



## ARTICLE

### Digitalization and digital transformation in schools: a challenge to educational theory?

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## **Digitalization and digital transformation in schools: a challenge to educational theory?**

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### **Abstract**

There is an apparent lack of theoretically robust definitions of digitalization and digital transformation in educational research. This article purposes to contribute to educational research and practice by understanding digitalization and digital transformation through educational theory. The approach to the research problem was first to theoretically define digitalization and digital transformation in schools in terms of human learning and development. This perspective suggested that digitalization may be a requirement for digital transformation but not an enabler. Moreover, it suggests that digitalization and digital transformation in schools are always anchored to human learning and development. Secondly, the approach empirically tests this theoretical development via a quantitative questionnaire survey with seventeen Swedish school leaders. The data indicated the theoretical development seems to hold in school practice as well as conceptually. Limitations to the approach were discussed, and suggestions to future research of remote teaching in rural schools are given. In particular, future research is suggested to develop, contrast, and use the definition.

Keywords: Digital transformation; digitalization; learning and development; quantitative survey; Swedish schools.

## Introduction

Educational research in Sweden is underdeveloped in terms of theoretically robust definitions of digitalization and digital transformation in schools (From, Pettersson and Pettersson, 2020). This in spite of much research about digitalization in schools. The phrase 'digitalization of schools' can even be portrayed as a political agenda rather than a research problem. In Sweden, for example, a national digital strategy for the digitalization of Swedish schools proposes that digital technologies today permeate society (Swedish Ministry of Education, 2017). In educational research, this permeation is sometimes termed ubiquity because mobile digital technologies today are available everywhere we go, and learn (e.g. Yu, Ally and Tsinakos, 2017). The suggested permeation implies that almost everybody today has some experience of what appears to be digitalization (as availability to digital technologies), and that we ought to expect digitalization to continue in the future. And since it can be argued that substantial parts of society have been digitally transformed via digitalization (e.g. McAfee and Brynjolfsson, 2017) we are led to assume that digitalization as *availability* (i.e. permeation) ought to transform schools. However, educational research often finds that increased digitalization in schools – as increased availability of digital technologies in schools – is neither uniform nor primarily positive (e.g. Selwyn, Nemorin, Bulfin, and Johnson, 2018; Tallvid, 2018).

The purpose of this article is to contribute to educational research and practice that wants to understand digitalization in schools as digital transformation. Specifically, an understanding that builds on educational theory and not general assumptions about availability of digital technologies. The approach taken in this article is to do this by developing a theoretical understanding of the concepts of digitalization and digital transformation in schools, and to put the understanding to use in empirical measurement. Of particular relevance for this special issue is that if remote teaching is an example of digitalization and digital transformation in schools (From, Pettersson and Pettersson, 2020), the understanding developed and tested in this article may be particularly relevant for educational researchers researching remote teaching.

The theoretical understanding of digitalization and digital transformation in schools developed in this article builds on Engeström's expansive learning (2015). More precisely, it builds on an assumption that there are theoretically distinguishable levels of learning within work activities, which consequently enable transformation of work activities (Engeström, 2001). As such, the argument made in this article is that digitalization and digital transformation in schools may be conceptualized and measured in terms of use of digital technologies in schools and the change or not in properties of work activities based on this use. In previous research, this theoretical understanding of digitalization and digital transformation in schools has been found productive in qualitative research approaches (Pettersson, 2020). The concept of digital transformation is in this article further theoretically developed, defined, and tested through a quantitative questionnaire with Swedish school leaders.

## Background

Researching digitalization in schools as digital technologies in schools is not new in Sweden nor internationally, for example, in terms of uptake and use of digital technologies in different organizational levels in schools (Voogt and Knezek, 2008; Olofsson, Lindberg, Fransson and Hauge, 2011). This body

of research arrives at conclusions that deal with conditions in practice that influence how digital technologies are used for teaching and learning in schools. This is perhaps the most commonly assumed meaning in research of digitalization in schools: digital technologies in schools used for teaching and learning. Educational research investigating digitalization in Swedish schools has indeed been conducted almost half a century (see Tallvid, 2015, p. 31 for an overview). From the beginning, in the 1970s and 1980s, politically initiated development projects seem to have been the starting point for the introduction of digital technologies in schools as well as research about the same. In the projects was the assumption that transformation (i.e. big change) could be expected as long as digital technologies were made available and used (cf. Karlsohn, 2009).

The transformation assumption can also be found internationally in for example influential North American educational research on digital technologies in schools from the 1980s (Papert, 1993). Papert imagined a radical – for the time – reconceptualization of the traditional methods of teaching and learning, to students becoming self-learning through computers and programming. Today, programming is very much back on the political agenda of digitalization in schools (Swedish Ministry of Education, 2017). Also in more contemporary research on digital technologies in schools, expectations on transformed teaching and learning are high, but seems elusive and uncritical (e.g. Cuban, 2001; Bayne, 2015; Player-Koro, 2016). In addition to research deliberating about conditions in practice, researching digitalization in schools in terms of input-mechanism-output, is also common in educational research. There are for example numerous policy enactment inspired studies, reflecting on what happens along the way from political intention (input) of digital technologies in schools (mechanisms) to what happens (output) in practice (Player-Koro, Bergviken Rensfeldt and Selwyn, 2018).

This short research backdrop is intended to guide the reader to consider two propositions. First, that *digitalization in schools* commonly understood as use of digital technologies in schools has a long history in research in general, and not least educational research in Sweden. We are still, however, looking for a theoretical understanding that can succinctly state what digitalization and digital transformation in schools actually is, for example is in terms of a precise definition (e.g. From, Pettersson and Pettersson, 2020). Since educational research – indeed research in general – has a principle of generating cumulative knowledge (Sundberg, 2018), a definition may be productive.

Second, that *digital transformation in schools* is often assumed to be caused (i.e. enabled) by availability of digital technologies in schools. Assumptions that rest on political history in Sweden (Karlsohn, 2009), and on research on digital technologies in schools. Player-Koro (2016), for example, finds that one base of this assumption in research on digital technologies in schools is built on the concept affordance. In this assumption, the mere availability and affordance of digital technologies in schools somehow predict and entail that transformation takes place, in spite of much evidence to the contrary (e.g. Cuban, 2001; Selwyn, Nemorin, Bulfin and Johnson, 2018).

This article does not take the technological availability, or affordance, route as the foreground in understanding digitalization and digital transformation, but the human learning route. More precisely, the expansive learning theory (Engeström, 2015) route. Thus, the first question answering to the

purpose of this article is: what is digitalization and digital transformation in schools, specifically, in terms of human learning?

### **Human learning and transformation of work activities in schools**

First of all, a clarification is required explaining how the concepts in this section are linked together in practice, since this is the base for the understanding in the article. Work activities in schools are produced and held together by people, in social practice. Change and transformation in work activities is thus built on the social practice of people. To intentionally change work activities, people need to learn new ways of working. In this way, we can attribute change in work activities to human learning. In the same way, we attribute transformation – as ‘big change’ – to human development – as ‘substantial learning’. This is the basic explanation of how concepts link together in social practice in this article, and in expansive learning theory (Engeström, 2015). Moreover, the social practice specifically focused in this article is schools – the ‘where’ of the particular work activities, subject to change and transformation.

Expansive learning theory takes the *activity system* as its foundation of understanding work activities. Since the activity system is the article’s entry point to understanding schools as social practice, this also requires a short description. An activity system (i.e. a school) is a cultural-historical system of object oriented, mediated human activity (Engeström, 2015). In an activity system understanding of a school, the actions people take are mediated through different concrete components in the activity system. The components consist of cultural artefacts (tools) with which to work; there is a division of labour between e.g. school leaders, teachers and students; there are rules for how work ought to be carried out; and there is a community where the history of the work is shared between its members.

When people work in a school, these components all influence the actions that they take, which are directed at a shared object. A concrete example of a shared object in a school is teaching in classrooms. Here, teachers may be expected to plan the content and pedagogic principles of the expected learning, students may be expected to learn the content through the principles, and school leaders may be expected to keep things running smoothly so that learning can take place as expected. As such, teachers, students, and school leaders share the object of teaching in the classroom in different ways. Without this shared object, the work taking place in schools would make little sense. This is also what makes shared objects in activity systems a meaning-making, motivating and complex thing to understand in work activities: while the object indeed can be considered shared, the motivation for the people to take part in the object driven activity can be both similar and different. For example, ‘going to school’ is not the same as ‘going to work’, which is not the same as ‘managing an organization’. All three, however, take place in schools at the same time, entailing different actions and outcomes for people. There is much more that can be expanded upon regarding schools as activity systems (see Englund, 2018 and Willermark, 2018, for some recent examples, and Engeström and Sannino, 2010, for yet others), but this brief description is sufficient for understanding *schools* in the coming theoretical development.

In expansive learning theory, there can be made a distinction between change and learning, on the one hand, and transformation and development, on the other (Engeström, 2015). The distinction rests on a Vygotskian distinction between learning and development, and Bateson's (1972) analysis of levels of learning (Engeström, 2015). The distinction that Engeström highlights is that there are three *levels of learning* in work activities, and that in "[Level 1] and [Level 2], in their interaction and contradictions, represent what is commonly understood as learning. [Level 3] represents what is often referred to as development ... [which means that in Level 3] development itself becomes the object of learning" (p. 123). Following this, in this article there is a strict distinction between change caused by human learning, and transformation caused by human development; to develop we must learn, but learning does not necessarily mean development; and to transform properties have to change, but change does not necessarily mean transformation. Previous recent studies adopting Engeström's (2015; 2001) levels of learning to understand digitalization in Swedish schools in terms of transformation are less strict in both distinction between learning and development, and digitalization in schools as change and transformation (see Pettersson, 2020; From, Pettersson and Pettersson, 2020). In this article, it is insisted that the distinction between learning and development is central to understanding digitalization and digital transformation in schools.

According to expansive learning theory, *transformation* of work activities takes place on the system-wide activity level, Level 3 (Engeström, 2015). On this level, transformation manifests as new ways of working that require collective historical analyses and engagement of the relations within the activity system (Engeström, 2001). Moreover, transformation manifests through a developed understanding of the object of activity. For transformation to take place as an effect of using digital technologies in schools, the understanding of the object of activity itself would have to be developed.

On Level 2, learning takes place as trial and error (Learning 2a) as well as experimentation within the given frame (Learning 2b) of work activity (Engeström, 2015, p. 117). In comparison to Level 3, there is indeed learning and change in Level 2, but, strictly, not development and transformation. In the case of digitalization in schools, this level of learning in work activities by use of digital technologies can indeed entail qualitative change in properties relating to work tasks, but this comes not as an effect from a transformed understanding of the *object of activity*. The object of activity itself is given and not subject to development.

On Level 1, in comparison, there is no particular reflection on ways of working, but focus is instead on operations that achieve goals. Learning here is the learning to use goal achieving tools, and not analysing and experimenting with ways of working (Level 2), or development of the object of activities itself (Level 3). However, the three levels require each other in a successive, dependent way: Level 3 requires Level 2 and Level 1, and Level 2 requires Level 1. The starting point, as such, is Level 1, which may lead to Level 2 and this possibly to Level 3. In other words, development requires learning the same way transformation requires change, but change does not necessarily lead to transformation. Consequently, implementing digitalization in terms of making digital technologies and their affordances available in schools and making sure they are used does not necessarily lead to digital transformation

in schools (Cuban, 2001). Moreover, the general starting point for implementing change and transformation in would be human learning.

Thus, in answer to the question “what is digitalization and digital transformation in schools, specifically, in terms of human learning?” a definition of digitalization and digital transformation in schools may serve as an answer, together with the above understanding of levels of learning. A definition is here proposed as:

Digitalization in schools corresponds with the use of digital technologies within school organizations for human learning and development. Digital transformation caused by digitalization in schools corresponds with the development of the shared object of work activities in school organizations. School organizations are complex object oriented systems of work activities.

### **Levels of learning in practice**

The second question that this article seeks to answer relates to the second part of the approach: to put the understanding to use in empirical measurement. By ‘put to use’ two things are meant. First, that the understanding will somehow be funnelled into questions that give ‘theory laden’ responses when asked in practice. Second, that there is a pragmatic approach to educational theory: if it does not appear to be useful, do not use it. The second question is: are the three levels of learning in relation to digitalization and digital transformation in schools separately distinguishable when measured in schools? This distinguishability seems a necessary requirement for the understanding of levels of learning to hold both conceptually and empirically. To this end, a survey was conducted with respondents in Swedish schools, based on a quantitative questionnaire; a questionnaire containing the concept levels of learning in relation to digital technologies in schools.

The questionnaire that respondents answered is an online self-administered, self-assessment quantitative questionnaire written in Swedish. Concretely, this means that respondents are given a web link to an online survey, which they complete individually (self-administered) where they (self) assess the statements and questions (items) in a closed-response (Likert-type scale) questionnaire.

The items of present questionnaire are constructed to correspond with the levels of learning in Engeström’s expansive learning (2015), where *digitalization in work activities* is measured. Digitalization in schools is thus in the questionnaire constructed as three concrete item levels (or index) corresponding to levels of work activity change caused by digital technology use in human learning. Consequently, Level 1 items measure the respondent’s own assessed *use* of digital technologies (tools) to achieve ‘daily’ operations. In the questionnaire, this level has five items (Table 1).

Table 1. Translated items 1-5 (I1-I5), corresponding to the first level of learning.

Level 1 items:
I1: I use digital technologies to plan my daily work tasks.
I2: I use digital technologies to do my daily work tasks.
I3: I use digital technologies for documentation.
I4: I use digital technologies for communication.
I5: I use digital technologies to search for information.

Level 2 items measure the respondent's assessed *changed work tasks*, caused by using digital technologies. This level has six items (Table 2).

Table 2. Translated items 6-11 (I6 - I11), corresponding to the second level of learning.

Level 2 items:
Stem: Using digital technologies has resulted in that I:
I6: have changed how I do work tasks.
I7: have changed how I plan work tasks.
I8: have developed new work tasks.
I9: have changed how I think about work tasks.
I10: have changed how I talk about work tasks.
I11: have different collegial discussions about work tasks.

Level 3 items measure respondent's assessment of collectively *transformed understanding of the object of activity* caused by the use of digital technologies, i.e. large changes in the (organization, school) activity system as a whole. This level has seven items (Table 3).

Table 3. Translated items 12-18 (I12-I18), corresponding to the third level of learning.

Level 3 items:
I12: In our organization, new digital ways of working are important in daily work.
I13: In our organization, we collaborate on questions regarding digitalization.
I14: In our organization, there is a culture that encourages development.
I15: Digital tools contributed to new ways of working that have spread throughout the organization.
I16: Digital tools enable us to achieve goals and visions that help develop the organization.
I17: Using digital tools has led us to talk about the organization differently than before.
I18: Using digital tools has led us to organize the organization differently than before.

Responses are given on a 5-point Likert-type scale, ranging from *completely disagree* (1) to *completely agree* (5). The Learning and ICT group in the Department of Education at Umeå University developed the questionnaire.

The survey's context is a small (circa 17 000 population as of 2020) coastal municipality (henceforth MX) in the north of Sweden. During the time of the survey (spring of 2020), MX was in the early stages



of a development project (not necessarily with a theoretical meaning of development as made above, however) directed towards developing school leaders' understanding of digitalization in schools, through workshops and collectively discussing digitalization in their schools.

The sample of respondents in present empirical study all have the formal work role of principal (for a description of the work role in Sweden, see Höög, Johansson and Olofsson, 2005) in MX. The respondents were deemed particularly appropriate to answer the questionnaire because they were actively engaged in the development project of MX, and as such actively engaged with questions regarding use of digital technologies in schools. The respondents were also actively working as principals in schools at the time of the study. The purpose of sampling school leaders in particular is that the work role may include responsibility of and insight into many different work activities in schools, where digitalization takes place in many activities in schools simultaneously. The sample size consists of the entire population of principals in MX: kindergarten, compulsory school, upper secondary school and special education. The principals do, however, represent a sample (rather than the population) of respondents reasonably able to provide assessments to digitalization in MX's schools, i.e. teachers would be another sample for a fuller picture. The overall selection of MX and respondents for the study can thus be described as purposive (Creswell, 2013). The questionnaire was sent to 21 principals in March and May of 2020, with a response rate of 17 completed questionnaires (81%).

The item responses from the survey are presented in Figure 1. On the horizontal axis at the bottom, the item numbers are indicated (the same items as in Table 1-3, where, e.g. 1 on the horizontal axis at the bottom represents responses to I1 in Table 1). For each item number, a mean value of all responses for that item has been calculated and is indicated in the circles. Between items five and six, and between eleven and twelve on the bottom horizontal axis, the vertical lines indicate a division between the three conceptual levels of learning (Levels 1-3). Index values for the levels are indicated below the "Level n" text, also as means. The mean 4,58 for Level 1 is the mean value of the means of items 1-5; the value 3,65 is the mean of means of item 6-11; and 3,24 is the mean of means for items 12-18.

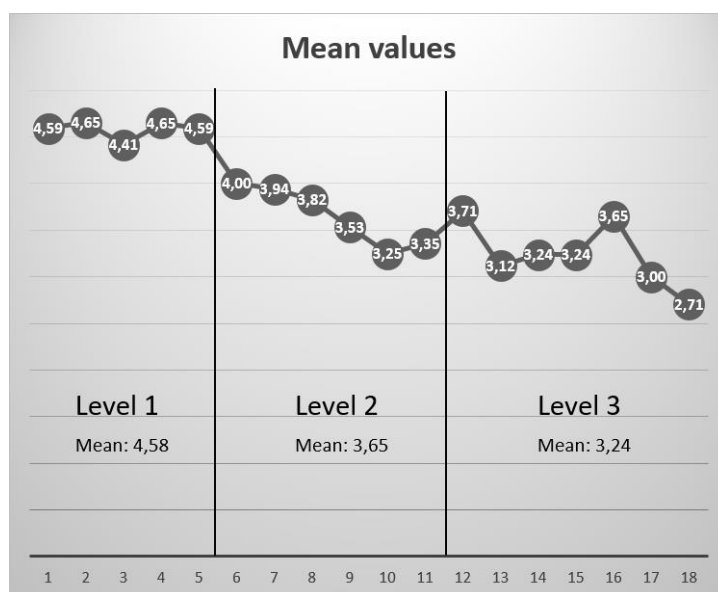


Figure 1. Questionnaire responses with mean item values and index values.

In summary, the question that this section of the article is set to answer was “are the three levels of learning in relation to digitalization and digital transformation in schools separately distinguishable when measured in schools?” This measurement has been framed as a questionnaire with eighteen items corresponding to the three levels of learning, and the answer to this question thus rests in the principals’ responses to the questionnaire and if they indeed are separately distinguishable. The values presented in Figure 1, seem to reveal some distinguishable features in the responses. Level 1 items clearly appear higher than Level 2 and Level 3 items. This first level of learning pertained to digitalization in schools as tool use for daily operations (Table 1) as assumed in Engeström’s (2015) theory. Level 2 responses show a substantial drop in response values to an index value of 3,65 (from the first level’s 4,58). The Level 2 items ask about digitalization in schools as change in work tasks because of digital tool use. Finally, Level 3 responses show another drop in response values to an index value of 3,24 (compared to the second level’s 3,65). The items in the third level of learning asked specifically about digital transformation in schools that would imply organizational development, i.e. changes specifically pertaining to the whole organization caused by digitalization. The relative difference between index values appears to answer the second question with a ‘Yes’.

## **Discussion and concluding remarks**

The research problem of present article was described through two propositions. The first that, in spite of a long history in educational research, digitalization and digital transformation in Swedish schools can be portrayed as missing a shared definition (e.g. From, Pettersson and Pettersson, 2020). The second proposition was that, throughout both research (Cuban, 2001; Player-Koro, 2016) and political history of digitalization in schools (Karlsohn, 2009), one influential and false assumption has been that mere availability of digital technologies corresponds with transformation, thanks to affordances of the technologies for learning. The purpose was thus to contribute to educational research and practice that wants to understand digitalization in schools as digital transformation, built on educational theory and not general assumptions. As a third question, we will consider: in what way has this article contributed to educational research and practice that wants to understand digitalization as digital transformation. Specifically, an understanding that builds on educational theory and not general assumptions about availability of digital technologies?

The approach taken in the article sought to answer the purpose through developing a theoretical understanding of the concepts of digitalization and digital transformation in schools, and to put the understanding to use in empirical measurement. Two questions were asked and answered in relation to the purpose. The first:

1. What is digitalization and digital transformation in schools, specifically, in terms of human learning?

The answer to this question was that “Digitalization in schools corresponds with the use of digital technologies within school organizations for human learning and development. Digital transformation caused by digitalization in schools corresponds with the development of the shared object of work activities in school organizations. School organizations are complex object oriented systems of work

activities". This definition built on Engeström's expansive learning theory (2015), where the ontological understanding of schools is the object oriented activity system. Moreover, the answer was that digitalization in schools as both every-day change and the more rare transformation, has its foundation in human learning and development. This learning and development was conceptualized as three successive and distinguishable levels of learning (Engeström, 2015), attributed to people who work and learn in schools. Digital transformation in particular was attributed to the third level of learning, where change takes place in the entire activity system by a transformed understanding of the shared object of work.

As such, the approach here contributed to educational research and practice with a definition built on an understanding of work in schools that has a rich and robust conceptualization in educational theory. This understanding precisely distinguishes digitalization in schools from digital transformation in schools.

The second question was:

2. Are the three levels of learning in relation to digitalization and digital transformation in schools separately distinguishable when measured in schools?

This question related to the pragmatic goal of the research approach (i.e. if not useful, do not use). The responses that principals in MX gave appear to indicate that the levels are separately distinguishable also when quantitatively measured as digitalization and digital transformation in school practice with working people, according to Figure 1. This in turn suggest that digitalization and digital transformation in schools indeed can be productively conceptualized according to the levels of learning also in practice, not only as a conceptual deliberation about educational theory and digitalization (although this itself is important).

At this point, it is appropriate to consider 'how much' of practice we can come to know with expansive learning theory and the type of measurement made in this article. Regarding the theory, we have considered the ontology of schools as human work within activity systems. Human activity within social practice has a particular meaning in cultural-historical activity theory in general (where expansive learning theory is a third-generation activity theory), that builds on Leoniev's activity concept (1972). Here, there is a distinction between activities, actions and operations that Engeström (2015, p. 122) corresponds with the three levels of human learning: Level 3 is learning on the activity level, Level 2 is learning on the action level, and Level 1 is learning on the operation level. Engeström (p. 114) goes on to say that "[Human] activity is to be conceived of as 'continuously proceeding transformations' between the levels", quoting Leontiev. This of course has practical implications for this article, which builds also on this ontological assumption. The implication being that digitalization and digital transformation in schools is not static, and what can be measured from one point of inquiry is thus limited. Given the continuous learning and change that takes place *between* levels of learning in human activity, the survey as an instrument for 'knowing practice' is thus best thought of as a snapshot. A conscious attempt to account for this in the questionnaire has been to formulate items that ask respondents to assess the historical change in work activities and activity system (see Table 2 and 3 and e.g. items

with “have changed” and “than before”). However, the measurement made through the survey aimed at verifying the distinguishing features between the levels of learning, not how they interact. This may be an interesting line of investigation for future research into digitalization and digital transformation in schools.

Moreover, there are limitations to consider regarding the small sample size of respondents, and some item response means (i.e. I12 and I16) that seem to deviate considerably from index values (i.e. Level 3). These limitations also limit how much of practice can be considered known in this empirical survey, in addition to above ‘conceptual-ontological’ limitations. Seventeen responses limit possibilities for statistical validity. The strategic sample of respondents can be considered helpful in this case, where it can be assumed that the principals are able to assess their schools in relation to the items, since they are actively working and engaged in the mentioned development project and common words have been used (as opposed to words uncommon to present schools in MX). For item wording in particular, the joint efforts of the Learning and ICT group in developing the questionnaire can be considered a checkpoint of appropriate item wording, where members have considerable experience of school practice and communicating with principals regarding digitalization in schools. Consequently, deviations in item twelve and sixteen means from the Level 3 index indicate that these items in particular ought to be subject to future revision or exclusion.

In the introduction, an assertion was made that the understanding developed and tested in this article might be particularly relevant for educational researchers researching remote teaching. This article is part of a special issue on remote teaching, after all. Let me then try to go full circle so to speak, extending the pragmatic approach towards a concrete example of digitalized school practice: remote teaching. In Sweden, remote teaching is defined in terms of teachers and pupils being separated in space but not time, where learning is fully mediated through digital technologies (Ifous, 2018). Moreover, in Sweden and other Nordic countries, it is held by educational researchers that schools in rural contexts (Pettersson, 2017) are particularly productive grounds for remote and distance teaching to bridge challenges e.g. in terms of providing equal opportunities and inclusion for children to learn in schools (Stenman and Petterson, 2020; Hilli, 2020). So, making use of the definition, a developed definition in the context of remote teaching in rural schools can thus be suggested as:

Digitalization in rural schools corresponds with the synchronous use of digital technologies within rural school organizations for human learning and development, where teachers and pupils are separated in space. Digital transformation caused by this digitalization corresponds with scaffolding democratic principles of education. Rural school organizations are complex object oriented systems of work activities.

With this definition in hand, *digitalization* would be researched in terms of using digital tools for learning achievement and experimenting with pedagogical models. *Digital transformation* would be researched in terms of *if*, *how*, and *why* the scaffolding takes place.

Regarding future educational research more generally, it is hoped that the definition provided in this article of digitalization and digital transformation in schools can be productive, at least as a starting point or contrast into other theoretical considerations and perspectives. At best as a foundation for understanding that digital transformation – if and when it happens – takes place on the back of the hard work of people in schools, learning and developing within work activities.

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### **Contributors**

The contributors listed here alphabetically by last name, and the author, all contributed to the development of the questionnaire: Jörgen From, Tomas Holmgren, J Ola Lindberg, Fanny Pettersson, Ulf Stödberg, and Simon Wolming, all working at the Department of Education, Umeå University, Sweden.

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