, the underlying conditions have altered so significantly, that further modification is no longer sensible. An entirely new approach is needed [8].

Siemens says that existing learning theories are occupied with the learning process itself and not with the value of learning something. To decide the worth of learning something is a meta skill that occurs before the learning itself has started [8]. This gives meaning in today's situation when we have access to a never-ending source of information. It is no longer possible to overlook what we can call relevant knowledge or what is possible to learn within a specific field. A concept of knowledge with the limitation of what can be stored and retrieved from an inner storage will not be able to capture what learning and knowledge is. We need a wider understanding of the concept of knowledge to be able to handle matters of learning and knowing when using technology that also considers the process of selecting what is worth learning. When it is no longer possible to learn "everything" it will be crucial to have skills that able learners to select what is worth to know and what is not. Or else learning will be a far too time consuming exercise.

Siemens views knowledge as a flowing circle, a model where knowledge flow through different stages where it is created and formed [15]. The model builds on that individuals, groups or organizations create knowledge in different ways, and that the knowledge circle contributes to refining, changing and further developing it. The different stages in the knowledge circle is "co-creation, dissemination, communication of key ideas, personalization, and implementation" [15]. The stages show different ways that knowledge processes through this flowing circle. With co-creation the ideas meet other ideas which integrates and takes new forms as they are elaborated by other participants in a network. The ability to build new ideas on the base of others thoughts and work, is important [15]. Lots of new knowledge today generates this way, through social media in knowledge networks that can develop knowledge about specific issues that hold high quality, for instance Wikipedia, which is a participant driven encyclopedia that today is viewed as an accurate and relevant source of information. Dissemination means the way knowledge is refined in networks through critical analyzes and reviews. All information is not «good» knowledge but dissemination filters and sort out and validates the knowledge that gives meaning within the specific network and context it is meant for [15].

Communication of key ideas is the stage that follows co-creation and dissemination, and sends the key ideas that are worth spreading wider through different networks [15]. At this stage of the refining process the ideas are ready to be tried out to see if they are meaningful in a wider perspective. The last stage, personalization, means an internalization of the knowledge to those who need it, a process that both involves reflection and discussions with others [15]. At this stage, new knowledge integrates with existing knowledge at an individual level. Finally, the knowledge reaches the stage of implementation when the individual acts in line with the new understanding [15]. New knowledge contributes to enlarge, strengthen or change existing knowledge constructions. Next, it will take new forms and go back into the knowledge flowing circle where it will be transformed and used in new situations and contexts.

With Siemens' contribution we see a new concept of knowledge taking form. Where knowledge construction earlier has been dependent of reliable and stabile sources like books and articles, we now see it as a flexible and rapidly changing phenomenon that takes new forms as it floats around in networks, being adapted by individuals, groups and organizations through continuous learning processes. The question of how we validate knowledge must be rethought. We are used to rely on experts and authorities

to valid knowledge but in Siemens' model, the information flow in itself contributes to validating knowledge through the different stages in the circle. This also involves that the traditional sources no longer can have «ownership» to knowledge because it creates through continuous social processes. In this perspective the concept of knowledge must be redefined from a fixed and controllable size to a flexible and rapid changing phenomenon that is being created and recreated continuously.

When implementing innovative technology in school it is necessary to develop new concept of knowledge in school. Like Salomon states, it is impossible to gain full benefit from technology if the frame we put technology into is the same as we put the traditional teacher in [14]. It is not an easy task, but Georg Siemens' connectivism can be an inspiration to find new ways to understand knowledge.

4.2. The limitation of connectivism theory and the concept of knowledge

The concept of knowledge that is presented by connectivism can only work in general educational purposes in school, like primary school and lower secondary school. Connectivism cannot be universal for all subjects and specifically not for higher education where the learners certainly need a base of knowledge that is internalized to develop profession oriented competences. This cannot be reduced to the knowledge that develop in Siemens' floating knowledge circles but has to be part of the profession competence that the student develops through their study [17]. Criticists also state that connectivism is not possible to describe as a theory of learning because it does not build on existing theories, especially on actor-network theory and activity theory in learning where the role of networks and artefacts are explored and explained [18]. Still it is a possibility to be inspired of connectivism to expand the concept of knowledge to something that is different from the traditional way view of school knowledge.

Bell [18] refers to Verhagen when suggesting that connectivism can be placed at the level of curriculum where it can help develop new pedagogies that puts the learner in control of the learning process. I support this idea because it captures some important issues about learning and knowledge in the future: "Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision" [18].

4.1. Conclusion

Learning in the future will not be the same as it is at the present. Technology brings in possibilities that brings forward the need to change our concept of knowledge. When it is no longer any «correct» knowledge, the ability to judge information, to argue for ideas, to validate knowledge in new ways, will be important skills to develop in school, to assure that students' don't build their knowledge creations on misconceptions and non-qualified facts.

George Siemens' connectivism cannot be regarded as a new theory of learning but it can be used as a model for inspiration when understanding what knowledge will look like in the future. Therefor it can be used to understand learning and knowledge in light of innovative technology. When knowledge is created along its way through the knowledge flowing circle, its sustainability depends on the response it meets along the way. The social collaboration in the network is central for this creative process. Learning must then be understood as active participation in networks where knowledge flow. In school this means that we need to focus on other learning strategies than remembering content. The ability to critical thinking and source critics will be crucial for students' learning outcome, and social skills that able students to participate, discuss and communicate, will be of most importance.

Technology have changed the way we learn because a lot of the processes that earlier had to be handled by the individual, now can be distributed to or supported to technology. This increases the cognitive capacity, both in individuals and organizations,

making more complex and demanding learning processes possible. Learning turns to be more than “knowing what or knowing how”. It also concerns “knowing where” to find relevant knowledge when needed [8].

5. Literature

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