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Reprint of: An analytical unit of transformative agency: Dynamics and dialectics[☆]

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1. Introduction: transformation and agency

Global issues and challenges, an increased turnover rate of knowledge production and networked technologies challenge educational research, systems, and practices worldwide. Increasingly, people face complex challenges and situations that require agents to change the situation they find themselves in, using or developing resources to break out of status quo and transform the situation (Aagaard & Lund, 2020). Such transformation in contexts and practices also means that we change as human actors (Packer & Goicoechea, 2000). Thus, transformation, unlike more superficial change, cannot be reversed but amounts to deeper and more sustained processes. In the words of Stetsenko (2017), “the emphasis is on people being transformed by their own transformative engagements, activities and social practices” (p. 175). This involves an epistemic principle of “we-know-the-world-as-we-change-it” and an ontological principle of “we-come-to-be-as-we-change-the-world” (p. 197). The dialectics between the situation and the agent(s) enacting such principles requires capacity to instigate and sustain transformation in order to improve on the original situation, a capacity that tends to be overlooked in education (Graesser et al., 2018). In the following, we refer to this capacity as transformative agency. Education valid for the networked knowledge society requires students to face situations and challenges that are complex and context sensitive, do not have one correct answer, involve risk and uncertainty, require collaboration and productive use of sophisticated resources, and an active, future oriented transformative stance (Stetsenko, 2017).

Whether we want to study phenomena that involve transformative agency or foster transformative agency in education, working life or various social settings, we need a unit of analysis that captures the dynamics and dialectics between problem situation and agentic and transformative use of resources. Such resources include recent development in digitalization, which has a direct impact on human agency. Digitalization does not merely result in powerful tools at our service but materializes in objects with intentions that interfere with and even override human decisions (Rozendaal, Boon, & Kaptelinin, 2019). In addition, as artificial intelligence continues to make fast progress, we encounter situations where fundamental questions related to ethics and essential human qualities such as consciousness meet superior computer intelligence (Harari, 2017; Tegmark, 2017). But digitalization also impacts on more commonplace educational situations where we seek to find productive courses of action when facing problems that exceed our current competence; consulting and navigating in infinite research archives online or finding a malleable digital representation of a naturalistic or social phenomenon (modelling climate change, manipulate correlations between income and life expectancy etc.). Thus, the interplay between humans and digital resources offers extended possibilities for transforming situations and practices. Against this

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background and these trends, we argue that we need a unit of analysis that suspends the more traditional separation between units that capture the individual, the collective, or the organizational phenomenon. As these units often have been associated with attempts to reduce a phenomenon to its minimal representation (e.g. an utterance) or capture its complexity (e.g. an activity system), they are suitable for examining entities but less suitable for examining transformative processes that also involve micro level interactions. A dialectic unit of analysis aims to capture reciprocity; the interplay between volitional action and use of resources to break out of difficult situations and resolve them.

We aim to conceptually propose and empirically operationalize a unit of analysis that captures transformative agency, not to 'replace' or 'outstrip' other units but to emphasize the need for such a unit to capture the efforts of agents seeking to deal with fuzzy or wicked problems. An activity system as a unit of analysis can capture transformation in organizations over time but, we argue, is not equally suited to capturing transformative agency at micro level and where the focus is on individuals struggling to transform a situation or a practice. Thus, we suggest a unit that can capture diverse levels and respond to a variety of research questions but where the phenomenon under investigation is characterized by uncertainty and volatility and, consequently, the need for transformative agency. The unit of analysis needs to be "well-suited to the intrinsic qualities of the object of inquiry" (Lefstein, Snell, & Israeli, 2015, p. 882).

In the following, we elaborate on the notion of transformative agency before we seek to connect transformative agency to a suitable unit of analysis. We do this by invoking some relevant scholarly studies of units of analysis. Next, we use a slight re-interpretation of the Vygotskian principle of double stimulation as a structuring principle for studying and fostering transformative agency. This is followed by a section in which we use empirical snapshots to illustrate how transformative agency can materialize in educational contexts. Finally, we discuss the snapshots in light of the conception of a dialectic unit of analysis.

2. Transformative agency

When is agency transformative? The Vygotskian tradition (including Cultural-Historical Activity Theory, CHAT, and sociocultural perspectives), emphasizes the connection between agency and development and learning and has recently devoted quite some attention to transformative aspects, (see e.g. Rajala, Martin, & Kumpulainen, 2016; Sannino, 2015a; Thorne, 2015). However, where agency becomes transformative is not always evident. Emirbayer and Miche's seminal article titled "What is Agency?" (1998) addresses this issue. When they ask, "how is it possible for actors to ever mediate or transform their own relationship to these contexts?" (p. 964) and focus on "the capacity of human beings to shape circumstances in which they live" (p. 965) we recognize the transformative dimensions of agency. However, Emirbayer and Miche did not examine the cultural resources that may be activated in order to mediate such agency. We also concur with Mäkitalo (2016) when she identifies agency as "... the capacity of humans to distance themselves from their *immediate* surroundings and [...] to intervene in, and transform the meaning of, situated activities" (p. 64, emphasis in the original). In this citation, agency and transformation are linked but the role of cultural resources is not explicated.

In order to emphasize the role of transformation and cultural tools in agency, we turn to the (neo)Vygotskian tradition where the interplay between agents and artifacts is crucial for development (Sannino, 2015b; Sannino & Engeström, 2017; Vygotsky, 1978). The agent - artifact relation is dialectic (the two components are mutually constitutive of agency) and holds the power to transform an initial problematic situation as well as the agents that engage in such activity. Thus, the artifacts involved, whether material, digital or discursive, are not merely mediating the activity but interwoven in and constitutive of the transformative endeavor.

From a CHAT perspective, Haapasaari, Engeström, and Kerosuo (2014) further unpacked the processes involved in transformative agency and identified (for analytical purposes) six types ranging from resisting change and criticizing current practices to explicating and envisioning new possibilities and models, and finally committing to and taking action to transform the current situation or activity. This categorization was put to work in a study by Brevik, Gudmundsdottir, Lund, and Strømme (2019) which examined how student teachers dealt with situations in their program that required transformative agency. Similarly, in a study by Lund, Furberg, and Gudmundsdottir (2019), the notion of transformative agency was used to analyze a case of digital literacy as agentic and with epistemological implications as digital resources were put to work in order to resolve a conundrum in the subject of genetics.

The studies referred to above demonstrate that transformative agency is examined in working life as well as in educational contexts. However, the boundaries between 'general' agency and transformative agency are not always clear. Blurred boundaries and grey areas are common, as we do not deal with discrete phenomena. Haapasaari et al. (2014) seek to make a distinction:

Transformative agency differs from conventional notions of agency in that it stems from encounters with and examination of disturbances, conflicts and contradictions in the collective activity. Transformative agency develops the participants' joint activity by explicating and envisioning new possibilities (p. 233).

The implication is that transformative agency does not stop at general decision-making, making a choice, or opting for an alternative. These are all agentic efforts, but they may or may not hold transformative qualities. In transformative agency, the problem situation is perceived as worrying or conflicting by the subject(s) that experience it. Thus, it involves personal investment, elements of risks, and an uncertain future outcome. Similarly, Virkkunen (2006) finds that transformative agency involves fundamental dilemmas; between acknowledging the problem situation and actually engaging in transforming it and between emotional commitment and a distanced, intellectual stance. "The basic dilemma" according to Virkkunen emerges when "The new general knowledge has to be connected to the practitioners' experiences and observations, and enriched and modified through them" (p. 47). This dilemma also exists in education but takes on added uncertainty as students are not (yet) enculturated into professional cultures. Thus, transformative agency does not necessarily presuppose a dramatic or fundamental double bind situation where there seems to be no way out (Bateson, 1972), but applies to situations where we seek to transcend contradictions, limitations, or impasses.

Although we find numerous studies that involve transformative agency, a focus on the unit of analysis for capturing the dynamics of transformative agency is not common. Hence, it is our purpose to establish a minimal unit that cuts to the core of the processes involved. We propose the underlying dialectic principle between problem situation and relevant resources (later referred to as S1 ↔ S2) as a unit of analysis for capturing transformative agency. Thus, we do not merely see the unit of analysis as a mediating device for reducing complexity. This line of reasoning prompts the following research question:

To what extent can we establish a unit of analysis that is conducive to identifying and examining transformative agency?

Although the domain in the present paper is education, the research question is kept in more general terms. It addresses situations that require transformation or expansion; breaking out of and transforming constraining situations of status quo whether it concerns the workplace, everyday situations, policy making or education. This corresponds with some relevant studies as demonstrated in the following section.

3. Connecting transformative agency and units of analysis

What units of analysis have been used to capture transformative agency? To get a sense of what already exists of relevance for our research, we conducted queries in the SCOPUS and ERIC databases, delimiting our search to education as a scientific field. Our search was guided by principles of snowball sampling, i.e. an explorative strategy where one result opens up for further related studies in a cumulative relationship (Atkinson & Flint, 2011). Searches combining the words “unit of analysis” and “education” generated more than 700 documents. We therefore added more specific words such as “transformation” or “transformative agency” to further refine the search, also using variations for “unit of analysis” such as “analytical unit” or “methodological unit”. These searches generated at totality of 57 unique documents when restricted to peer reviewed publications. The majority of these are either special cases (e.g. nursing, quality assurance, food categorization), or publications where the link between transformative agency and a unit of analysis is peripheral to the essence of the paper. Only a small number of the studies address relationships between a unit of analysis and transformation or transformative agency. For example, [Jornet Gil and Erstad \(2018\)](#) address units of analysis “that emphasize the fluid and boundless character of learning and living across settings and time” (p. 1). [Arnseth & Silseth, \(2012\)](#) introduce analytical concepts for “grasping the tensions, connections and transformations that occur in participation across sites” (p. 23). [Damşa, Froehlich, and Gegenfurtner \(2017\)](#) address the relational versus transformative nature of agency related to units of analysis. Some publications address issues related to *activity* as a unit of analysis ([Calderón, 2009](#); [Engeström, 2010](#); [Henley, 2015](#); [Young, 2010](#)). While these are relevant examples, studies focusing on units of analysis and phenomena that are characterized by transformation are not common.

With this sampling as our point of departure, we in the following seek to make visible how a unit that captures transformative agency can be conceptualized. A valid unit of analysis carries theoretical as well as analytical essentials that have explanatory power when examining a phenomenon ([Säljö, 2009](#)). The implication is that the unit of analysis can be found on a scale from linguistic markers to cultural-historical activity systems. It is the phenomenon, what previous studies have revealed about it, and the new research questions that arise that amount to a potential need for an additional or refined unit of analysis. From a cultural-historical perspective and with transformative agency as the phenomenon to be examined, we briefly investigate some relevant studies.

[Matusov \(2007\)](#) argues that the unit of analysis within the sociocultural tradition experiences a ‘crisis’ (p. 325). He points to two potential fallacies; reductionism, *vertical* and *horizontal*, and holism. Vertical reductionism reduces a complex phenomenon (as in e.g. behaviorism) while horizontal reductionism makes a part of a complex system representative of the whole system; i.e. important relations are neglected. In both cases, the unit of analysis misses the essence of the phenomenon. The alternative search for increasingly holistic units sooner or later becomes unmanageable, or may take the form of searching for a context un-specific universal, according to Matusov. We follow Matusov in his critique and his proposal of several, context specific units depending on the phenomenon and the questions asked. However, when he concludes by proposing “An Open and Unfinalized Unit of Analysis” (p. 326) that also affords multivoicedness “in order to develop the dialogic truth of the research” (p. 328), we disagree due to different positions. Dialogism differs from dialectics in that there is no clear tension and reciprocity resulting in a new synthesis. To us, there is a danger of relativism. Matusov admits that his proposal “is vague, sketchy, and lacking in important details (and illustrations). It is incomplete and weak” (p. 329). Thus, it may be unfair to disregard his contribution at this stage.

From a cultural-historical activity theoretical (CHAT) perspective, [Kerosuo \(2017\)](#) reminds us that “*Transformative agency* is considered a quality of expansive learning in activity-theoretical studies” (336, emphasis in original). Using “transitional episodes” (p. 339) as a unit of analysis, she analyzed how transformative agency was initiated, both by individuals and groups in the form of ‘knotworking’, in the construction industry. She also contends that in her study this has not been studied previously (p. 333). However, transitional episodes, while representing key incidents and shifts in interactions where new possibilities emerged, did not capture the dialectics between the problem situation and the resources (material, digital, discursive, and social) activated to break out of, transcend, or transform it past moments of initiation.

The anthology *Learning and Expanding with Activity Theory* ([Sannino, Daniels, & Gutiérrez, 2009](#)) devotes a section to units of analysis. Three chapters make up the section. What they have in common is that they take the activity system as a *given* unit of analysis; it is not questioned or problematized but applied to the analyses of different phenomena. [Blackler \(2009\)](#), working with organizational theory, observes that the activity system is unique in the sense that “activity theory prioritizes the thing or project that people are working to transform” (pp. 26–27). [Russell \(2009\)](#) applies activity theory to written communication and re-interprets *genre* in activity theoretical terms, but adheres to an organizational or systemic perspective when analyzing written documents. Finally, [Roth \(2009\)](#) makes a case for including “sensuous aspects” (p. 53) in the activity system and as part of the agentic dimensions of activity. Despite

the interesting takes on a unit of analysis, the three contributions do not specifically address how agents cope with, and seek to transform problematic situations.

In Yamagata-Lynch's (2010) book on Activity Systems Analysis Methods, three of the studies focus on the individual as the unit of analysis, while the remaining three focus on multivoicedness and institutional dimensions. However, the units lend themselves more to an 'entity'-feel than development and transformation. Nussbaumer (2012) reviewed 21 classroom studies where a clearly defined unit of analysis was one of the criteria for inclusion. A focus on change or transformation could be detected in several studies, but only one (Roth, 2007) proved to demonstrate an explicit dialectic relation between agency and structure in order to theorize emotional, motivational, and identity-related aspects of everyday human praxis. Roth's approach deserves to be rendered in more detail:

"From a cultural-historical perspective, these identities are an integral part of the activity as a whole, which requires theorists to use a unit of analysis sufficiently large that it encompasses all the mediations that lead to the enactment and construction of identities. Practical activity is the unit of analysis and cannot be reduced to the acting subject, object/motive driving the activity, tools, community, division of labor, or norms. These structural aspects of activity are not elements but different ways in which activity is expressed—in one-sided form. True understanding of activity requires us to go further than the analysis of these structural aspects and consider the dialectical relation that integrates agency and structure together" (p. 88, our emphasis).

It would seem that Roth's approach would alleviate many of Matusov's (2007) concerns and correspond to our aims in this paper. A more recent paper (Jornet, Roth, & Krange, 2016) focuses on 'transfer episodes' where participants encountering tasks make prior experience relevant for the current task organization. In order to study such processes, "a minimal unit of analysis must include whole persons (...), their material and social environment, and their transactional relations (mutual effects on each other) as these change over time" (p. 286, emphasis in original). The authors also observe transformation in the acting subjects: "In experience, learners undergo a process of transformation, the end of which they cannot foresee while experience is still in the making" (p. 292, emphasis in original). Such emphasis on temporality and continuity could also hold a future dimension non-separable from a unit of analysis intended to capture moment-to-moment transformative agency.

This brief review shows that both identifying and operationalizing units of analysis that capture complex and fluid phenomena are not common. With the exception of Matusov (2007) there are few studies that offer any extended discussion that directly pertain to a unit of analysis aiming to capture the dialectics of transformation. When this is the case, it is mostly on a discursive, systemic or organizational level, rarely on an agentic level in order to capture the mutual contingency and constitution of agents, contexts and artifacts for transformative enactment. What seems to be lacking is a consistent analytical lens through which we can unpack and analyze transformative endeavors. Thus, we agree with Sannino (2015a) suggesting that such a lens may be found in the principle of double stimulation. However, when we continued our search in the SCOPUS and ERIC databases, connecting double stimulation to a unit of analysis, the result is only two publications, one by Sannino and Engeström (2018) and one by Engeström (2011).

Thus, there seems to be very few attempts at establishing a unit of analysis on the principles of double stimulation. However, the two papers that emerge in SCOPUS are very relevant. Engeström (2011) points to double stimulation as an "emerging methodology of formative interventions" (p. 625) but keeps the activity system as the unit of analysis. Although Engeström connects double stimulation, agency and transformation, the focus is on the intervention and not so much on how we can study the agents' efforts to transform their problem situation. Sannino and Engeström (2018) also point to "double stimulation as the generative principle behind transformative agency" (p. 50). Still, they do not unpack this principle and apply it as a unit for studying transformative agency but stay with one or even "two or more activity systems" (p. 46) as the unit of analysis. Hence, the principle of double stimulation requires some elaboration before it is put to work as a minimal unit.

4. Analytical lens: the principle of double stimulation

In order to capture transformative agency, we need to examine what agents invest in and struggle with in order to make sense of situations where they experience challenges, dilemmas, gridlocks, conflicting motives, impasses, and difficult choices. Willful transformative agency takes place when people experience demanding situations and conflict of motives, creating a wish or need to break out from the current situation. This also involves uncertainty and risk-taking; students can become agents of their own learning and development but they cannot predict all consequences of the process. Also, transformation may be incremental over time, take many directions, and involve hiatus and interruptions and, consequently, appear as diverse manifestations (Emirbayer & Miche, 1998). This makes it even more challenging to identify a productive unit of analysis to capture such volatility and complexity. But the Vygotskian (1978) principle of double stimulation affords an analytical lens when examining transformative agency.

The principle of double stimulation was introduced by Vygotsky (1978) but not in a complete and rigorous way; fragments are scattered in his writings. Thus we in the following also build on a series of more recent conceptualizations of the principle (Engeström, 2007; Sannino, 2015a, 2015b). Double stimulation can be understood as an underlying principle for transformative agency (Sannino, 2015a). Double stimulation involves a first stimulus (S1) that represents a problem situation. A problem situation can involve a conflict of motives, a double bind, an impasse or gridlock. It may materialize at a global level with serious political stakes (e.g. ecology/economy issues), but also at social, professional and educational levels where reflection, volition, analysis and agency are needed in order to resolve seemingly mundane situations but that are experienced as difficult by the subjects involved. It is the subject(s)' perception of the situation that decides to what extent the situation calls for transformative agency and not independent attributes of the situation. As these are psychological processes we have to look at the persons as they engage in external activity to identify how they make use of second stimuli, i.e. resources that are mobilized and put to use. These stimuli may be material/digital, conceptual/

discursive or symbolic artifacts but also types of social interaction and collaboration. It is thus important to see the second stimulus (S2) as a *series* of stimuli, leaving an audit trail of the participants' agentic endeavors.

Lately, several researchers have explored the principle of double stimulation, in education as well as in working life, in order to examine processes of agency and transformation (see e.g. Ellis, 2010; Engeström, 2007; Lund & Rasmussen, 2008; Sannino, 2015b; Thorne, 2015). However, few, if any, focus on the use of digital resources and the role they can play when breaking out of status quo. As such resources have become pervasive in work, public sectors, leisure activities and, increasingly, in education there is a need to analyze their function as second stimuli (S2), especially as digital resources also exercise agency, as 'objects with intentions' (Rozendaal et al., 2019) that impact on the division of labor between humans and non-humans. Spell checkers overriding flawed orthography and algorithms that suggest what to study or do based on the agents' cumulative online actions are well known. But such agency can be increasingly observed in classroom robots that facilitate students' learning but may also infringe on their privacy (Serholt et al., 2017).

We are aware that when we re-introduce cultural-historical concepts from Vygotsky's work into practices where sophisticated resources abound we risk extrapolating our current context onto Vygotsky's framework (Dafermos, 2016). Vygotsky referred to second stimuli as "neutral objects", open for the person to instill it with characteristics of a meaningful sign (Vygotsky, 1978, p. 74). The notion of "neutral objects" is problematic in naturalistic situations where people are surrounded by cultural artifacts that come with dispositions, affordances, inscriptions and even prescriptive features. For example, digital and networked resources are artifacts that suspend constraints in time and space, they link minds, hand and emotions, and they are representations of collective insights developed over time. Also, they change practices and research agendas. Consequently, they function as gatekeepers of and 'glue' in cultures. They also suspend the separation of cognition and context, mind and world. And when information is digitized, it can be accessed, copied, manipulated and re-organized and re-published in a few keystrokes. The implication is an epistemology that has to acknowledge that we come to knowledge in very different ways than in the analog classroom or auditorium (Lund, 2016). As complex and technology-rich environments afford multiple resources, the question is how resources are picked up and appropriated by agents and put to use for object-oriented endeavors.

Thus, we recognize the need to align the principle of double stimulation with situations where we have a series of complex tools as S2. We do not see digital technologies as being mapped on to Vygotsky's notion of neutrality but argue that they serve to influence and coordinate activities in specific ways as much as being mediators of meaning-making (see Lund & Rasmussen, 2008). Our main argument is accurately summarized by Säljö (2007, p. 13): "What people can do with support from digital technologies is radically different from what they can do without them." When second stimuli come with powerful inscriptions or affordances, they can be appropriated by human agents to the effect that the original S1 becomes transformed and its appearance as an impasse or its conflicting features can be suspended or resolved. Thus, the 'co-woven agency' of humans and artifacts transforms the first stimulus, not as a single operation but dynamically over time and with several permutations. Consequently, we propose *the dialectic relation, represented by S1↔S2* as the dynamic and dialectic unit that captures the essence and processes of transformative agency and not merely the outcomes. This will be operationalized in the following section.

5. Examining transformative agency: empirical snapshots

5.1. Setting

We report from an intervention (spring 2017) aimed to foster professional digital competence (PDC) in a five-year teacher education master's program at the University of Oslo, Norway. PDC can be quite daunting as it involves linking digitalization to epistemology, to pedagogy, subject didactics, and professional endeavors such as class management, and connecting academic and experience based knowledge (Lund, Furberg, Bakken, & Engeliën, 2014). This places student teachers in a series of demanding, sometimes confounding and even conflicting situations where there is a potential need for transformative agency in order to expand their professional educational repertoire. Developing PDC was, thus, the *overarching S1* in the intervention. The student teachers had to cope with a series of tasks, assignments and discussions related to PDC in an online learning environment. For the student teachers, these tasks also represented a diversity of S1s, a nested system subsumed under the overarching S1 of developing a comprehensive PDC. Developing PDC was partly a cognitive and reflective endeavor connected to a research based approach to teacher education, partly connected to classroom practices and developing educational designs for teaching and learning in technology rich environments. Thus, an S1 would often involve the difficulty of relating to multiple contexts and knowledge logics.

5.2. Research based PDC: a conflict of motives

To identify how student teachers documented and articulated transformative agency, we searched for traces in responses to their assignments, their perceptions of the PDC requirements in an online survey we conducted, and in transcriptions from the group interviews. In the survey, student teachers were asked to report to what extent they experienced developing their PDC as a result of the intervention. While 62% found this to be the case to a great or certain extent, 34% reported this only to a limited extent or not at all ($N = 195$).¹ This indicated an S1 where there might be resistance, confusion, uncertainty, double binds and/or a conflict of motives on a

¹ The remaining 3.5% did not answer the question.

collective level. The survey results made us search for how and why the student teachers developed their PDC, or why they might not have done so. In the following, we zoom in on group interviews where the S1↔S2 dialectics materialize. In order to clarify our approach and show how a dialectic unit of analysis serves the research purpose, we, after the first excerpt, briefly analyze the exchanges through alternative units of analysis related to Cultural-Historical Activity Theory (CHAT), Dialogic, and Experience-oriented perspectives. The aim is not to show that alternative units are ‘deficient’, but that diverse units of analysis can be put to work depending on how we want to respond to research questions and analytical foci; i.e. that explanatory power depends on this correspondence.

During one of the group interviews, interventionists/researchers addressed an assignment in which student teachers were asked to locate a research article and explain its relevance for their PDC development. The reason for this assignment is partly found in the PDC principles as outlined above, partly in Norwegian teacher education being expected to be research-based. This was a situation that in the survey reflected the student teachers' ambivalence as to relevance and usefulness of the task, i.e. they experienced a conflict of motives on a collective level. This S1 was the point of departure for the exchanges in [Table 1](#).

5.3. Affordances of some frequently used units: activity, dialogue, experience

From a CHAT perspective, the above situation can be analyzed as a subject-object relation where students make visible diverse understandings of the object (developing PDC). CHAT would emphasize the collective activity at group level or institutional level and how the agents are engaged in constructing the complex and heterogeneous object. CHAT would also afford analyzing the situation as a boundary zone between different activity systems; the practicum schools and the research community. Thus, the unit of analysis would capture very valuable systemic aspects of the phenomenon, but – we argue – not the micro level moments where a problem situation on group level is dialectically transformed into new opportunities.

A dialogic unit of analysis could capture the multivoicedness of the students involved and how these might deviate from more authoritative voices; one voice reflecting the teacher education institution's more normative ideal of “the teacher with the researcher's eye” and one reflecting the more practical orientation. These two voices can co-exist but also with implied tensions. In contrast, our approach would be to pursue the dynamics, dialectics and possibly transformative elements between such voices, resulting in risk taking, future orientation, looking for ways out and breaking away.

A perspective that would introduce *experience* as a unit of analysis would emphasize how previous experience influences the here-and-now situation and with a distinct ‘emic’ (from within) perspective. Such a unit would require more longitudinal research designs and data. The S1 ↔ S2 unit gives more emphasis to the ‘etic’ (observer) perspectives and with a focus on transformation that also affords a distinct future orientation. However, a dialectic unit of analysis can be put to work in diverse perspectives; a more diachronic approach to S1 ↔ S2 as a series or instantiations along a trajectory could make a developmental and longitudinal dimension of transformation visible.

5.4. A transformative unit of analysis

This brief excursion into analyzing the same passage with different analytical units shows how they are conducive to capturing different and highly relevant dimensions of the phenomenon under study but without fully corresponding to the need for unearthing the dialectics involved. Thus, we now turn to a transformative perspective. An S1 ↔ S2 analysis seeks to operate a unit that captures and examines students' reciprocal agency, their dialectic interaction with peers and artifacts. This approach aims to capture the dialectics and the moment-to-moment interactions that can tell us something about transformative instantiations. The exchanges in [Table 1](#) reflected the dynamics and the dialectics of a situation involving collaborative transformative agency. The point was not to demonstrate a ‘successful’ transformation of practices, but to display how the S1 ↔ S2 unit can be put to work. In the following, we point to some key aspects of a transformative unit of analysis.

The first aspect is the availability of second stimuli (S2). Jakob and Vilde perceived S1 differently. Vilde approached from an academic context where there were a series of S2 available. On an individual level, Vilde does not experience a problem situation as she relates to the academic context and the value of research literature in this context. Jakob approached from a practice context where he did not find a (series of) suitable S2. This resulted in a potential conflict of motives; partly for Jakob but also on group level. A second aspect is unpredictability of outcomes despite object orientation. In the above excerpt, we see oscillation between conflicting motives and commitment through S2s that also involved an alternative program structure (Martine's suggestion), an expanded teacher role, and commitment to examining ‘how things turn out’, i.e. future orientation but with unpredictable outcome. Transformative agency is riddled with tensions and uncertainty, and the exchanges reflect this. A third aspect is the emphasis on escape strategies. The common denominator in the excerpt above and in the data corpus is that the student teachers were looking for ways out. Their proposals amounted to explorations of and commitment to expanded teacher role and co-configuring further design of the PDC component in the master's program.

In one situation where students discussed the connections between digitalization, student active learning and their own practices, they encountered digital resources such as Padlets (shared templates for collaboration) and TalkWall (digital support for visualizing subject oriented plenary discussions). This aspect of developing PDC sparked the following student teacher reflections:

Emilie: This was totally new to me

Table 1

A situation of S1 ↔ S2 involving the use of research papers in teacher education (emphasis added).

Exchanges by student teachers (emphasis added)	Comments
Vilde: I really liked [...] where we looked at research reports. It was so useful because there is such an unbelievable quantity to be found on the net [...] you could make use of <i>in your assignments</i> and such. So, I thought this was very.... It will be exciting to see what this research is about too, because then you <i>increase your insights into how things turn out</i> .	Vilde has identified research papers as an S2 conducive to building PDC, the overarching S1. She justifies her opinion by demonstrating transformative agency relating both to herself and her increased understanding of technology mediated learning. The future orientation is explicit.
Martine: Actually, I do not quite agree with you [...] it was so <i>far removed from my life world</i> . [...] yes, it is very important to see, like, the macro perspective, but I don't know. For me, rather, it might have been better to start with it (= the assignment on research). To get more, like, an overview instead of, like, ending the module with it after having been working with so much personal stuff. <i>That you get this before the placement period, perhaps</i> .	Martine expresses non-relevance of this instantiation of the intervention. The S1 shows conflict of interest in the group/professional community. Transformative agency applied to suggesting an alternative temporal structure as S2.
Vilde: In fact, that is a very good idea! Because we have been introduced to [the notion of] " <i>the teacher with the researcher's eye</i> ", or whatever. [...]	Vilde invokes a teacher role matching a research based PDC. The S1↔S2 dialectics produces a sustainable way out in the form of expanded teacher role.
Researcher: Jakob, what did you think when you did that <i>task</i> ?	The task is to make use of research in developing PDC
Jakob: [...] I found it <i>difficult</i> to see how it (= the article) could be used <i>related to the pupils I teach</i> , it is probably more like you (addressing Vilde) touched upon when you brought up " <i>the teacher with the researcher's eye</i> ", or what they called it, then it <i>could be extremely interesting</i> . [...] I would really have <i>liked to learn how to use it</i> (= the article), but not... because this felt like "you should apply this to the pupils and how the pupils can use it". [...] So it was, like, I get the idea but don't know how much, like... <i>I do not see myself reading it closely during placement periods thinking "this is something I will use right now"</i> .	For Jakob, research lacks of relevance for S1 since he moves beyond developing merely his personal PDC to include value for his pupils, which he does not recognize. A conflict of motives. Alleviates the situation somewhat by drawing on Vilde's S2. Signals commitment to agency. Revisits conflict of interest between immediate use value and more long-term PDC development.

Camilla: (...) There is a lot awkwardness, but you just have to keep pressing [keys] and experiment a bit and such (...) I experienced during many of the lectures that now that we use this *Padlet*, that is so OK. Because this opens up for participation even if we do not have to raise our hands, (...) I really felt included. (...) To get everything up onto the whiteboard and read what others had done, and... that was so OK. (...) So, I got curious about all the stuff that appeared and thought, "yes, I want to try this"... If we could have more, like, trying stuff out, that would have been so all right.

Emilie: Quite fun with that *Padlet*. Because then we could actually see some of the challenges we encounter in the classroom.

Camilla's last sentence points to digitalization as a way to resolve a common S1 in schools; engaging whole classes including reticent students is a well-known challenge for teachers. In this excerpt, the focus is not so much on the student teachers' perceptions of this S1, but rather the digital resources made available. As Emilie puts it, "This was totally new to me". The S2 in the form of the Padlet/TalkWall artifacts make the problem situation visible and shared. The S2s afford an embryonic transformation in the student teachers' agency; willingness to take risks, a future orientation, and recognizing how digitalization provides an inclusive way of orchestrating and visualizing plenary discussion. Again, the issue is not whether student teachers 'successfully' transformed the S1 or not but how a relational and dialectic unit of analysis makes the oscillations between S1 and S2 visible and, thus, can capture the genesis, instantiations and processes of transformative agency. While other units could be applied – discursive and systemic as we demonstrated with the first situation – we have argued that while they capture important aspects of a phenomenon, they do not seem to capture the potentially transformative moments at micro level; how agents can break out of S1 by invoking a series of diverse resources.

6. Discussion: understanding and enacting transformation

The complete data corpus revealed many S1 situations where student teachers experienced conflicts or dilemmas related to integration of knowledge types (academic and experiential), digital technologies as educational resources or entertainment, coping with extremely diverse school cultures when integrating ICT, ethical issues (e.g. privacy, cyber bullying), and the PDC course components and their place and structure in the program. Thus, we have a nested system with an overarching S1 – an intervention aimed to develop and foster PDC – and a plethora of instantiations that also separately place the students in situations they need to transform. For each S1 instantiation, the student teachers turned to a series of diverse S2 in order to cope with the S1 in question (see also [Brevik et al., 2019](#)). However, for further research to uncover the processes in more detail, we see the need for more longitudinal ethnographic observation and micro analysis of discourses and activities.

The empirical snapshots illustrate two types of problem situations; one involving the students' need to use research for their own professional development and enactment across educational contexts, the other involving their need for experimentation and expansion when appropriating digital resources in order to resolve a persistent teaching challenge and transform their practices. Our theoretical as well as empirical approaches to a dynamic, dialectic and relational unit of analysis fundamentally challenge the notion of a 'bounded unit', whether reduced to a turn or expanded to several interconnecting activity systems. The dialectics in S1 ↔ S2 relations has explanatory power for analyzing correspondence or match/mismatch between a problem situation, the resources used to break away, and – in effect – transform the original problem situation into something that does not equal abdicating or resorting to passivity but into a springboard for further action. In the empirical data we see how in the case of student teachers this is connected to an expansion of their professional repertoire, but without knowing in advance what the results may look like. Neither can the

interventionist know as the S1 emerges from the lived experience of the agent(s). This unpredictability has very much to do with the increasingly sophisticated and powerful digital resources that are no longer mere ‘tools’ but that we co-act with when negotiating situations that demand more than our current competence.

Understanding and operationalizing the relationship between the phenomenon under examination and an appropriate unit of analysis is a crucial phase in research. By avoiding radical reductionism as well as unmanageable holism (Matusov, 2007), we argue that an S1 ↔ S2 unit of analysis captures the *dynamics and dialectics* involved in transformative agency and not merely a reduction of its complexity. In the introduction we pointed to digital resources becoming partners and even potential decision makers and not merely tools at our service. In this perspective, identifying and analyzing transformative agency involves distributed agency between humans and non-humans (Harari, 2017; Rozendaal et al., 2019; Tegmark, 2017). Increasingly, we find this to be the case in modern working and social life – from self-driving cars to sophisticated surgery, use of artificial intelligence and design of social futures. But we also find such distributed agency in everyday chores and educational efforts. In the latter case, there are also epistemological implications. Epistemic work increasingly involves the use of agentive technologies, accentuating questions pertaining to where knowledge is located, how we come to knowledge, and by what means. A dialectic unit of analysis makes it possible to closely examine such epistemic processes by focusing on the *connections* between agents and artifacts.

7. Conclusion

This paper has argued for a dynamic and dialectic unit of analysis since it affords capturing phenomena that transcend minimal entities, whether individual, collective, material or organizational. It is not a normative position where we use a dialectic unit of analysis to bring about change, but a descriptive unit that makes us identify and unpack transformation when we encounter it. Although our empirical analysis has taken a researcher initiated, formative intervention as a point of departure, we see no reason why S1 ↔ S2 cannot be used in more observational research designs including those situations where agents themselves identify, experience, and analyze diverse S1s. Also, a dialectic unit can be put to work within different conceptual frameworks, constructivist as well as cultural-historical or socio-material. As the unit addresses fluid phenomena and processes, it suspends the individual – collective dichotomy. We have proposed the *dynamic and dialectic relation, represented by S1↔S2* as the unit that captures the essence and processes of transformative agency and not merely the outcomes. We do not argue that the S1 ↔ S2 unit is a panacea, but that it serves to make sense of transformative agency, a capacity that emerges as particularly relevant for epistemic work which requires that “we-know-the-world as we change it” (Stetsenko, 2017).

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