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ORIGINAL ARTICLE

A theoretical framework for digital learning spaces: learning in individual spaces, working groups, communities of interest, and open connections

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The paper presents a theoretical framework of four digital learning spaces: Individual space, Working group, Community of interest, and Open connections. The theoretical framework aims to highlight the unique potentials of digital technologies to expand learning activities. More specifically, the framework contributes with descriptions of specific learning activities that highlight the learning potentials of different social forms as well as learning potentials of digital technologies. The paper highlights learning potentials of digital technologies within each learning space; digital technologies as cognitive partners, collaboration tools, sharing tools, and as network relations and network effects. The framework is developed on the shoulders of existing educational frameworks, and contributes to learning technology research by combining conceptions of social forms, learning theory, and digital technology studies. Further, the framework is directed towards educational practice as a tool to develop learning activities, and to design digital learning spaces. The framework intends to function as a guiding framework that can help teachers and developers to focus on different levels of learning spaces and specific learning activities. Finally, the paper argues that digital technologies have the potential to expand opportunities for learning: specifically, to expand individual agency (within the individual space), collaborative knowledge building (within the working group), transparency (within a community of interest), and interaction with the outside world (through open connections).

Keywords: Online education; social forms; learning potentials; digital technology

Introduction

The objective of the paper is to develop and present a theoretical framework for digital learning spaces. The major contribution of the paper is that it combines: (1) conceptions of social forms, (2) learning theory, and (3) digital technology studies. The ambition is to combine these three areas of research into a unified framework for digital learning spaces. More specifically, the framework combines the three dimensions of (1) social forms, (2) learning activities, and (3) digital technologies – as three dimensions that each influence learning and teaching (see Figure 1).

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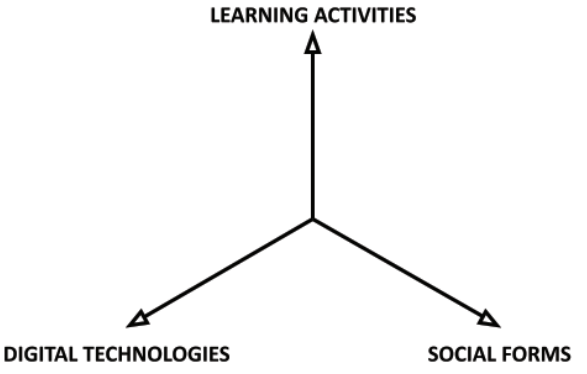

Figure 1. Three dimensions of learning activities, digital technologies and social forms.

To do this, the framework builds on research within each of these three areas. What the presented framework adds to existing concepts and frameworks is the explicit connection between social forms, learning activities, and digital technologies.

First, the framework unfolds different social forms based on online education research, building on works such as Dron and Anderson's (2014) distinctions between group, set, and net, Garrison (2016) community of inquiry framework, and the broader field of networked learning (Jones, 2015). The outcome is a distinction between the four *social forms of individual and self-governed actions, collaborative and cooperative work, collective activities, and stigmergic production*.

Second, to develop a conception of learning activities, the framework draws on social learning theory, primarily sociocultural theory (Dewey, 1916; Engeström, 2015; Lave & Wenger, 1991). Fundamentally, the framework is activity-centred, meaning that it takes the activities of the learners as the starting point.

Third, the framework builds on theories of digital technologies, drawing on technology and media research. We draw on social conceptions of technology such as technology as a cognitive partner (Salomon et al., 1991), hybrid minds (Säljö, 2012), and open tools (Hutchins, 1996). The outcome is a conception of *digital technology as cognitive partners, collaboration tools, sharing tools, and as network relations and network effects*.

A theoretical framework for digital learning spaces

The theoretical outset of the framework is the argument that digital technologies change the ways that we can act and learn. This premise is grounded in sociocultural theory that argues technologies do not merely mediate our existing teaching practices, but hold the potential to transform and expand the ways we think about and practise education. This argument is not new, and was put forward by Säljö (2010): '[...] technologies do not merely support learning; they transform how we learn and how we come to interpret learning' (Säljö, 2010). From this, we argue that digital technologies hold the potential to expand learning activities in different ways within different social forms – and the framework aims to highlight these different potentials.

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Following this argument, the paper asks, what are the potential roles of digital technologies in learning, and what are the opportunities for changing and expanding the ways we teach and learn using technology? As Fawns (2022) argues from a postdigital perspective, terms and distinctions such as online or offline, digital or analogue, hybrid or blended are irrelevant to this understanding of learning. Focus is rather on new *activities* made possible by digital technologies. Fawns (2022) also calls for a move beyond a 'pedagogy first' principle or a 'technology first' principle of using digital technologies. Thus, when we write 'digital learning spaces', we refer to the unfolding of activities made possible by the involvement of digital technologies. The ambition of the framework is to take the first steps in outlining and describing new kinds of learning activities made possible by the inclusion of digital technologies without falling into the pedagogy-technology dichotomy (Fawns, 2022). The intention is to create a theoretical framework that can be used for designing digital learning spaces that support such new kinds of learning activities. Following this intention, the framework aims to provide answers to these main questions:

- What are the unique *characteristics and potentials of digital technologies* for learning within different social forms?
- How do digital technologies support and *expand different social forms*?
- Which *new kinds of learning activities* are made possible by digital technologies?

Below, the framework is presented in Figure 2 that shows how social forms, digital technologies and learning activities are combined. The framework consists of four different learning spaces: *individual space*, *working group*, *community of interest* and *open connections*. First, these learning spaces are developed from the four different social forms: *individual and self-governed work, collaborative and cooperative work, collective activities, and stigmergic production.* Second, the framework describes specific learning activities such as *inquiry, construction and communication* within each of the four learning spaces. Third, the framework shows how digital technologies have different roles within each learning space: *cognitive partners, collaboration tools, sharing tools, and network relations and network effects.* Finally, the framework argues that the use

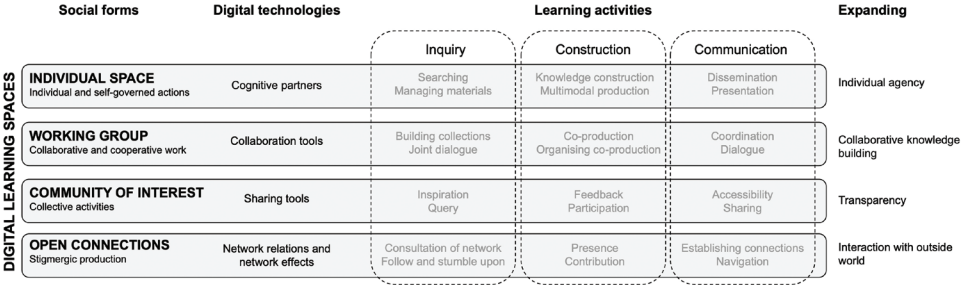

Figure 2. A theoretical framework for digital learning spaces.

of digital technologies for specific learning activities within each learning space has the potential to expand *individual agency*, *collaborative knowledge building*, *transparency*, and *interaction with the outside world*.

The framework and all its concepts will be developed and discussed in the sections below.

Learning through inquiry, construction and communication

First, we present the learning theoretical dimension of the framework by developing a terminology for learning activities. The framework is built on social learning theories that include pragmatism (Dewey, 1916), activity theory (Engeström, 2015), sociocultural theory (Hutchins, 1996; Säljö, 2010), and social learning theory (Lave & Wenger, 1991; Wenger, 1998).

Fundamentally, learning takes place within activities that are directed towards an aim, that is solving a problem, answering a question, a curiosity, etc. Dewey (1916) describes learning as goal-directed, and as having an 'end-in-view'. Following Engeström (2015), learning is the very performance of activities towards the aim. As Lave and Wenger (1991; Wenger, 1998) also argue, learning takes place within practices and should be viewed as the very unfolding of activities within practice. The framework is based on the three main learning activities of *inquiry*, *construction* and *communication* that together are directed towards an aim.

Inquiry

Dewey (1916) describes *inquiry* as a process of asking questions and searching for answers related to the aim. Thus, inquiry can be described as a dialogue with the objects of a given situation. Inquiry does not entail reaching a goal or answering a question, but rather investigating how to do that.

Construction

Processes of *construction* make up the very act of trying to solve the problem or reach the goal. As Säljö (2010) argues, all actions are mediated by tools. Thus, processes of construction are activities, where the learner employs tools to mediate an aim using tools. Construction could be taking notes, drawing sketches, creating models, building, writing, modelling, etc.

Communication

Finally, processes of *communication* are relevant to social learning theories, because they fundamentally view learning as situated in social practices. Communication includes what Lave and Wenger (1991; Wenger, 1998) term participation in communities of practice, which includes close collaboration, dialogue, and sharing. Communication also covers the individual's relations to and insight into the larger sociocultural practice of his/her activities (Engeström 2015). With the term 'distributed cognition', Hutchins (1996) argues that the physical and social practice is part of what we learn and what we are able to do.

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Learning in different social forms: spanning self-governed actions and stigmergic production

From the dimension of social forms, we develop a terminology for social forms that is used to distinguish between four digital learning spaces.

The individual space: individual and self-governed actions

Individual and self-governed actions form the basis of the digital learning space that we term *the individual space* where the learner manages his/her own personal tools and develops his/her own working methods. Individual and self-governed actions emerge from the individual learner's own aim, problem or question as described above. In order to learn, the individual learner must make the tools her own by being consciously aware of the goal and perform actions that aim at mediating the goal (Säljö, 2010).

Working group: collaborative and cooperative work

The social form of collaborative and cooperative work forms the basis of the digital learning space that we term *the working group*, where a number of learners work closely together within a shared practice. To describe learning activities within this social form, we include the distinction of O'Malley (2012) between 'collaborative and cooperative work'. As Dillenbourg et al. (1996) also state, cooperative work divides a task in mutually independent sub-tasks, whereas collaborative work represents a shared task of all members of a group. As Garrisons' framework of 'community of inquiry' has made evident, a group is able to move inquiry beyond the individual. In line with this, Dron and Anderson (2014) in their framework describe the learning opportunities within the social form 'group'.

Community of interest: collective activities

The social form of collective activities forms the basis of the digital learning space that we term *community of interest* where a (potentially large) number of people are joined by a common interest. Leontev (in Engeström, 2015) introduces the concept of 'collective activity' to describe the collected activities of a number of individuals who are not directed towards the same aim, but all contribute to an overall activity that an individual is unable to perform. However, especially social media have changed the way that we look at this social form. Baym (2015) describes online communities as an example of a social form that collectively can create something that is not a product of joint work. Baym's (2015) notion of online community describes a social form that often develops from a shared interest, but no shared aim, goal or problem. This also resembles what Dron and Andersson (2014) refer to as a 'set'.

Open connections: stigmergic production

The social form of stigmergic production forms the basis of the digital learning space that we term *open connections* where the learner builds, contributes to and activates online social networks. We use Elliot's (2006) concept of 'stigmergic',

which describes structures that emerge on their own with no central and determining operator. One example is posting on Twitter, a personal blog, Instagram or similar, where you will not be in control of retweets, likes, reposts, shares, etc. that can bring your post out to all kinds of unknown contexts. Stigmergic production is closely related to network structures, and for the individual to benefit from (and contribute to) stigmergic production, the individual must engage in network structures and relations. According to Boyd and Ellison (2007), social networks differ from collaborative and cooperative work as well as from collective activities, because social networks revolve around the individual, and not a shared goal or interest. Similarly, Dron and Anderson (2014, p. 82) use the concept of 'nets' which 'are social forms where the connections between individuals and sometimes clusters of individuals are what bind them together'.

Expanding learning through technology: digital technologies as cognitive partners, collaboration tools, sharing tools, and network relations and network effect

From the final dimension of digital technology, we develop a terminology for learning potentials of digital technologies. Below, the terminology is connected to the four digital learning spaces, and we discuss how digital technologies have the potential to expand learning in different ways within each of the four learning spaces.

Cognitive partners for individual agency

Within the individual space, digital technologies can expand on the individual learner's *agency*. That is, the learner's abilities to act, produce, create, express oneself, etc. Salomon et al. (1991) use the term 'cognitive partner' to describe the potential relationship between the individual and technology as a partnership. The key point of this partnership is that the technology helps the individual in performing tasks that the individual otherwise would not have been able to do on his/her own. Technology does not take over and perform the task *for* the individual, but enhances, extends or expands on the individual's (cognitive) abilities. Säljö (2012) uses the term 'hybrid minds' to describe how we extend our cognitive abilities to include objects and technologies outside the mind. The partnership is not an attribute of technology; technology as a cognitive partner is a *way of using* technology.

Collaboration tools for collaborative knowledge building

Within the working group, we are inspired by what Scardamalia and Bereiter (2014) term *collaborative knowledge building*, which also relates to Cress and Kimmerle's (2018) more recent concept of 'collective knowledge construction'. Digital technologies can strengthen a working group's collaborative knowledge building by providing *collaboration tools* and spaces. This focus on the computer as a tool for collaboration has been evolving since the early days of Collaborative Learning, Computer Supported Collaborative Learning (CSCL) and Computer Supported Cooperative Work (CSCW) (Dillenbourg et al., 1996). Today, we see new emerging student practices within working groups, with examples such as collaborative writing (Sundgren & Jaldemark, 2020).

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Sharing tools for transparency

Digital technologies can expand and support *transparency* within a community of interest through *tools for sharing*. To utilise the resources of a community, it is necessary to get access to the collective knowledge of the community. Hutchins (1996) uses the term 'open communication' to describe a form of communication that is characterised by being available and accessible for everyone. Hutchins (1996) also speaks of 'open tools' that are artefacts available to all members, but that are not used in the same way. Digital technologies have particular capabilities to support transparency within a community. For example online forums are examples of open communication that is available to all members of the forum. Online forums (think of support forums) can also be viewed as open tools that make resources available to everyone, and in that respect they become knowledge bases for the community (Ryberg & Christiansen, 2008). Dalsgaard and Paulsen (2009) have argued for the educational strengths of transparency between student activities in order to utilise the collective resources within a class. Participation in such a community can help students by looking at the work of and learning from fellow students (Ryberg & Davidsen, 2018).

Network relations and network effects for interaction with the outside world

Finally, digital technologies can expand and support students' *interaction with the outside world* through open connections that are enabled by the mechanisms of *network relations and network effects* that can connect students to people and resources from all over the world. Jones (2015) uses the concept of networked learning and draws a direct line between networking and learning. He stresses the importance of facilitating 'connections between learners, learners and tutors, and between learners and the resources they make use of in their learning' (Jones et al., 2008, p. 90). Network relations and network effects relate to Dron and Anderson (2014) who describe the social form 'set'. A key learning potential of the set is, as they state: 'The Internet makes it possible to interact with a vast number of people with whom we have no shared social connection at all'. This means that the student can gain inspiration and knowledge from a diverse network, but also that the student's own thoughts, posts and questions can be present in networks, meaning that the student can contribute to stigmergic production.

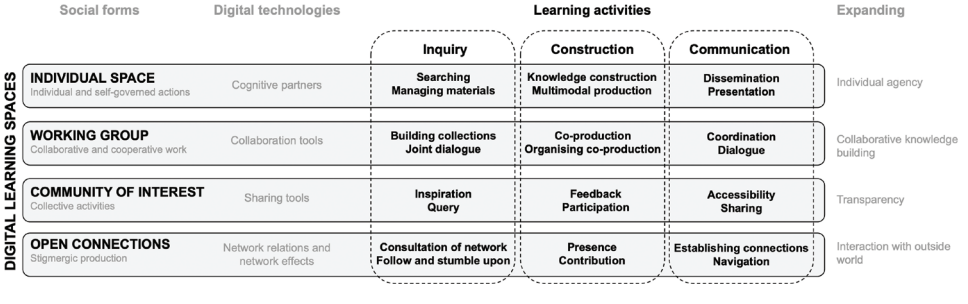

Figure 3. Zooming in on specific learning activities within the four digital learning spaces.

A theoretical framework for digital learning spaces

Based on the combination of the three dimensions of social forms, learning activities, and digital technologies, we have now developed a theoretical framework for digital learning spaces. To support the design of online learning spaces, a key question to the framework is: How can digital technologies expand the learning activities of inquiry, construction and communication within each of the four learning spaces?

In Figure 2, we have presented the framework for digital learning spaces. Below, we wish to initiate a discussion of potential learning activities made possible by digital technologies. To do this, we now zoom in on specific learning activities and provide examples of different kinds of inquiry, construction and communication activities that can be expanded within each of the learning spaces (Figure 3).

Learning in the individual space

Inquiry: searching and managing materials

In the individual learning space, digital technologies can expand students' inquiry by providing access to large amounts of information. Inquiry through *search* is a key activity in students' individual learning space. As Berinato and Fisher (2015) argues, knowing how to search is not a trivial task, but involves knowledge of search engines and the pitfalls of 'invisible search' (Haider & Sundin, 2019). Students can access large amounts of information such as texts, images, and videos, and in the form of news, data, discussions, etc.

Also, digital technologies can expand student inquiry by providing tools and systems for storing and analysing information. Inquiry through *managing materials* is also a key activity enabled by technology (Caviglia et al., 2018). Fundamentally, managing materials includes how to store and organise files on your computer, but it also includes how to read and annotate texts, images, websites, videos, etc.

Construction: knowledge construction and multimodal production

There is a unique potential of digital technologies to strengthen student agency to allow them to produce their own materials and build their own personal collections. This perspective has not least been explored within the area of personal learning environments, which emphasises the importance of students managing their own digital tools (Sclater, 2008). The concept of *knowledge construction* asks: what can students accomplish *together with* digital technologies? Knowledge construction is about utilising the computer's abilities (as a cognitive partner) to perform actions or processes that otherwise would not be possible. For instance, the individual student can make use of the computer's ability to calculate, to correct spelling and grammar, or to make 3D visualisations, etc.

Secondly, construction in the individual space is supported by digital tools for *multimodal production*. A unique potential of digital tools is to create products combining audio, text, video and images. This includes an expansion of students' opportunities for expressing themselves in many different formats such as podcasts, posters, videos, etc.

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Communication: dissemination and presentation

Within the individual space, communication is naturally not about dialogue, but rather relates to dissemination and presentation of the student's own work. *Dissemination* is traditionally something that we do, when we have finalised a product. However, because digital products are easy to share and grant others access to, we can share in the process of making the product. By dissemination in the individual space, we wish to highlight how digital technologies can help students to show their work (in progress) to others in order to get response from teachers or fellow students (Holgaard et al., 2021).

Presentation in the individual space describes the student's finalised work. The perspective here is that the student can make his digital work available to others and potentially contribute with his own work to others. One can argue that there is a lot of unfortunate 'waste' within education, because students are producing new things, but they are only seen by the teacher. The idea of digital tools for presentation is to focus on how students can present in digital formats that are suitable for presenting to others. A portfolio is a good example of the communicative aspect of the individual space (Qvortrup & Keiding, 2017), because it contains students' own productions, and at the same time it can be used to present the work to others (Lolle et al., 2023).

Learning in working groups

Inquiry: building collections and joint dialogue

Shared inquiry within a working group can be expanded by digital tools that support students in *building collections* of materials. For example, digital technologies can be used as 'common information spaces' that support a joint working area for group members (Bossen, 2002). Such information spaces are digital infrastructures where a working group can store and share joint materials. Such collections could be file systems, links, bookmarks or references managers, or shared note taking applications (Caviglia et al., 2018).

Inquiry in a working group also entails *joint dialogue* around those collections. For instance, students' annotation of files is a form of dialogue around the character of the materials. Students can engage in what could be termed 'shared reading' by sharing an online article or book and use either comments or annotation tools. Thus, digital tools allow students to engage in a shared inquiry of the text.

Construction: co-production and organising co-production

Supporting *co-production* is one of the obvious potentials of digital technologies. Software that we have been accustomed to using as individuals is now increasingly becoming available as collaborative tools – for writing, drawing, doing presentations, editing images, etc. Thus, a key potential of digital tools is to support collaborative construction, where students are actually creating the same product, and not dividing it into separate subsets to be assembled in the end (Sundgren & Jaldemark, 2020).

These many emerging tools for co-production, however, also raise an important question of how students can *organise co-production*. For instance, although students

have access to the same document, they should not necessarily write together all the time. Organising co-production is a matter of juggling with many different digital tools, often at the same time; for instance, combining collaborative writing, chat, and video call in an online group meeting (Davidsen et al., 2020).

Communication: coordination and dialogue

Working closely together in a working group makes *coordination* important in order to have insight into and align with the activities of fellow students. Digital tools can support coordination, for instance shared calendars, to-do lists, dedicated tools for project management or assignments boards. As Ryberg et al. (2018) have shown in their study, students intermix and switch between online and offline spaces, and between physical and digital resources in complex collaborative work.

Finally, digital technologies can expand on a working group's opportunities for engaging in *dialogue*. Different kinds of communication forums can make students available to each other – no matter where the students might be. Such tools can provide flexibility in establishing dialogue, and can also bring students closer to each other. Students can quickly open a video meeting, or they can create chat forums for being in touch (Sørensen, 2018).

Learning in communities of interest

Inquiry: inspiration and query

Because a community of interest (or a class) is engaged in the same or related activities, the community is an obvious place to seek out *inspiration*. Inquiry within a community of interest is a matter of being informed about what takes place within the community. In online communities, participants are available to each other and everyone has access to the collective production of the community (Baym, 2015). Thus, we can see a community of interest as a collection of materials that the individual student can find inspiration from (Ryberg & Davidsen, 2018).

Also, inquiry can take on the form of a *query* to the community of interest. When faced with a problem or question, a student can make a query in a community of interest (for instance, her class). In that sense, the student not only inquires through searching the web or looking for inspiration from the work of others, but also through asking questions to a community, and thus drawing on the collected resources and knowledge of the community.

Construction: feedback and participation

The perspective of construction within a community of interest is that the community can influence the student's own work by providing *feedback*. This can be a sort of indirect feedback where a student himself finds an answer within a forum of the community. For instance, a student might see a solution to a problem within an assignment of a fellow student. This can be compared to apprenticeship learning, where the apprentice learns from being within a practice and watching the work of the experienced. Also, formalised peer-feedback is also an example of using the community of a class to support construction (Stenalt, 2021).

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A community of interest within a class is also a matter of establishing a class culture where students actively *participate* and contribute to each other's work (Ryberg & Davidsen, 2018). Participation is similar to inspiration (above), but the difference is that participation is an active choice to contribute to and help other participants within a community. An example comes from a study of student Facebook groups that showed how students in upper secondary schools used Facebook groups to share school work, help each other with assignments, discuss subject matter, etc. (Aaen & Dalsgaard, 2016).

Communication: accessibility and sharing

Open communication within a community of interest is first and foremost supported by establishing *accessibility* between students. Asynchronous communication forums are especially suitable for supporting open communication and transparency, where students can be available to each other for sharing thoughts and ideas, for asking questions and for helping each other (Dalsgaard & Thestrup, 2015). Such a forum can be a place where the individual student can follow and be informed about the activities within the community of interest.

An objective of working with open communication and transparency could be to develop an open *sharing* culture within a community of interest (or within a class). Digital technologies can support an open sharing culture by making it possible for students to discuss their activities and to share their work in the form of drafts, suggestions, thoughts, ideas and questions concerning a specific topic.

Learning in open connections

Inquiry: consultation of network and follow and stumble upon

Within online networks it is possible to *consult* your network to get answers to questions or input to subject areas. The unique potential of networks to expand student inquiry is to consult a large group of people, be that on Twitter, Instagram, YouTube, LinkedIn, etc. Networks can expand inquiry well beyond an institutional setting and national boundaries, and can provide the student with input from many different sources and perspectives (Downes, 2019).

A key benefit from inquiry in social networks is, however, not necessarily the direct consultation, but rather to *follow and stumble upon* information over a longer period of time (Ünlüsoy et al., 2014). This is particularly where open connections differ from the other spaces; the feed from a social network is a personalised news service that continuously brings new information that the student is not actively searching for.

Construction: presence and contribution

Construction in open connections is related to students' creation of a personal profile (or a channel). This could be a professional profile, for instance on LinkedIn or Twitter. A profile forms the student's *presence* and representation in a network (Boyd & Heer, 2006). The personal profile is where the student can construct by sharing thoughts, images, links, stories, opinions, etc. Construction is first and

foremost a matter of creating this representation that can be connected to other people in the network.

Construction in open connections can also take on the form of active *contribution* where students share content through personal profiles. Contrary to the working group or community of interest, students' contributions in open connections can be distributed in very different contexts that are beyond the control of the students (Ünlüsoy et al., 2014). Thus, construction in open connections is the opportunity of the student to contribute to stigmergic production.

Communication: establishing connections and navigation

A prerequisite for making use of open connections is to *establish connections* to other people and by that building online networks. Such a network is an infrastructure for information that can supply the individual learner with information and materials that she did not know she needed (Ryberg & Larsen, 2008).

Networks can, however, easily be so complex that they are difficult to manage. Thus, it is important to use features of online networks to *navigate* within the networks. This includes choosing and prioritising people to follow, but also using hashtags or favourites, or developing lists with specific people to follow.

Conclusion

The theoretical framework presented in this paper aims to highlight the unique potentials of digital technologies to expand learning into new activities. What the framework contributes with in relation to learning technology research and existing frameworks is first and foremost the combination of the three areas of research: (1) conceptions of social forms, (2) learning theory, and (3) digital technology studies. More specifically, this unified framework contributes with descriptions of specific learning activities that outline learning potentials of different social forms as well as learning potentials of digital technologies. In that sense, the objective of the framework is also analytical; to help distinguish between different ways in which digital technologies can expand learning activities.

An implication of the framework for research is that it can be a theoretical framework for positioning future learning technology research. The framework calls for studies that move beyond both a 'pedagogy first' and 'technology first' principle. Rather, it calls for research that includes all three dimensions and is directed towards the discovery of new forms of (expanded) learning activities made possible by digital technologies.

The framework also has implications for educational practice. Although the framework revolves around learning activities of students, it is developed as a tool to support teachers. The framework is intended as a tool to develop learning activities, and to design digital learning spaces. The framework addresses teachers and educational developers that are organising teaching where students are actively engaged in productive and problem-solving activities. Hopefully, these concepts can be useful for understanding opportunities for expanding learning through the use of digital technologies, and hopefully they can be used as a starting point for designing specific learning activities in different educational settings. The framework intends to function

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as a guiding framework that can help teachers and developers to focus on different levels of learning spaces and specific learning activities. The implications for educational practice of the presented framework is for teachers and institutions to focus on how to utilise the *unique* potentials of digital technologies to expand on our existing and well-known learning activities – by developing new learning activities and learning spaces.

Finally, the presented framework raises questions regarding ambitions for designing for learning with digital technologies:

- Should students start viewing themselves as 'networked learners' that demonstrate agency and learn by producing, contributing and engaging in activities with peers and subject matter experts in society at large?
- Should teachers and educators start utilising the resources that exist within students' collaborative and collective spaces of sharing, participation, transparency, and exchange?
- Should institutions start considering themselves as 'active contributors' to society, by making educational activities and student productions available to the public, and not least to other institutions?

These questions call for design-based or action research exploring these areas, for teachers to experiment with new learning activities, and for policy makers and school managers to consider their visions for education in new formats.

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