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Student teachers' experience of participating in a research and development project in Norway

Sindre Øyan Blomsø[1]*, Rachel Elise Jakhelln[1] and
May Britt Postholm[2]

[1]Department of Teacher Education, Faculty of Humanities, Social Sciences and Education, UiT The
Arctic University of Norway, Tromsø, Norway, [2]Department of Teacher Education, Faculty of Social and
Educational Sciences, Norwegian University of Science and Technology, Trondheim, Norway

This study investigates student teachers' experience of participating in a research and development project named Learning, Assessment and Boundary-crossing in Teacher Education (LAB-TEd). LAB-TEd is a tripartite collaboration project between student teachers, practice teachers and university teachers from two universities in Norway. Framed by cultural-historical activity theory (CHAT), participatory data analysis workshops, known as Change Laboratories, have been used to ensure the relevance of the student teachers' thesis work for professional development, and to uncover obstacles and barriers to change. Recent research highlights that teachers are typical participants in Change Laboratories implemented in teacher education and schools. There are few studies that highlight student teachers as participants in such interventions, and this may indicate that this is a field of research that is important to investigate. The purpose of the article is to provide insight about how student teachers' experience participating in a research and development project grounded in CHAT. The data material consists of qualitative interviews with 34 student teachers. Findings from this study indicate that student teachers experienced a development journey by participating in the project. The following are the main findings from the study: The student teachers experienced that their own drive and motivation went from self-interest as the driving force for participation, to a more collective understanding. The student teachers first experienced tripartite collaboration as non-existent, later to become tripartite collaboration. The student teachers experienced how their role in the project's tripartite collaboration developed from serving as a communication link between university and school, to becoming an actual participant. The student teachers also experienced how their role in Change Laboratories changed from being voiceless participants to becoming more equal partners in the project. The discussion elaborates on the development journey that the participants experienced.

KEYWORDS

cultural-historical activity theory, change laboratory, developmental work research, teacher education, student teachers, tripartite collaboration, higher education, Norway

Introduction

Many countries strive for an enhanced tripartite collaboration between teacher education and schools and hence there is a need for more knowledge about barriers and potentials for such a collaboration. The workshop method change laboratories (CL) developed within cultural historical activity theory (CHAT) is as well a topical issue and of great interest in several research fields.

In the last decade, teacher education (TE) in Norway has emphasized the development of methodological competence for student teachers to be able, as teachers, to continually develop their own and the school's collective practices. Since 2017, the TE for school grades 1–10 has required all student teachers to follow a master's degree program. The final master's thesis must be relevant for the teaching profession. This re-formatted master's level aims to prepare student teachers for continuing professional development based on knowledge of scientific theories and methods. The TE is intended to ensure high academic quality, as well as comprehensiveness and cohesion among subjects, subject didactics, education and practice placement, as well as close interaction with professional practice and the communities in which the field schools belong (Ministry of Education 2016a,b).

TE relies on collaboration between two institutions with different tasks and knowledge bases. The student teachers' development as teachers depends on crossing the boundary between the two knowledge fields of school and university (Zeichner et al., 2015). We will argue that the latest reform represents a paradigm shift in the teacher's role and that close collaboration between school and university is crucial to achieving the new ideals for TE. We will also argue that a solid analytical foundation providing a holistic perspective on practice is crucial. This article is a result of 2 years in the project, where the student teachers in cohort 1 work on their research and development (R&D) thesis in year one and cohort 2 in year two in the project. The project is grounded in cultural-historical activity theory (CHAT) and named Learning, Assessment and Boundary-crossing in Teacher Education (LAB-TEd). The project is a collaboration between teacher education for primary and lower secondary schools at two universities in Norway. The project is still ongoing and includes three partners: teacher educators at school and university and student teachers.

This study is based on the participating student teachers 'obligatory practice-based, professionally oriented R&D thesis (Ministry of Education 2016a,b). Framed by CHAT (Engeström, 1987, 2015), participatory data analysis workshops, known as Change Laboratories (CLs; Engeström et al., 1996), were used to ensure the relevance of the thesis work for professional development. The collaboration in the CLs builds on three voices: the student teachers, the teacher educators in schools and the teacher educators at the university. The aim of LAB-TEd project is twofold: (1) to develop collaboration between universities (teacher educators), schools (teachers and school principals), and student teachers, to build capacity for practice-based, professionally oriented research; and (2) to research these processes using CLs and CHAT to uncover obstacles and barriers to change. This article aims to understand how student teachers experience participating in a project grounded in CHAT when working on their R&D thesis. This is to contribute to the literature on student teachers' experiences in such projects, which are missing in current research. The article is based on interviews with 34 student teachers who participated in the project, and these interviews were guided by the following research question:

How do student teachers experience participation in a project grounded in CHAT when working on their R&D thesis?

Theoretical framework and related research

Theoretical framework

CHAT is developed on the basis of Lev Vygotsky's thoughts and ideas. Engeström (1987) refers to Vygotsky's work as the first generation of CHAT, the second generation is based on Leontèv's work, and his own contribution as the third generation of CHAT. The third generation of CHAT is focusing on collaboration between two or more activity systems and thereby forming networks of interacting systems (Figure 1). In their network, the subjects acting in various systems act on the object that is partly shared between the systems. In this study, it was relevant to use the third generation activity theory because the project included three partners and this study investigated one of these three partners in relation to the others.

In CHAT, the unit of analysis is the activity system (AS). The upper part of the triangle in the AS is the same as Vygotsky's (1978) fundamental triangle, but is turned upside down, with the "mediating artifacts" (signs and tools) at the top. In the middle of the triangles, we find "subject" and "object," and at the bottom of the triangles, we find "rules," "community" and "division of labor" (Engeström, 1987; Cole and Engeström, 1993). The factors in the AS are defined as the following: the "subject" is the acting subject, which can be either an individual or a group of people who partially share an object and motive over time (Engeström, 1999). The "object" is an overall goal and constitute the collective motive of the activity. "Mediating artifacts" function as intermediary aids which the acting subject chooses to use when seeking to attain the goals of actions. The rules refer to guidelines, norms and conventions for actions towards the goals. "Community" refers to a group who share the same object, and "division of labor" means that the work or actions focusing on goals have been distributed among the people in the community (Engeström, 1987, 1999). These factors make up several triadic relations, and these relations are (re)presented in the AS. The concept of "division of labor" makes it possible to distinguish between collective activity and individual action (Engeström, 1987; Cole, 1998; Engeström and Miettinen, 1999). The factor of "division of labor" may also represent a hierarchical relationship between people with different roles when acting on an object. The AS is a unit of analysis and makes the system view and the subject's view complementary factors (Engeström and Miettinen, 1999).

In CHAT, tensions and contradictions within and between ASs form the starting point for change and development (Engeström and Sannino, 2010). These may be "tensions or contradictions in factors." If student teachers are defined as the acting subject in an AS, some of them might want change, while others might prefer stability. The tensions within a factor are called "primary contradictions." "Secondary contradictions" are tensions or contradictions between factors. Student teachers in the project, as the acting subject, do not quite agree on how the object of the activity should be designed. "Tertiary contradictions" are tensions or contradictions between new and the remains of old practice in an organization. Tensions or contradictions may also arise between collaborating student teachers,
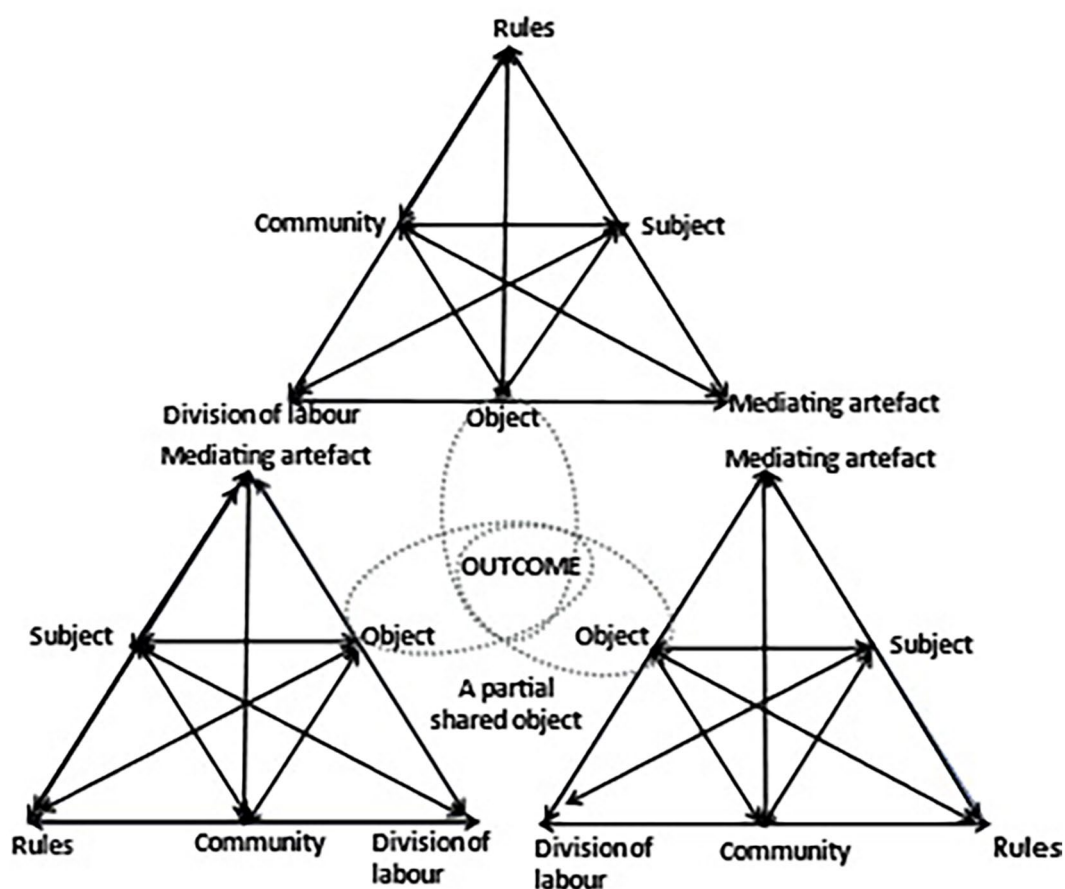
FIGURE 1
A network of activity systems representing the third generation of cultural-historical activity theory (CHAT).

university teachers and practice teachers represented by three different ASs. These are named "quaternary contradictions." According to Engeström and Miettinen (1999), change and development can occur when tensions or contradictions are resolved. When tensions or contradictions are identified, mediating actions are conducted to be on the way to the object. These goal-directed actions are visualized in the cycle of expansive learning (Engeström, 2001). Engeström (1987) theory of expansive learning is understood as a collective process in which participants, through learning actions, change and create new activities by going beyond practices within the activity system. Expansive learning is defined as "to learn something that is not yet there" (Engeström and Sannino, 2010, p. 2), meaning that a new activity is developed. The cycle of expansive learning is often used as a tool in formative interventions. Participants taking part in these formative interventions bring into the CLs experiences from their participation. The cycle of expansive learning works as a "development radar," used by practitioners and researchers to monitor and manage the various processes in the development project (Toiviainen et al., 2009, p. 515).

As already mentioned, CLs are defined as participatory data analysis workshops (Engeström et al., 1996). In the CLs, "Mirror data" is used as a tool for analysis in these workshops. Mirror data is data (observations, interviews and documents) the researcher collects and presents to the research participants (Cole and Engeström, 2007),

using this data as a mirror for the participants to help them understand the situation, and as a mirror of problems in their practice. A CL is a meeting place where participants can explore their own practice and develop it by analyzing disruptions, as well as designing innovative models of the analyses in the CL. It is also considered to be an effective method to both stimulate and study change, due to the conceptual tools that give the participants in these CLs a basis for analyzing, understanding and working for systemic change (Engeström, 1987; Engeström and Miettinen, 1999; Engeström and Kerosuo, 2007). CLs are designed to trigger expansive learning (Virkkunen and Newnham, 2013) and provide agency to the participants (Morselli and Sannino, 2021), thereby promoting the development of work practices by the practitioners themselves (Engeström et al., 1996). In addition, the CL method draws on other important terms such as agency and the zone of proximal development (Sannino, 2015). Transformative agency can be defined as "breaking away from the given frame of action and taking the initiative to transform it" (Virkkunen, 2006, p. 49). Agency can be seen as an expansive transition from individual drive to collaborative actions to achieve change and development. Interventions within CLs can facilitate this (Engeström, 2011).

Vygotsky's term "zone of proximal development" (Vygotsky and Cole, 1978), related to collective activity systems, can be defined as "the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively

generated as a solution to the double bind potentially embedded in everyday actions" (Engeström, 1987, p. 174). The concept of the "more knowledgeable other" is integrally related to the concept of zone of proximal development. According to Vygotsky (1978), important learning by the child takes place through social interaction with a more competent other. The more competent other can model behavior and give verbal instructions to the child as a supervisor. In the study, however, we consider the more competent other as someone who has a better understanding of CHAT then the student teachers.

Related research

During the last 10 years, several formative interventions have been conducted in school and teacher education (Ellis, 2008; Bal et al., 2014; Kramer, 2018; Thorgeirsdottir, 2019; Cenci et al., 2020; Augustsson, 2021; Yang, 2021; Diao et al., 2022). Participants have different experience from using the CL as an arena for analysis and change.

In Brazil, a formative intervention was conducted with Brazilian school teachers to develop strategies for their work with students with disabilities. Even though the participants felt that the formative intervention did not contribute to change, they felt that it helped to shed light on the problem and created an opportunity for future development (Cenci et al., 2020). In England, a formative intervention was carried out with the aim of reconfiguring the school-university partnership on a more collective level and developing a form of work that emphasized professional collaboration. Findings from this study indicated that the CL led to increased agency to the participants who practiced and exercised a formative intervention in teacher education and in schools (Ellis, 2008). Similar findings about increased agency appeared in other CL-interventions carried out in school and teacher education (Bronkhorst et al., 2013; Penuel, 2014; Thorgeirsdottir, 2019). Several studies indicate that the theoretical tools within CHAT stimulate an increased understanding of one's own practice in teacher education and school (Ellis, 2008; Rainio, 2008; Tunney and van Es, 2016; Thorgeirsdottir, 2019). The AS and the cycle of expansive learning contributed to the teachers themselves being able to understand tensions and gave a greater understanding of the teacher identity and agency for the teachers (Ellis, 2008). In addition, several studies framed by CHAT that use the CL as a method to construct a partially shared object show that the participants develop ownership (Ellis, 2008; Bronkhorst et al., 2013; Penuel, 2014; Thorgeirsdottir, 2019).

Teachers are typical participants in most of the CL-interventions carried out in schools and teacher education. It is difficult to find research on how student teachers experience participating in a project that is framed by CHAT. However, there are a few interventions who have been carried out concerning student teachers, which can be relevant to this study. A formative intervention conducted in Sweden had a one student representative, and this study examined the evolution of participants' collective transformative agency in a CL-intervention (Englund and Price, 2018). Other formative interventions who have been carried out in USA had just a few students, but not student teachers as participants. The aim of these studies was to address racial disproportionality in school (Bal et al., 2018; Ko et al., 2022).The LAB-TEd project seems to be one of the few interventions where student teachers participate in a project framed by CHAT (Jakhelln and Postholm, 2022).

Context of the study

This study concerns two cohorts of student teachers who participated in the project. Their main subject was either English, mathematics, science or physical education. Cohort 1 of the student teachers were in the third year of their five-year integrated master's degree in teacher education in 2019–2020, and cohort 2 in their third year in the 2020–2021 year, and thus in their 1. year in the project. Both cohorts participated in the interviews when they had almost completed their third year and their R&D thesis. Regarding the other partners in the project, the practice teachers and university teachers participated throughout the project.

In the project, the participants worked on the R&D thesis in addition to the work with the project's various goals. The participants met physically or digitally for CLs two times during each semester in a four-year period, each CL lasting 2–6h. In the CLs, the student teachers and the other participants used mirror data, the cycle of expansive learning and a network of activity systems (the third generation of CHAT) to analyze tensions and contradictions related to the work with the R&D thesis. The CLs were also used for planning the student teachers' work on their R&D project. For both universities, the topics for the first four CL's meetings conducted during the student teachers' first year in the project, were about tensions and contradictions related to guidance and writing processes in tasks that connect theory and practice. Assessment criteria and supervision of R&D thesis and development of models for supervision was also discussed. In addition, the participants met outside the CLs, for example for practice meetings and guidance.

The student teachers worked in both homogeneous and heterogeneous groups in the CLs, i.e., some CLs student teachers collaborated with other student teachers (homogeneous groups), while in other CLs, the student teachers collaborated with teacher educators in schools and universities (heterogeneous groups). The CLs were led by an intervention researcher, termed "IR" (Virkkunen and Newnham, 2013). In this study, the main focus was to investigate how student teachers experienced participation in a project grounded in CHAT when working on their R&D thesis. It will now be explained how we proceeded in terms of data collection and analysis.

Method and materials

A qualitative interview study (Kvale et al., 2015) was conducted to answer the research question. In this study, we considered focus group interviews to be an appropriate method because they would open up reflections and discussions between the informants (Ravitch and Carl, 2019). The study operated with two selection criteria. The student teachers who participated had completed the third year of their 5-year integrated master's degree in teacher education and participated in the project.

Altogether 34 student teachers participated in the project. The student teachers who took part in the study were both women and men aged 20–35. With this selection, the intention was to gain a broad, in-depth understanding of how student teachers experience participation in a project grounded in CHAT when working on their R&D thesis. An information letter was sent to the student teachers about the purpose of the study, data processing procedures and information about confidentiality. In addition, the student teachers were made aware that digital focus group interviews would

be conducted. The interview guide was sent to those who required it. No one chose to withdraw from the study.

Data collection

An interview guide was developed containing 17 open-ended questions (e.g., questions dealing with the student teachers' experience with the theoretical tools/models within CHAT, experience from taking part in CLs, their view on the significance of the theory and their experience from participating when working on their R&D thesis).

In the spring of 2021, eight focus group interviews were conducted by the first author, with three to six student teachers per group from both cohorts separately. The focus groups were created on the basis of to which university, school subject and cohort the student teachers belonged to. The interview guide was written in Norwegian, and conducted in Norwegian, which is the student teachers' mother tongue. The focus group interviews were conducted digitally via Zoom software, due to the coronavirus pandemic. The interviews had a duration of approximately 1 h and were recorded. The audio and video files were transcribed (150 pages) by a research assistant and the first author.

Quality and ethics

Member checks were performed to check the accuracy and resonance of the participants' experiences, thereby ensuring the credibility of the study (Lincoln and Guba, 1985; Merriam, 1994; Stake, 1995). In accordance with ethical guidelines, all research participants in the study were made anonymous and given fictitious names in the text (NESH, 2022).

The student teachers were informed both verbally and in writing before and after the study that participation in the study was voluntary and that they could withdraw from participation at any time. This is in line with the ethical guidelines (NESH, 2022).

Data analysis

The authors used the constant comparative analysis method to structure and analyze the data (Postholm, 2010, 2019; Creswell, 2013; Corbin and Strauss, 2015).The analysis started by structuring the data material with the use of open coding process. We searched for patterns, meaning and to develop a deeper understanding of the data material. We coded sentence by sentence, and paragraph by paragraph, of raw data of which the content was relevant and linked to the research focus. We did the coding work with pen and paper. The NVivo analysis program was used to search for several experience-related quotes in the data material after the first coding phase. Memos were also written for each interview we analyzed (Charmaz, 2014) and all quotes were translated from Norwegian into English. Table 1 illustrates how we proceeded in the first round of open coding of the data material.

After the first round of open coding, we continued the analyses of the data material by looking for similarities and differences in the various interviews. The second round of open coding resulted in the

main categories developed. In addition to open coding, we undertook axial coding of the data material to develop subcategories (Postholm, 2019). Table 2 illustrates how codes were developed into main categories and subcategories by asking when, how, in what way and under what conditions did this main category appear. The developed main categories form the structures for the presentation of findings. The findings in each main category are presented as a narrative that includes selected quotes (Riessman, 2008). The three main categories that were developed in this study are:

1. The reason for participation in the project.
2. The significance of the R&D thesis for the participants.
3. CHAT and the significance of the CLs for collective development work.

In the next paragraph the findings are presented by using the developed main categories as the structure for the presentation.

Findings

The reason for participation

The student teachers said that they primarily participated in order to gain access to better supervision and closer follow-up of the R&D thesis. The student teachers were initially individually oriented and focused on their own goal, which was to perform as well as possible on the thesis. The second issue that motivated the student teachers was their interest in learning more about research. The third aspect concerned the need to be able to deal with previous practice and the weak tripartite collaboration they had experienced earlier.

It is in the meeting between the university and the practice school that the R&D thesis is written. Tripartite collaboration did not exist previously, according to the student teachers. Earlier, the student teachers experienced themselves as a child of divorce or a communication link between the university and the practice schools. Lars described his previous experience as follows:

> (…) I have felt like an intermediator who gets information from the university. Then I will pass it on to the practice teacher, and then the practice teacher will give me information that I will take back to the university teacher. We feel a bit like a child of divorce listening to mum and dad arguing. I have felt that there has not been such great collaboration between the university and the practice teachers. But instead, both have used us as a third party to communicate for them.

The student teachers felt that the communication between the university and the school was weak and that they had to take care of the communication between the participants.

The significance of the R&D thesis for the participants

The student teachers had positive experience from the collaboration on the R&D thesis in the project. They felt that the meetings in the CLs strengthened the collaboration between student

TABLE 1 Examples of raw data and open coding.

Raw data	Open coding
Question 2. Why did you choose to participate in this research project? (Excerpts from focus group interviews from both cohorts)	
Nora: "I was just thinking more guidance, more meeting points and closer follow-up on the R&D thesis."	More guidance, closer follow-up, R&D thesis.
Ole: "I signed up for this research project because it felt important. Because like the experiences we have had with previous practice and the weak tripartite collaboration, it felt good to be part of changing that for those who come after, so that they do not have to have the same experience."	Previous practice, the opportunity to influence, trying to create change.
Lars: "I thought this was a positive project to be a part of, to see if you could make changes. We also knew that we would get more guidance, and yes, skilled supervisors. So at least that was something that motivated me to participate."	More guidance, influence, make changes, skilled supervisors.
Nadia: "Same here. For me, it was about the supervisors, that we could get even more help, or help to write the R&D thesis."	More help, more guidance, R&D thesis.
Lena: "For me it was exciting to be involved in contributing to research and extra guidance."	Contributing to research, more guidance.
Mari: "I wanted to learn more about research and R&D."	Learning more about research and R&D.
Ida: "More and better guidance on the R&D thesis was probably what interested me the most, I thought it would contribute to a better result on the R&D thesis."	Better guidance, R&D thesis, better result.

TABLE 2 Examples of the coding and categorization process (development of main categories and subcategories).

Open coding (step 1)	Main categories (step 2)	Subcategories (step 3)
1.1 Better and more guidance, more help, skilled supervisors, better results for the R&D thesis, close follow-up, a lot of benefits and strengthened supervision, object for the student.	(1) The reason for participation.	1.1 Individually oriented.
1.2 Contribute to development and research in teacher education, interesting to participate in research projects, want to understand more about research.		1.2 Engaged in research and development.
1.3 Reckoning with previous practice, the opportunity to influence, trying to create change, the opportunity to report existing practice experiences.		1.3 Opportunities to influence.

teachers, practice teachers and university teachers. The student teachers experienced the value of having a common object. Liv stated: "I think it has been very positive and helpful that everyone has had a little bit of the same object (…) that we are working on completing the R&D thesis." Peter said: "(…) I think the collaboration has been outstanding. We managed to get to the point that interested all of us." The student teachers emphasized the importance of all participants being equal. Good collaboration among the participants in the project was seen as crucial for good work on the R&D thesis, and for everyone's development: the university teachers, the practice teachers and the student teachers. The following statement from Simen confirmed that:

> (…) What do we student teachers put into the R&D thesis, what do we intend to achieve? What does the practice teacher think to achieve? What does the university teacher think to achieve? We sat together and talked, and then a lot of little things came out that I hadn't thought much about. That the practice teacher would like to have it (the thesis) practice-oriented, but the university teacher will often bring in theory and all that, and then the student teacher will try to combine both of those needs.

The student teachers stated that the work on the R&D thesis contributed to them becoming more development-oriented. The student teachers were also concerned that the R&D thesis should not just be a product that was produced and put in a drawer. They wanted the R&D thesis to contribute to development in schools. Sophie said:

> (…) It was very motivating that our R&D project had value in practice this school year. We also carried out projects in practice before we joined the project. I felt like all our experiences earlier in our practice were going to die with us, in a way. No one was really interested in what we were doing, and no one got anything out of our experiences, because our experiences were not taken further into the practice school's work.

The student teachers felt that what they did in their R&D project had value. Ole confirmed this in his statement:

> (…) that we could, in a way, become a resource for the school we were at, we talked about "what do you need?", what do you want to know more about, and what challenges do you have? The practice teachers were more included in the work with the R&D thesis and wanted to see the result of the R&D thesis. Yes, that was a good thing! Felt there was a purpose to doing the thesis. It wasn't just getting a grade.

The collaboration changed the student teachers' view of the R&D thesis from an individual-oriented goal to a more collective object. This is also claimed in Nadia's statement:

> (…) my experience of being part of the project has evolved from being individually motivated … to that, I now see and understand how participation can have an impact on something that is bigger than just me and my thesis.

The student teachers experienced increased ownership connected to the work when working on their R&D thesis. It gave them a good feeling of being able to be a resource for the practice school, as the R&D thesis gained value for the schools. A student teacher, Nora, also experienced that the work on the R&D thesis would be vital for her as a future teacher, in addition to having an impact on the school's development.

> It was a good R&D thesis. We have done systematic research over time, and I felt we learned a lot from it. And the findings we had, I felt they had an impact on our future, how we can conduct teaching, what works, and what doesn't work. That kind of research improves your practice. But also, we presented our findings to the practice school, and it may be that some of the other teachers got a little insight into what they can do. Important work in that sense. Which meant that the thesis … could be a resource for the school.

CHAT and the significance of the CLs for collective development work

The importance of CHAT as a theoretical framework

None of the student teachers were familiar with CHAT before joining the project. When the student teachers talked about CHAT, they highlighted the AS and the cycle of expansive learning, stating that these models were difficult to understand. Petter expressed this about the AS: "What exactly do those factors in the triangle mean? Mediating artifact like, it's so hard to understand, the language." Ida mentioned that the AS was messy and not so readable, while the majority pointed out that they did not have enough knowledge about the AS. The cycle of expansive learning was described by the majority of the student teachers as more understandable and easier to handle because of the simple and clear language of the model.

The student teachers experienced that the theory became more understandable and applicable to them when they worked with the theory with someone who knew the theory and guided the use of the models. As some pointed out: the understanding of the AS increased with help and guidance, but working alone with the theory did not make it understandable. Lena said:

> (…) I don't have enough knowledge about it. It works well when we have those meetings with the head of the project (IR), which kind of drives it forward then, and who has a lot of control. Because then you understand more, when you have someone who has such control, who kind of controls it, and who … uses these tools with you. Alone, I hadn't understood it.

There were different understandings of the usefulness of the AS and cycle of expansive learning. In the case of the AS, it was mainly understood as an essential tool for uncovering tensions between the various ASs. According to the student teachers, AS was also considered a useful tool to highlight the needs of the various groups of participants in the project. One of the student teachers pointed out that

understanding increased when visualizing the various ASs. Lars said: "… The triangles reveal, it was somehow revealed by these triangles that we had different understandings about things (…). When it was set up, it was very much revealed that we were not working towards the same object." According to the student teachers, AS was understood as an important tool for uncovering tensions. In addition, AS was understood as an important tool for bringing out the different perspectives between groups of participants, and for this reason AS was considered a fruitful tool to use at an early stage of a development project, to find a common object. Mari pointed out: (…) "It helped to use those triangles to find a common object in the project, and you kind of got an overview then."

By being represented with their "own" AS in the project, the student teachers experienced an increased sense of belonging and a greater sense of ownership of the research project. As Petter pointed out "I feel that it was useful that we got our own triangle and that we were perhaps more listened to." This was confirmed by Nora, who said: "You gained confidence and that we were an important part of the project. That it was sort of not just us who were being researched, in a way, but that we were active participants."

When it comes to the cycle of expansive learning, the student teachers felt that the model was useful because it visualized where we collectively were and all wanted to be in the project, according to themselves. They perceived it as a clear model that described the various phases of the development work. Pål stated this about cycle of expansive learning:

> (…) We had a situation that was now, a situation you wanted, then it was like "how can we start getting there?" And it made a lot of sense for me to think like that, at least ….

Some student teachers claimed that they saw the value of being able to use either the AS or the cycle of expansive learning, or both, in a future teacher role and development work in schools.

The importance of CLs

Concerning the student teachers' experience from participating in CLs, they found it scary to participate at the start of the project. The student teachers felt that they had the lowest position in the hierarchy in the tripartite collaboration, and for several reasons. One was related to how student teachers were scared to collaborate with practice teachers and university teachers who, at a later stage, would assess the work of the student teachers. Lars said:

> (…) At the first CL, I was very careful and thought that I would not make a bad impression on the practice teacher … And there is also the power relationship with them being involved in judging me as to whether I am suitable as a teacher or not. But the feeling really disappeared quite quickly.

Another reason why the student teachers experienced the CLs as a scary arena at the start of the project was that the student teachers felt that they had the least knowledge in the project. As Brynjar said: "That the others had the most knowledge perhaps and felt like they then had the most power. Since we knew so little, it was very much like that." Similar to the previous statement, this student teacher Liv also pointed out that it was scary at the start: "It was really scary at the

beginning. But as I said, we quickly felt that we were there for a reason and that we were important."

The student teachers felt that they were the little ones, a feeling that arose at an early stage of the project, but there was a change after a while, and gradually they experienced themselves as a more equal partner. There were several reasons that contributed to this:

The student teachers felt that good leadership was a contributing element in increasing participation in the CLs. A variation in the composition of groups in CLs was seen as a fruitful way to increase understanding of the theory and strengthen student teachers' voices. That is, varied by using homogeneous and heterogeneous groups. Pete said:

> I also think it has been … the use of these homogeneous group divisions and the different group divisions has helped a lot … just we the student teachers could discuss together, but also discuss with both the practice teachers and the university teachers.

The student teachers perceived that they became active participants and that they were given a voice. When they were represented in their own AS, they felt as though they were an equal part of the project. Nora stated: "(…) I feel that it was useful that we got our own triangle and that we were perhaps more listened to." The student teachers gradually felt safe and experienced mutual respect from the other participants, and their voices were valued and listened to. As Lars pointed out: "(…) I felt the hierarchy disappeared quite quickly." Ida also mentioned this:

> (…) It was very nice to feel that they were somehow interested in hearing how we experienced writing an R&D thesis, and how we experienced the collaboration with the school, and … not least, the university teachers and the practice teachers were also interested in hearing.

According to the student teachers, their possibility to be active participants in the CLs became important to their feeling of being an equal partner. At first, everything seemed distant, most of them stated, but gradually the student teachers felt that they could contribute to the project. Ida stated: "(…) We contribute our inside perspective, which is why we are an important contributor to the project." Another student teacher also pointed this out: "(…) When I now work on the R&D thesis, I feel that we have a lot to contribute as well. And the more we can contribute, the more equal we feel.

The student teachers experienced mastery and a sense of ownership in the discussions taking place in the CLs. They felt like an equal partner in the community and had become more comfortable with the theory and could contribute to the project. As one student said: "(…) as I understood more of this theory, it became more comfortable to participate, it gave me a sense of mastery to be able to contribute to the discussion."

Discussion

From a communication link to an actual participant in tripartite collaboration

The tripartite cooperation was described as non-existent by student teachers early in this study. They described how they experienced poor communication and a lack of understanding among themselves, practice teachers and university teachers, and how they had to be the communication link between university and school.

In the project, over time, the student teachers experienced strengthened tripartite collaboration and it became fruitful for all the participants. The study shows that the CLs helped to develop the collaboration into something better. The CLs became an arena where the different participants met, and where they could communicate and get to know each other better, and an arena that helped stimulate change and development. This is also the intention of the formative intervention methodology, where the CL is a common meeting place between several ASs (Engeström and Toiviainen, 2011) and where the participants use tools such as the AS and the cycle of expansive learning to analyze the existing practice as a starting point for development (Engeström et al., 1996).

The study shows that using the ASs as a visualization of and reflection of the participants' different perspectives in the CLs contributed to their increased understanding of each other's points of view and needs. For example, when the ASs was used to determine what the content of an R&D thesis should be, it emerged that the participants had different thoughts related to the thesis. In the course of the dialogs that unfolded related to the work with the R&D thesis, the study shows that the student teachers gradually felt that everyone was working towards a partially shared "object" (Engeström, 1999), which was to design and undertake an R&D thesis that made sense for everyone. Several studies show that applying the AS as an analysis tool in a CL contributes to an increased understanding of one's own practice (Ellis, 2008; Rainio, 2008; Tunney and van Es, 2016; Thorgeirsdottir, 2019). The study shows that, in addition to an increased understanding of one's own practice, an increased understanding is gained of the other people's practice when the participants use the AS in homogenous and heterogenous groups in CLs.

From self-interest to a collective understanding

The student teachers took an individually oriented approach to the project in the beginning. They highlighted their self-interest as the driving force for participation. Everyone participated in the project because they wanted to perform as well as possible on the R&D thesis, and they considered participation to be a golden opportunity to achieve the necessary help. The "object" is the overall goal and constitute the collective motive of the activity (Engeström, 1999), and for the student teachers the object was to submit the best possible R&D thesis. Nevertheless, the object and the student teachers' perception of the importance of the R&D thesis changed. The study highlights two aspects that contributed to this development and which, in combination, contributed to student teachers changing their own object. One aspect was related to the organization of the CLs. In some CLs, heterogeneous groups were used, and at other times, homogeneous groups, or a combination of these groupings. The second aspect was related to using AS as a tool to analyze one's own practice (Engeström, 1987). In the CLs the AS was used to analyze and articulate existing practices in homogeneous groups, before visualizing and engaging in dialog about the various practices in heterogeneous groups at a later stage. This contributed to the student teachers moving

from an individual and egocentric understanding of the development of the R&D thesis to a more collective understanding.

Based on the dialogs in CLs, the student teachers gained an understanding of the other participants' points of view, which contributed to an increased understanding of the R&D thesis and what it could mean, as well as changing their own goals. For example, the student teachers gained increased insight into the challenges faced by the practice schools when the AS was used as an analytical tool. As one of the student teachers said: "The triangles reveal!" The student teachers' object was no longer solely to achieve the best possible result for the R&D thesis. The thesis should not just be left in a drawer but stimulate development and change in the school. The thesis should provide value for the practice schools. By using the AS as a unit of analysis, the participants in the project gained an overview that made them collectively oriented in their work, so they wanted to work towards a partially shared object. Several studies show that the AS can stimulate an increased understanding of one's own practice in teacher education and school (Ellis, 2008; Rainio, 2008; Tunney and van Es, 2016; Thorgeirsdottir, 2019).

The study showed that the use of heterogeneous groups combined with use of the AS as a tool in CLs contributed to the student teachers' object developing from being individually-oriented to becoming more collectively oriented, as also described by Engeström in his definition of the collective zone of proximal development (1999). The result of working in heterogeneous groups in the CLs, and the visualization of the participants' points of view in the analysis of the AS, contributed to them getting to know each other and gaining an understanding of each other's needs. This affected the student teachers' agency, and their agency could be seen as an expansive transition from individual drive to collaborative actions, to achieve change and development, which the CLs facilitated.

From voiceless participants to more equal and active agents in the project

Based on the first experiences in the project, the student teachers experienced participation in the project as hierarchical. The student teachers characterized themselves as "the little ones," the lowest rung on the hierarchy ladder and those with the least knowledge. They also found it a challenge to have to collaborate with those who assessed their work. The student teachers found tensions between the ASs (Figure 1, p. 3), specifically in the factor division of labor. Sannino and Engeström (2010) characterize this type of contradiction as "quaternary contradictions." In the factor division of labor in the network of the ASs, tensions such as power, hierarchy, role position and different knowledge of the theory emerged early in the research project.

According to Engeström and Miettinen (1999), tensions both within and between ASs can serve as the starting point for change and development, when tensions or contradictions are resolved. The study shows that the "quaternary contradictions" (Engeström and Sannino, 2010) related to the factor division of labor across the ASs gradually disappeared. The student teachers' experience of feeling like "the little ones" changed during the year into an experience of being a significant and more equal partner in the tripartite collaboration. The study shows that several aspects influenced the perceived change. The first aspect is related to the system of activity and its impact (Engeström,

1987). The student teachers felt that the hierarchy was reduced and the sense of ownership of the project increased when they experienced that they were represented by their own AS. The student teachers said that they became active participants and that they were given a voice because they owned an AS. Visualizing the student teacher's perspective in an AS also contributed to increased equality between the participants and to the student teachers' sense of ownership. When the student teachers, like the other participants in the project, were represented in an AS, the student teachers perceived that they had their own voice. The student teachers felt they were essential to the research project, in the collaboration between the groups of participants in the project (Jakhelln and Postholm, 2022). They developed an agency that involved an ability and willingness to influence their behavior and surroundings (Sannino, 2015).

The CL is designed to promote the development of work practices by the practitioners themselves (Engeström et al., 1996) and the study shows that there was a clear connection between a sense of ownership in the research project and the perception of being able to contribute to the research project. As pointed out earlier, this was a tension that student teachers experienced early in the research project. The student teachers had insufficient knowledge of CHAT, which was the theoretical and methodological framework of the research project. This meant that several of the student teachers felt small in the CLs, because they did not fully understand how they could contribute without knowledge of the theory and the prevailing models such as the AS and the cycle of expansive learning. This understanding of the theory was developed and tensions between the factor division of labor in the network of ASs (Figure 1) were reduced over time.

One reason for this related to the fact that the student teachers had, after all, important experiences from practice that they brought into the collaboration. Another reason was that the student teachers experienced an increased understanding of the theory when it was applied together with other participants in the project. Especially in CLs with the use of heterogeneous groups, student teachers felt that they received the help they needed to understand and apply the theory and to contribute more strongly in the CLs. This was when the groups were divided, so that the student teachers came into contact with the more "competent others" (Vygotsky and Cole, 1978). Use of heterogeneous groups in the project and the student teachers' increased awareness that their experiences are valuable for the project led to increased sense of ownership and ability to gain agency for the student teachers. This led to the student teachers being able to break away from the given frame of action and take the initiative to transform it (Virkkunen, 2006, p. 49). Other studies have also found that the CLs can help increase participants' agency and their sense of ownership. The power of research participants is vital to achieving development (Bronkhorst et al., 2013). Therefore, all groups of participants in a CL should be recognized and develop their possibility to act. If this does not happen, this could limit the importance of the CLs in promoting equal collaboration and development. The collaboration should be of such a nature that everyone should contribute in a joint dialog. The student teachers in the study gained agency by being represented by their own AS, and the student teachers gained increased agency because they gradually developed their understanding of the theory and the theoretical models used in the CLs. These two aspects contributed to student teachers changing from voiceless participants to more equal and active agents.

Conclusion

The problem formulated for the study was the following: how do student teachers experience the participation in a project grounded in CHAT when working on the R&D thesis? Several student teachers experienced their participation in the project as a development journey. The first stage of the journey touched on the lack of communication the student teachers had experienced in previous practice. In many ways they were the link in the communication between the university and practice. This changed and the collaboration was strengthened because the groups of participants in the project met inside and outside the CLs during the year. Not only was there more frequent contact between the participants, physically and digitally, but they also experienced that they got to know each other better and gained insight into each other's different needs. The use of the AS in homogeneous and heterogeneous groups in the CLs became an essential arena for resolving tensions and contradictions. This resulted in the student teachers going from being a communication link to actual participants in the tripartite collaboration.

The second stage of the journey concerned how the student teachers entered the research project mainly on the basis of their own self-interest. They considered their participation as a golden opportunity to obtain the necessary help. This changed to the student teachers gradually seeing the work on the R&D thesis as something greater than themselves. The thesis should not just be left in a drawer but should impact development and change at the school and be useful for the practice schools. This was a result of working in heterogeneous tripartite groups in the CLs. Visualization of the participants' points of view in the analysis of the AS helped the participants to get to know each other and understand each other's needs. This meant that the student teachers gained an overview that made them collectively oriented in their work, so that they wanted to work towards a partially shared object. They entered the project with a self-interest and gradually experienced an increased collective understanding.

The third stage in the student teachers' perceived development affected their entry into the project and their contribution throughout the work with the R&D thesis. They experienced the CLs as a hierarchy and themselves as the lowest rung on the ladder. This changed with time, and the sense of ownership were the main reasons for this change. Over time, the student teachers perceived themselves as a significant and more equal partner in the tripartite collaboration. The student teachers increased their ability to act by being represented by their own AS, and gradually developed their understanding of the theory and theoretical models used in the CLs. This development contributed to the student teachers changing from voiceless participants to more equal and active agents in project. One can say that the theory impacted the development work in the CLs. This collaboration resulted in strengthened collaboration between the groups of participants, greater understanding between the participants, increased understanding of CHAT and its theoretical models and, not least, the collaboration contributed to an R&D thesis that is useful for real life in the school.

There is a gap in the literature about student teachers' involvement in R&D research, and there is lacking research about how participants experience participating in CL-interventions in school and teacher education. This article can contribute to closing these gaps in the research literature because this study illustrated how student teachers could be involved in tripartite collaboration and how they could be equal and active agents in research and development work grounded in CHAT. However, the findings of this study must be viewed considering two limitations. First, this was a qualitative study, and the small sample size limits inferences and generalizations drawn from this study. Secondly, the study was based on interviews and dependent on the student teachers' narration of their experiences. The study includes just one the groups who participated in the project. In future studies, it will therefore be appropriate to investigate all participants who attends CLs and include other approaches to data collection, such as observations in addition to interviews, to gain a more nuanced understanding of how the participants experience to participate in a R&D project that uses CLs as an arena for change and development. This study may hopefully inspire teachers and researchers to consider the topic for further research with a larger sample both in similar and different contexts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Norwegian Center for Research Data. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SB developed the research idea, conducted data collection, analysis, and wrote the first draft of the manuscript and revised all parts of the manuscript. RJ assisted with the data analysis, and wrote the introduction section of the article and provided feedback and comments on all versions of the manuscript. MP assisted with the data analysis, and wrote a part of the section theoretical framework and provided feedback and comments on all versions of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Augustsson, D. (2021). Expansive learning in a change laboratory intervention for teachers. *J. Educ. Chang.* 22, 475–499. doi: 10.1007/s10833-020-09404-0

Bal, A., Afacan, K., and Cakir, H. I. (2018). Culturally responsive school discipline: implementing learning lab at a high School for Systemic Transformation. *Am. Educ. Res. J.* 55, 1007–1050. doi: 10.3102/0002831218768796

Bal, A., Kozleski, E. B., Schrader, E. M., Rodriguez, E. M., and Pelton, S. (2014). Systemic transformation from the ground-up: using learning lab to design culturally responsive Schoolwide positive behavioral supports. *Remedial Spec. Educ.* 35, 327–339. doi: 10.1177/0741932514536995

Bronkhorst, L. H., Meijer, P. C., Koster, B., Akkerman, S. F., and Vermunt, J. D. (2013). Consequential research designs in research on teacher education. *Teach. Teach. Educ.* 33, 90–99. doi: 10.1016/j.tate.2013.02.007

Cenci, A., Lemos, M. F., Bôas, D. F. V., Damiani, M. F., and Engeström, Y. (2020). The contradictions within inclusion in Brazil. *Learn. Cult. Soc. Interact.* 24:100375. doi: 10.1016/j.lcsi.2019.100375

Charmaz, K. (2014). *Constructing Grounded Theory*. London: Sage.

Cole, M. (1998). *Cultural Psychology: A Once and Future Discipline*. Cambridge: Mass. Harvard University Press.

Cole, M., and Engeström, Y. (1993). A cultural-historical approach to distributed cognition: Distributed cognitions: Psychological and educational considerations. G. Salomon. Saloman G. Cambridge: Cambridge University Press, 1–46.

Cole, M., and Engeström, Y. (2007). "Cultural-historical approaches to designing for development" in *The Cambridge Handbook of Sociocultural Psychology*. eds. A. Rosa and J. Valsiner (Cambridge: Cambridge University Press), 484–507.

Corbin, J. M., and Strauss, A. L. (2015). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks, Calif: Sage.

Creswell, J. W. (2013). *Qualitative Inquiry & Research Design: Choosing Among Five Approaches*. Los Angeles: Sage.

Diao, C. T., Zhou, X., Mao, Q. M., and Hong, J. Z. (2022). The development of transformative Agency of Teachers in teaching research activities in China. *Front. Psychol.* 12:724175. doi: 10.3389/fpsyg.2021.724175

Ellis, V. (2008). Exploring the contradictions in learning to teach: the potential of developmental work research. *Chang. Engl.* 15, 53–63. doi: 10.1080/13586840701825295

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.

Engeström, Y. (1999). Activity theory and individual and social transformation. *Perspect. Activity Theor.* 19, 19–30. doi: 10.1017/CBO9780511812774.003

Engeström, Y. (2001). Expansive learning at work: toward an activity theoretical reconceptualization. *J. Educ. Work.* 14, 133–156. doi: 10.1080/13639080020028747

Engeström, Y. (2011). From design experiments to formative interventions. *Theory Psychol.* 21, 598–628. doi: 10.1177/0959354311419252

Engeström, Y. (2015). *Learning by Expanding*. Cambridge: Cambridge University Press.

Engeström, Y., and Kerosuo, H. (2007). From workplace learning to inter-organizational learning and back: the contribution of activity theory. *J. Work. Learn.* 19, 336–342. doi: 10.1108/13665620710777084

Engeström, Y., and Miettinen, R. (1999). "Introduction" in *Perspectives on Activity Theory*. eds. R.-L. Punamäki, R. Miettinen and Y. Engeström (Cambridge: Cambridge University Press), 1–16.

Engeström, Y., and Sannino, A. (2010). Studies of expansive learning: foundations, findings and future challenges. *Educ. Res. Rev.* 5, 1–24. doi: 10.1016/j.edurev.2009.12.002

Engeström, Y., and Toiviainen, H. (2011). "Co-configurational design of learning instrumentalities: an activity-theoretical perspective" in *Learning Across Sites: New Tools, Infrastructures and Practices*, eds S. R. Ludvigsen, R. Säljö, I. Rasmussen, and A. Lund (Abington: Routledge), 33–52.

Engeström, Y., Virkkunen, J., Helle, M., Pihlaja, J., and Poikela, R. (1996). The change laboratory as a tool for transforming work. *Lifelong Learn. Eur.* 1, 10–17.

Englund, C., and Price, L. (2018). Facilitating agency: the change laboratory as an intervention for collaborative sustainable development in higher education. *Int. J. Acad. Dev.* 23, 192–205. doi: 10.1080/1360144x.2018.1478837

Forskningsetiske Retningslinjer for Samfunnsvitenskap, J.O.H.O.N.N.C.f.R.E. (2022). NESH. 2022. Forskningsetiske Retningslinjer for Samfunnsvitenskap, jus Og Humaniora

Oslo: Norwegian National Committees for research ethics. [online]. Available: https://www.forskningsetikk.no/ (Accessed 2022).

Jakhelln, R., and Postholm, M. B. (2022). University–school collaboration as an arena for community-building in teacher education. *Educ. Res.* 64, 457–472. doi: 10.1080/00131881.2022.2071750

Ko, D., Bal, A., Bear, A. B., Orie, L., and Mawene, D. (2022). Indigenous learning lab as prefigurative political action to dismantle settler-colonial system of exclusion. *Int. J. Incl. Educ.*, 1–20. doi: 10.1080/13603116.2022.2119488

Kramer, M. (2018). Promoting teachers' agency: reflective practice as transformative disposition. *Reflective Pract.* 19, 211–224. doi: 10.1080/14623943.2018.1437405

Kvale, S., Brinkmann, S., Anderssen, T.M., and Rygge, J. (2015). *Det kvalitative forskningsintervju*. Oslo: Gyldendal akademisk.

Lincoln, Y. S., and Guba, E. G. (1985). *Naturalistic Inquiry*. Beverly Hills, CA: Sage.

Merriam, S.B. (1994). Fallstudien som forskningsmetod. Lund: Studentlitteratur.

Ministry of Education (2016a) in *Forskrift om Rammeplan for Grunnskolelærerutdanning for Trinn 1–7 [Regulation for the Framework Plan for Primary School 1–7]*. ed. M. O. Education (Oslo).

Ministry of Education (2016b) in *Forskrift om Rammeplan for Grunnskolelærerutdanning for Trinn 5–10 [Regulation for the Framework Plan for Primary School/Lower Secondary School 5–10]*. ed. M. O. Education (Oslo: Ministry of Education).

Morselli, D., and Sannino, A. (2021). Testing the model of double stimulation in a change laboratory. *Teach. Teach. Educ.* 97:103224. doi: 10.1016/j.tate.2020.103224

National Committee for Research Ethics in the Social Sciences and the Humanities (NESH). (2022). Available at: https://www.forskningsetikk.no/en/guidelines/social-sciences-humanities-law-and-theology/guidelines-for-research-ethics-in-the-social-sciences-humanities-law-and-theology/ (Accessed November 15, 2022).

Penuel, W. R. (2014). Emerging forms of formative intervention research in Education. *Mind Cult. Act.* 21, 97–117. doi: 10.1080/10749039.2014.884137

Postholm, M.B. (2010). *Kvalitativ Metode: En Innføring Med Fokus på Fenomenologi, Etnografi og Kasusstudier*. Oslo: Universitetsforl.

Postholm, M.B. (2019). "*Research and Development in School: Grounded in Cultural Historical Activity Theory*". Leiden Boston: Brill|Sense.

Rainio, A. (2008). Developing the classroom as a figured world. *J. Educ. Chang.* 9, 357–364. doi: 10.1007/s10833-008-9083-9

Ravitch, S. M., and Carl, N. M. (2019). *Qualitative Research: Bridging the Conceptual, Theoretical, and Methodological*. Thousand Oaks, CA: Sage Publications.

Riessman, C. K. (2008). *Narrative Methods for the Human Sciences*. Los Angeles: Sage.

Sannino, A. (2015). The principle of double stimulation: a path to volitional action. *Learn. Cult. Soc. Interact.* 6, 1–15. doi: 10.1016/j.lcsi.2015.01.001

Stake, R. E. (1995). *The Art of Case Study research*. Thousand Oaks, CA: Sage.

Thorgeirsdottir, H. (2019). The change room promotes teachers' agency to change their practice. *Educ. Action Res.* 27, 248–268. doi: 10.1080/09650792.2018.1436080

Toiviainen, H., Kerosuo, H., and Syrjälä, T. (2009). "Development radar": the co-configuration of a tool in a learning network. *J. Work. Learn.* 21, 509–524. doi: 10.1108/13665620910985513

Tunney, J. W., and van Es, E. A. (2016). Using video for teacher-educator professional development. *New Educ.* 12, 105–127. doi: 10.1080/1547688X.2015.1113348

Virkkunen, J. (2006). Dilemmas in building shared transformative agency. *Activités* 03, 43–66. doi: 10.4000/activites.1850

Virkkunen, J., and Newnham, D.S. (2013). *The Change Laboratory: A Tool for Collaborative Development of Work and Education*. Rotterdam: Sense Publishers.

Vygotsky, L. S., and Cole, M. (1978). *Mind in Society: Development of Higher Psychological Processes*. Cambridge: Harvard University Press.

Yang, H. (2021). Epistemic agency, a double-stimulation, and video-based learning: a formative intervention study in language teacher education. *System* 96:102401. doi: 10.1016/j.system.2020.102401

Zeichner, K., Payne, K. A., and Brayko, K. (2015). Democratizing teacher Education. *J. Teach. Educ.* 66, 122–135. doi: 10.1177/0022487114560908