Students' Framing of a Reading Annotation Tool in the Context of Research-Based Teaching

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ABSTRACT
In the studied master's course, students participated both as research objects in a digital annotation experiment and as critical investigators of this technology in their semester projects. The students' role paralleled the researcher's role, opening an opportunity for researcher–student co-learning within what is often referred to as research-based teaching. Drawing on a sociocultural approach, this article reports on how this setting may affect students' framing (Goffman, 1974). It compares students' framing of the tool used during the digital annotation experiment (Case 1) with students' framing of the tool when investigating the technology in their semester projects (Case 2). The study shows that students' framing of the tool and researcher–student collaborative inquiries were principally different in the two cases. Case 1 mostly adapted the original framing of the tool (*tool perspective*), whereas Case 2 challenged this framing (*tool inquiry perspective*). The exploration of these two foci provides a better understanding of students' epistemological, social, and affective framing under varying contexts and the consequences these have for their tool inquiries.
Keywords: Framing, activation of contextual resources, annotation technology, research-based teaching, co-learning.

INTRODUCTION

Digital annotation tools are an emerging educational technology, but they have not yet been extensively used and examined in education (Novak, Razzouk, & Johnson, 2012). The purpose of this study is to explore students' use of what is commonly referred to as annotation software/technology (Novak et al., 2012; Ovsiannikov, Arbib, & McNeill, 1999; Wolfe, 2002) within the setting of *research-based teaching* (Healey, 2005). The research-based teaching context has several potential advantages: it brings attention to the knowledge construction, here, the construction of the tool as opposed to merely its use; it involves students more as co-learners/co-constructers of knowledge and draws more actively on their experiences; and it can increase the pace and quality of the proof of concept testing (Griffiths, 2004; Heron, Baker, & Mcewen, 2006).

The basic principle for annotation software is to add data to other data. The researcher argues that to varying degrees, studies of this type of technology have tended to treat it as a *ready-made* resource simply *passed on* to the students instead of as being *in-the-making* and *co-constructed* between researcher/teacher and student (Latour, 1987). A minority of the studies problematize how this technology is constructed through its use (Arnseth & Säljö, 2007; Ludvigsen, 2012; Ludvigsen & Mørch, 2003), but not as a process of co-construction where the students take a more active position as co-learners. This prevents the experience of using the tool from becoming a richer learning experience, for example, where students learn to reflect on how the tool mediates their learning (Wertsch, 1991).

This article is based on a study of a master's course in technology-enhanced learning in Norway that attempted to build on principles of research-based teaching. The goal of the article is twofold: first, to provide a brief review of the educational use of annotation technologies in order to get a better sense of what roles this technology may play as well as list current challenges and opportunities to address in future research. The second goal is to explore researcher–student co-learning by describing students' framing of the particular annotation tool. *Framing* refers to how certain aspects of reality take precedence in individuals' perceptions and in groups' collaboration and communication as well as the social mechanisms involved in these processes (Goffman, 1974; van de Sande & Greeno, 2012). To help explore the participants' framing, the contextual resources they rely on (Linell, 1998), and how they activate these resources (van de Sande & Greeno, 2012), a sociocultural approach (Rasmussen & Ludvigsen, 2010; Wertsch, 1991) will guide the study.

The two research questions are as follows:

1. What is the educational role of annotation technologies, and what are the current challenges that require further research?

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This question provides context for the focus of the research and the teaching in the research-based teaching and hence a potential context for the framing of the technology addressed in the second research question:

2. What characterizes the participants' framing of the technology?

The second section begins by elaborating the concept "research-based teaching." The third section addresses research on framing and the current study's theoretical position. The two following sections contain a case description (the fourth section) and the methodology (the fifth section). The sixth section examines related technologies and provide answers to the first research question. The seventh section presents findings in relation to the second research question. The eight section summarizes the findings by comparing participants' framing in two cases, and the ninth section provides conclusions and suggestions for further research.

RESEARCH-BASED TEACHING

The master's course had a strong focus on research as part of the teaching and learning processes, and the experiment tried to adapt to this focus, i.e. the research–teaching nexus. One of the most common perception of the research–teaching nexus is that the research findings are integrated into lecture courses; hence, the research influences the subject knowledge students learn. This is, however, a very restricted way of seeing this nexus. Students may, for instance, do the following:

> learn about research methods and techniques; they may undertake their own projects…; they may assist staff with their research; and they may gain experience of applied research and consultancy through work-based learning… Staff may model research-based approaches in the way they teach, through, for example, adopting an inquiry-based learning approach. (Healey, 2005, p. 2)

A related matter concerns the direction of the relationship between research and teaching. Conventionally, this relationship has mainly been perceived as unidirectional, from research to teaching; however, this relationship can benefit from adopting a more reciprocal, two-way approach (Griffiths, 2004) in a manner of *co-learning* between teacher and student (Heron et al., 2006):

> Students can provide immediate feedback on research ideas and research findings which, while not informed by the expertise of academic peers, can nevertheless help to identify flaws in the analysis, as well as provide reassurance and motivation. …student learning activity can itself be a source of research materials, especially when this activity is 'research-based' or 'inquiry-based'. Student projects can, for example, help to test the analytical frameworks that academic staff are developing, or provide the beginnings of comparative studies that can later be pursued more systematically. (Griffiths, 2004, p. 722)

The experiment drew on Healey's (2005) distinction (cf. also Griffith's (2004)) between four different ways of perceiving the research–teaching nexus (cf. Figure 1). These distinctions imply different views of teacher/researcher–student collaboration and different research foci.

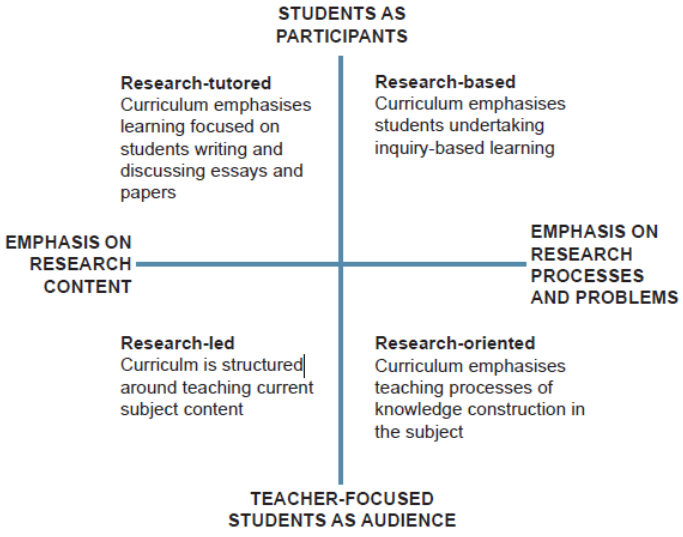


Figure 1. Curriculum design and the research–teaching nexus (Healey, 2005, p. 70).

Traditionally, most teaching has fallen under research-led in the bottom left quadrant, but few curricula taken as a whole fit entirely in one quadrant (Healey, 2005). School reforms over the last couple of decades have called

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for a much stronger focus on the research process (cf. research-oriented, bottom right quadrant) but also to combine the former with students' active involvement, in other words, more student-centered approaches (research-tutored and research-based, the two upper quadrants). Inquiry-based learning is particularly highly regarded in this context: "research-based learning structured around inquiry is one of the most effective ways for students to benefit from the research that occurs in departments" (Healey, 2005, p. 8). A concern in the experiment was to increase the focus on research processes and problems and enroll students more as participants/co-learners/co-researchers.

THEORY

A sociocultural approach to framing

The researcher's use of the framing perspective will be grounded in a sociocultural approach. The sociocultural approach perceives learning as a social process that is situated in a particular social, historical, cultural and institutional context and mediated by language and by material artifacts deriving from this context (Vygotsky, 1978; Wertsch, 1991). Whereas the focus on framing in the cognitive sciences has been concerned with individuals' cognitive structures and processes (Minsky, 1974; Rumelhart & Ortony, 1976), the sociocultural approach relates framing to the social structures mediating interlocutors' framing, and seeks to understand these structures (Strømme & Ludvigsen, in review; van de Sande & Greeno, 2012).

Framing

The framing perspective draws on multidisciplinary research, which includes anthropology (Bateson, 1972), sociology (Goffman, 1974), sociolinguistics (Tannen, 1993), media and communication (Entman, 1993), and cognitive science (Rumelhart & Ortony, 1976), among others.

Four essential characteristics of frames emphasized in the sociocultural approach are as follows: Frames are associated with *salience*. A central focus adapted in the learning science has been to try to understand how humans individually and in collaboration try to understand and communicate "What is it that's going on here?" (Goffman, 1974, p. 8), "What is expected in this situation" etc. A second property of frames are *selection*, or phrased as a question, "How does something become salient?" This directs attention to the social act of the *selection*/*construction* of what is regarded as salient and as non-salient. Framing naturally involves two parallel processes, *inclusion* and *exclusion* (Bateson, 1972), both of which are crucial for understanding learning. A third property is the *logic* frames impose, or in question form: "What are the functions/consequences of salience?" These functions or logic can, for instance, be a structure for further thoughts, actions, judgments, or sentiments, e.g.:

> To frame is to *select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation* for the item described. (Entman, 1993, p. 52)

A fourth property is frames' reliance on *social and contextual resources that mediate the framing*. This implies that frames also need to be studied through the logic these resources and contexts provide, in other words, the sociocultural history of the mediating resources.

The perspective of this study is that framing involves a process of *activating latent resources*, and it is necessary to find analytical concepts that can explore this process, for example, how resources are made relevant and become activated or not, including contributing factors and obstacles. In his outline of a theory of context, Linell emphasized that instead of stable, objective contexts, we have "*contextual resources*, potential contexts that can be made into actual, relevant contexts through the activities of the interlocutors in the dialogue" (1998, p. 128). Similarly, Hammer, Elby, Scherr, and Redish (2005) criticize the view of knowledge as an intact cognitive unit/structure that can be transferred from one context to another. Instead, they suggested that we need to focus on *activation of resources* and how multiple aspects of framing interact in this activation process, for example, *epistemological framing* (participants' views about the nature of knowledge and learning), *social framing* (participants' expectations of how to act), and *affective framing* (participants' feelings toward the situation). The social and epistemological framing need further elaboration; here, this study draws on van de Sande and Greeno (2012). *Epistemological framing* refers to:

> the participants' understanding of kinds of knowledge that are relevant for use in their activity and the kinds of knowledge, understanding, and information they need to construct to succeed in their activity (e.g., what kind of information would count as a solution to the problem they are working on). (p. 2)

Social framing, which van de Sande and Greeno (2012) called *positional framing*, refers to:

> the way in which participants understand themselves and one another to be related to one another in the interaction, especially regarding the kinds of contributions each of them is entitled, expected, and perhaps obligated to make in the group's activity (2012, p. 2).

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The aspect of social framing they emphasized is how social accomplishments are achieved through taking positions, which they extend by two analytical foci: *source* and *listener*. A *source* is a provider of information (human or nonhuman), which some participants lack in order to construct and reach a mutual understanding. A *listener* is the human participant inquiring into the information. A related term to social and positional framing used in later discussion is *participation structure*.

Double framing

Double framing is the presence of two or more frames. All four emphasized characteristics of frames—*salience*, *selection*, *logic*, and *mediation*—are affected by double framing. When trying to analyze the activation of latent resources, the interrelation between resources that different frames draw from becomes a relevant concern. Resources might be compatible but also incompatible, competing, conflicting, etc. (Hetland, 1996), i.e. they might involve tensions that make some recourses less likely to co-occur. Double framing can therefore impose ambiguities that obscure the latent resources and the activation processes. It is important to draw attention to different types and levels of conflict between frames and how this affects further (re)framing. The study differentiates between two double framing and (re)framing situations—*rekeying* and *breaking frame*:

> The distinction between breaking frame and re-keying are that somehow the existential grounding of meaning is retained in the re-keying, and 'normal' heuristics are used to sort out the uncertainties and options associated with the possible outcomes. (Manning & Hawkins, p. 221)

Rekeying can be solved within the existing frame(s); it does not necessitate a reframing. *Breaking frame*, on the other hand, implies a more fundamental disruption/reframing where the logic of the former frame(s) is/are shattered.

CASE DESCRIPTION

The experiment entailed students in groups of two analyzing an assigned research article from their curriculum through the help of different categories, which they used to categorize the content in the article (cf. Figure 2).

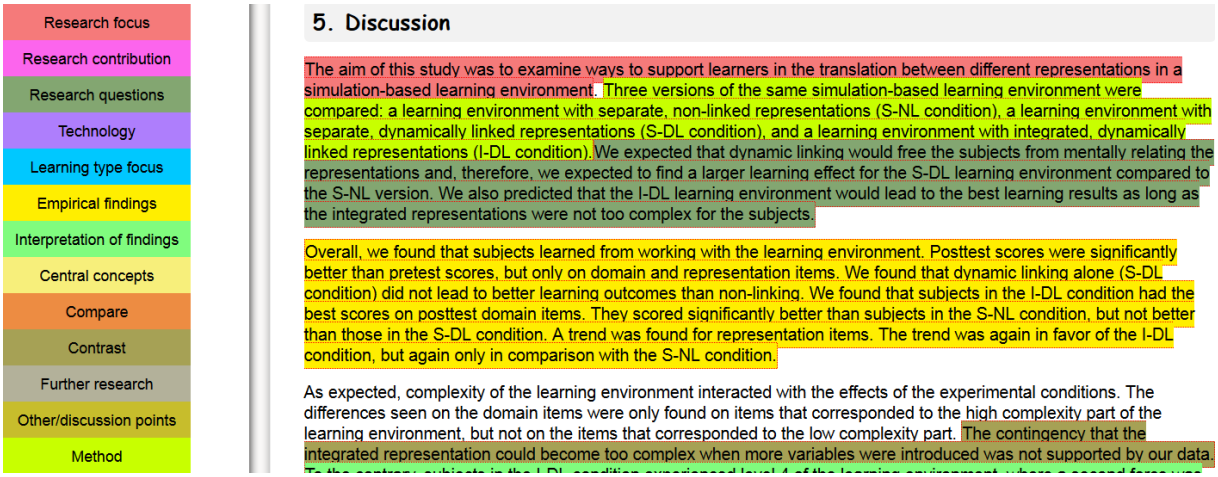


Figure 2. The highlighter/annotation script to the left. To the right, a part of the assigned article that students categorized with the help of the highlighters.

The experiment was associated with a short-term task (students' presentation of the article to the class) and a long-term task (a semester project). More importantly, the semester project made the annotation tool or other parts of the wiki the central object of study (*tool inquiry perspective*), hence enhancing a meta-reflection. This kind of experimental setting constitutes an interesting area for further investigation. That is, a setting that mixes experiences on different levels: using and reflecting on tool functionality (*tool perspective*), scrutinizing its more fundamental conditions (*tool inquiry perspective*), and students being research subjects as well as doing research themselves. Furthermore, which has a focus that parallels the researcher's own research, hence bringing the student and researcher closer together in a potential co-learning/co-researching situation.

RESEARCH DESIGN AND METHODS

Analytical procedure

Interaction analysis was employed to analyze the researcher–student co-learning and inquiry (Jordan & Henderson, 1995). This is a methodological framework for studying socio-culturally embedded moment-to-moment interaction (i.e., microanalysis of meaning production). The unit of analysis is the embedded interaction between humans, including interaction with the socio-material world (e.g., artifacts mediating the interaction).

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Participants, tool and task

The subjects in this study were ten female and six male students in their early to mid-twenties participating in a master's course in technology-enhanced learning.
–student co-learning to evolve during the course of the study. The lectures Fourteen of the students came from the Department of Informatics, and two students came from the Department of Education.

The experiment took as its starting point a naturally occurring activity in many tertiary educations—students' reading of research literature and applying some sort of reading tip/guidance from teachers in how to approach and analyze the material (e.g., locating research questions, contributions, theoretical perspective, methodological concerns, etc.). The researcher decided to build the experiment around this activity and to integrate the reading guidelines as scaffolds in an annotation/highlighting script. The highlighting technology was implemented in a wiki and resembles the highlighting pens or the color markers in Microsoft Word, but with the extra feature that each color was linked to a specific category (cf. Figure 2). Each of the categories was also connected to a question or reflection prompt.

At the beginning of the course, guidelines for "how to read an article" were introduced to the students by the course-coordinator. This was a regular activity that was part of the course, not an intervention. The original highlighting/categorization script was a literal copy of these guidelines. Some changes were later made to the script to achieve more critical attention to the research process that led to the particular content knowledge, and hence the relative and conditional nature of the knowledge presented in the article. In comparison, the first script focused on *research content* (cf. left quadrants in Figure 1), whereas the later scripts emphasized *research processes and problems* (cf. right quadrants in Figure 1). Figure 2 shows one of the later scripts.

One of the assigned and graded tasks in the course was as follows: students in groups of two performed a close reading of an article from the course literature and presented this article to the rest of the class. This was a regular task, not an intervention.

However, as an additional task—designed to observe the collaborative use of this particular scaffolding tool—the researcher asked the same student groups to jointly categorize the article they were going to present, using a highlighting scripts introduced by the researcher, which they could make changes to. The students' interaction with the categories was observed and video recorded with a stationary camera and a screencast. The whole interaction was transcribed, and the qualitative data analysis software NVivo was used for a more comprehensive analysis. It should be noted that none of the teachers participated in the experiment. A concern was that the experiment was in need of a teacher's scaffolding and should involve a learning experience. In the teacher's absence, the researcher became more involved in providing for this; hence, the researcher also took on the role of a teacher.

Another assigned and graded task in the course was a semester project. This was also a regular task, not an intervention. However, the course-coordinator decided that the wiki technology implemented as part of the experiment was going to be the focus of the students' semester project. Hence, the technology and task interventions potentially also had an additional impact far beyond the original special purpose annotation task the researcher had created in order to study the technology.

Data collection and participation structures

In the course, there was a contradiction between a curriculum that had a strong sociocultural commitment (which often implies more student-centered approaches) and other parts of the curriculum design that were more traditional and lecture-based. As a result, there were few occasions for the researcher gave few openings. The two most significant opportunities were in connection with the tool experiment and the semester project kick-off meeting with each of the groups, and the data studied therefore draws on these two.

Nevertheless, a wide variety of data was gathered throughout the course (see Appendix 1). The overview illustrates the researcher's range of involvement, and it can be associated with three different roles: the researcher role, the technology developer role, and the assistant teacher role. These roles traditionally relate to different activity types, contextual resources, and participation structures, constituted by 1) researcher vs. research subjects, 2) technology developer vs. user/customer, and 3) teacher vs. student. In order to connect the activity to the relevant contextual resources and facilitate co-learning, the participants had to maneuver between these participation structures, identify the relevant structure, and manage to take each other's perspective. How these roles are negotiated is central to the understanding of how the research–teaching nexus may or may not facilitate co-learning. The two presented cases are representative of two principally different patterns of tool framings and co-learning inquiries and are purposively selected to illustrate these differences.

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TOOL DESIGN

The design took its inspiration from wikis, annotation technologies, and knowledge building environments. The review below has two purposes: 1) to address the first research question: What is the educational role of annotation technologies, and what are the current challenges that require further research? 2) to compare the tool design with related technologies.

Wikis

A wiki is a web-based collaborative space where anyone can quickly and easily create, edit, or delete documents and link them to other documents in the wiki (Leuf & Cunningham, 2001). Wikis are part of Web 2.0, the interactive, user-generated web that provides opportunities for everyone to author, edit, and discuss documents, not only read what others have written, hence making students accountable to a bigger community. In the present study, the wiki was a background element—it acted primarily as a platform for enhancing an annotation technology, the focus of the review. However, there can be some inherent conflicts between the presented technologies, so the wiki context may still affect the framing.

Annotation technologies

A survey of Ovsiannikov, Arbib and McNeill (1999) showed that the absolute majority of researchers and students preferred to print out an electronic paper before reading and annotating it. However, electronic annotations have many capabilities that can make electronic annotation not only as good as, but also far superior to, their paper counterparts (Ovsiannikov et al., 1999).

It has been claimed that "annotation is becoming a new form of communication, and that understanding and managing this new medium presents a major challenge" (Buneman & Steedman, 2001, p. 1). This challenge is partly a result of new attempts to move beyond the single user and see annotations as part of a greater ecosystem, where the many forms of collaborative uses poses new challenges (Marshall, 1998). In the context of a larger ecosystem for annotations, many new issues must be addressed, such as, formal versus informal annotations, explicit versus tacit annotations, public versus private annotations etc. (Marshall, 1998). Formal annotations try to secure user interoperability and require compliance to conventions. Informal annotations lack this feature, but is therefore also more flexible. Many personal annotations are telegraphic, incomplete and tacit; they are understandable only for ourselves. The content and meaning need to be more explicit in order for annotations to become a shared resource. However, this requires more effort from the annotator. The informal and tacit nature of personal annotations can make the author see them as private. Enforcing a public sharing of digital annotations can demotivate students from annotating.

Like metadata (data about data) in general, there are fundamental challenges concerning the relation between the source document and its metadata/annotations, and how changes in the source document affect the annotations/metadata (Brush, Bargeron, Gupta, & Cadiz, 2001). The present study, solved this complicated issue by instead focusing on static documents, thereby also compromising the fundamental idea of wiki as an open and dynamic community space (Leuf & Cunningham, 2001).

Annotation technologies regularly involve highlighting or some form of anchoring of the relevant text, often in combination with opportunities to include written comments as marginalia, inline comments, footnotes, threaded discussion etc. (Ovsiannikov et al., 1999; Wolfe, 2002). However, the prototype at the time of the experiment included the highlighting facility, but it did not include an option to add comments. A distinguishing feature with the prototype in comparison with many other annotation technologies, was the possibility to create different highlighting groups (visually separated by colors), in which each group could be defined as a category and further be connected to a prompt or category description to scaffold its use (cf. Figure 2). With respect to this last feature, the prototype bears resemblance to knowledge building environments discussed below (Muukkonen, Hakkarainen, & Lakkala, 1999; Scardamalia & Bereiter, 2006). However, the strong focus on annotation as part of the reading process ties the prototype more closely to the traditional use of annotation technologies reviewed in this section.

What are annotations about? What purpose do they serve? Fowler and Barker (1974) found that highlighting can have a positive effect on retention, but also that the effect might be adverse for the retention of the remaining unemphasized material. Not surprisingly, they found that the effect of active highlighting was superior to the passive reading of highlighted material, though this effect was also dependent on whether the reader had faith in the person responsible for the highlighting. This was the same tendency that Chen and Liu (2012) found when comparing learner-generated and instructor-provided annotations: doing annotations oneself outperformed viewing the instructor's annotations. However, a combination that also reaps the benefits of collaborative learning is even better. For instance, when Hwang and Hsu (2011) investigated the effect of students'

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annotations as part of pre-reading (reading before class) exercises, they found that the positive effect was strengthened by students sharing their annotations, which also helped the teacher to identify students' prior knowledge and to prepare the lecture accordingly.

Ovsiannikov, Arbib and McNeill (1999) found that annotation fell in four primary uses: to remember, to think, to clarify and to share. A context for several studies has been to facilitate a deeper level of engagement and more active reading and learning strategies (Porter-O'Donnell, 2004; Simpson & Nist, 1990), which have also been observed to have a positive effect on writing (Porter-O'Donnell, 2004). Annotation studies have been concerned with how annotation affects critical thinking, metacognitive skills, motivation, attitudes toward annotations and the tool, and tool usability (Novak et al., 2012). Wolfe and Neuwirth (2001) identified four main functions of annotation in the current use of annotation technologies:

> 1. to facilitate reading and later writing tasks; 2. to eavesdrop on the insights of other readers (e.g., by examining annotations made by previous readers of a text); 3. to provide feedback to writers or promote communication with collaborators (e.g., by making annotations while reading that are directed to other authors); and 4. to call attention to topics and important passages (e.g., by making annotations while authoring that are directed to the readers). (pp. 336-337)

The conclusion that can be drawn from the reviewed annotation studies is that annotation can serve a wide variety of purposes, also relying on the ingenuity of the users, but that more research is needed to contextualize the use conditions. The annotation studies tend to focus on the isolated learner as a unit of analysis. Missing in the studies is the sociocultural history of this resource. For instance, were the tool and the annotation practices *passed on* from teacher to students, or in some way a *co-constructed* resource, and if so, how? The studies show that annotations play a double role that can be quite problematic, which has been little researched. They are strongly connected to the students' personal habits and preferences. However, they are also subject to the teachers' interventions, because of the key value annotation practices are perceived to have for learning processes. This tension is likely to deeply affect the outcome of the former studies. The current study will shed light on this tension and the co-constructed nature of annotation resources, which are little discussed in other studies.

Knowledge building environments

An important inspiration for combining highlighting with procedural and epistemic categories was the knowledge building environments. The knowledge building framework was created by Marlene Scardamalia and Carl Bereiter, and it has inspired many similar designs, such as Future Learning Environment (FLE) (Muukkonen et al., 1999). One purpose of these designs has been to introduce new theoretical approaches as well as to design learning practices and technology based on these theories. The underlying pedagogic models have tended to imitate scientific thinking, and more generally, experts' knowledge practices. This review will start with Scardamalia and Bereiter's (2006) "Knowledge Forum", formerly known as "computer supported intentional learning environments" (CSILE), to establish central principles for these environments. It continues with reviewing critical research on FLE that has general relevance to the current topic.

Scardamalia and Bereiter (1994) championed the notion that schools should replace traditional classroom discourse with discursive patterns (knowledge building discourse) that characterize knowledge building communities outside school. Schools should try to facilitate intentional learning and the process aspects of expertise (i.e., the research process as opposed to objectifying the research content). Quintessentially, schools should focus on "the continual improvement of ideas" (Scardamalia, 2004, p. 12) and progressive problem solving (Scardamalia & Bereiter, 1994). "Knowledge Forum" targets students' individual and collaborative inquiries, where students try to identify, articulate, and solve problems and build knowledge and theories. The knowledge building tools aim to support "epistemic agency" (Scardamalia & Bereiter, 2006) by providing scaffolds for essential steps in knowledge building processes and to facilitate collaborative learning and knowledge building by making the results of these steps a shared resource. Frequently used epistemic scaffolds are category prompts and sentence openers, which structure students' thinking and knowledge inquiries in a progressive manner and help establish awareness and a shared focus for collaborative knowledge building, e.g.: "My theory; I need to understand; New information; This theory explains; This theory cannot explain". The traditional use of the annotation tools reviewed in the previous section was associated with a source document and the reading process. In comparison, knowledge building environments typically take a real-world problem as their starting point and seek to support the writing process, which is oriented toward exchanging and improving ideas. The annotation facilities are here connected to knowledge building scaffolds that provide support for the creation of notes that address a problem or the earlier contributions/notes to solve that problem. The knowledge building and collaborative capabilities of these environment are best demonstrated in the ways these tools provide "flexible build-ons" and a range of opportunities to display, link, and make the notes objects of further

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idea improvements, which is more consistent with how knowledge building processes actually function (Scardamalia, 2004). As for wikis (Leuf & Cunningham, 2001), a concern for the knowledge building environments has been to facilitate better alternatives to the traditional knowledge building and annotation solutions: "Threaded discourse now dominates the Internet, despite the fact that it in many ways defeats knowledge building" (Scardamalia, 2004, p. 5).

Later research has problematized fundamental assumptions in the original knowledge building models, and the possibility of an easy transfer of scientific and expert models to the school context. Ludvigsen and Mørch (2003) found that the progressive inquiry model in the discussion forum in FLE was too rationalistic for students' knowledge building. The model was not sensitive towards students situated meaning making, and rather than aiming at conceptual artifacts, students' knowledge building was task specific and oriented towards the local meaning production. In a follow up study, Ludvigsen (2012) problematized how the transfer of expert models into a school context lost contact with the institutional underpinning of these models, turning the scientific concepts into a set of abstractions. Hence, the models failed to make the scientific practice transparent to the students. The categories, in combination with teacher intervention provided, however, transparency to students' own work, and they could therefore potentially also provide a more systematic orientation toward educational activities. Ludvigsen argued that the categories both supported a focus on the subject content and the working process, but the author claimed that there are great challenges related to both foci.

Arnseth and Säljö (2007) discussed challenges related to what is referred to in this study as the students' and the teachers' *social* and *epistemological framing*. Instead of discussing and evaluating the appropriateness of the available categories, the students tended to choose categories they perceived as neutral and uncontroversial. The "preference for reaching agreement" took "precedence over the need for understanding the relation between a category and a knowledge object" (2007, p. 433). Arnseth and Säljö emphasized the importance of teacher's scaffolding in order for the epistemic categories to work. In their study, the instruction failed to address how knowledge should be tied to the students own accounts, and, how it should be used to support their arguments (i.e., the underlying knowledge model), and how the categories could be exploited as a resource for making judgments about the validity of knowledge and the quality and extension of the students' arguments.

In conclusion, the knowledge building research, but in particular the later critical investigations of these environments (Arnseth & Säljö, 2007; Ludvigsen, 2012; Ludvigsen & Mørch, 2003), has taken a stronger interest in the sociocultural dimensions of these tools. However, the students have been the object of focus rather than participating in the inquiry—the previous studies in this field have mostly studied students' *tool use* rather than the students' *research* on the tool they used. Hence, these studies tend to perceive the tool more as a *passed on* resource, rather than being (potentially) a co-constructed product of the interaction between the students and the teacher/researcher.

ANALYSIS

This section addresses the second research question: What characterizes the participants' framing of the technology?

A letter was sent to the students (cf. Appendix 2) at the beginning of the course emphasizing that the technology was ready to be explored, but was by no means "finished", and how the weaknesses could be productive for their learning and semester projects. Hence, a meta-framing (cf. *tool inquiry perspective*) was verbally present early on in the course. However, the contextual resources relevant for this focus were not equally latent and easy to activate for the participants in the two cases presented.

When introducing the tool, the researcher (in Case 2 also the course-coordinator) emphasized the tension between individualizing the categories and finding a kind of standard or unified language that might better facilitate the communication, collaboration, and comparison of each participant's tagging. This double framing prepared the ground for a *tool inquiry perspective*. However, only the second case activated these resources.

Case 1: Tool focus

What follows are four episodes from the interview of the students in Case 1, where the tool is an object of inquiry. Although the participants' framing of their inquiry involves a lot of zooming in and zooming out, the resources activated in this case maintain a rather local context compared to the next case we will study. The interaction in Case 1 has been translated from Norwegian. In Case 2, all of the interactions took place in English. Transcription notation is based on the Jefferson system.[i]

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Excerpt 1:

Episode 1

3	Researcher:	I think partly I ask now, and partly that you tell me in a way what's on the top of your minds, and partly that we look through the text and what you have tagged and (.) that you say something about what you have tagged, and the process, ehm (.) How did the script work this time, do you think? Now you got a chance to make a suggestion that we added the *Method* [*category*], and (.)
4	Student B:	Well (.) it really depends on the article how such a script works (.) and it should be better opportunities to customise it to the work you're doing. And this article was well organised. It was very straightforward and clear, and divided into specific chapters, and was simple to use in that sense. But it would vary a great deal (.) the articles, how useable the script is.
5	Researcher:	Yes, yes, indeed. And it's not really meant to be a completely generic script. The intention is that one creates the script oneself. It is a prototype. It is an early version of the script, and then it is, it is what it is in a way, and it becomes a bit more cumbersome. Well, it was not very difficult, you saw that when we added the *Method* [*category*]; that operation only takes 30 seconds. So it is not worse than that. But I think for the average user, you are technical, compared to the (.) larger group of users (.) it needs to be made easier. Apart from that, what did the script offer for better or for worse with regard to your work?
6	Student B:	Well, it was okay when one could sit together so that one could discuss
7	Researcher:	Umm
8	Student B:	So it was okay (.) yes to discuss the article
9	Researcher:	Umm
10	Student A:	Umm
11	Researcher:	Exactly. Other immediate experiences [*"opplevelser"*] and afterthoughts [*"erfaringer"*], so that I don't lead your thoughts too much with my questions?
12	Student B:	What's sort of the purpose with the script, or what's the idea behind it?
13	Researcher:	((*Long description where researcher elaborates his ideas*))
14	Researcher:	Umm (.) Okay, if you can go through what you have done, just to show me. Talk me through, just scroll down.

In Episode 1, the researcher's framing of the interview situation starts with an open frame (asking the students to share "what's on the top of their minds"). The question deriving from the initial framing is, however, much more narrow: "How did the script work this time, do you think?" Student B claims that how well the script will work depends on the article, which necessitates a customizable script. Her framing focuses on a *tool text dependency*. We can also observe that she moves between two contextual frames when discussing this dependency: the general and the particular. The tool worked okay on this specific article but can be problematic to use on other articles. The researcher supports this line of thinking and adds that it is a prototype (indicating limitations) and that the idea is that the users create the script themselves. However, the researcher's further inquiries in line 5 maintain the local framing—he asks about this particular script with regard to this particular task/article. In lines 6 and 8, Student B frames the situation where the tool had a positive impact (i.e., in collaborative activities, and where one uses it to discuss the article). The researcher waits seven seconds for students' further thoughts before asking for other "immediate experiences and afterthoughts" (line 11). A dimension could easily have gotten lost in translation, since both the words *"opplevelser"* and *"erfaringer"* in the original Norwegian wording are regularly translated into *experiences*. However, *opplevelser* are more immediate and unprocessed and rely more on our feelings or intuition toward the situation, whereas *erfaringer* refer to the cognitively more processed products in which the immediate experience has been integrated with other experiences and knowledge. This last group of experiences is often referred to with words like *knowledge* or *wisdom*, which signify their cognitively more developed status.[ii] Hence, whereas *erfaringer* imply that students' framing should draw actively on cognitive and metacognitive resources, *opplevelser* also have strong connotations for the *affective framing* of experiences (participants' feelings toward the situation), suggesting that the students also can use their feelings as a resource. A potential pivotal moment for broadening the frame is reached in line 12 when Student B raises the question "What's sort of the purpose with the script, or what's the idea behind it?" The researcher has a lot to say about this theme, and a long description of design ideas follows. The students sustain the role as listeners, only nodding as he speaks. Discovering that his design ideas do not trigger further discussion, the researcher proceed with asking the students to elaborate on their tagging.

Excerpt 2 presents three other tool-oriented episodes to elaborate upon the framing and to illustrate its further development.

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Excerpt 2:

		Episode 2
85	Student B:	((*Scrolls*)) The *Learning type focus*, is in a way okay, but it's difficult fo- like for us technology students who don't speak about learning (.) that is (.) this tag ((*points*)) is only for education=
86	Researcher:	=Eh (.) yes and no=
87	Student B:	=I will claim=
88	Researcher:	=but mostly no. Eh (.) I have worked with implementation of technology for some years now. And you will never be skilled in that job if you don't find out what are the main activities and what are the main objectives=
89	Student B:	=Yes, but with this particular tag "learning type focus", I feel that in this subject this is a relevant tag to have, but in the other subjects I take=
90	Researcher:	=Yes yes (.) yes yes=
91	Student B:	=this wouldn't have been a relevant tag=
92	Researcher:	=No, indeed, this [*script*] is addressed to this particular curriculum, yes yes=
93	Student B:	=So here I think it fits, but (.) yeah=
94	Researcher:	=No, no this script with its particular focus is very tailored to this course, so the epistemic tagging must somehow maintain the focus of each course
95	Student B:	Yes
96	Researcher:	You know
		Episode 3
111	Student B:	Umm ((*scrolls down several pages with little variation in the tagging*)) Here it was a little more ((*short laugh*)) happening
112	Student A:	Umm
113	Student B:	But I think they often are very clear, yeah (.) some of the tags were very simple, and there were some that were a little more like (.) didn't quite fit anywhere, but (.) yeah
114	Researcher:	Yes
		Episode 4
121	Student B:	Yeah ((*scrolls to the end of the article*)) that was it.
122	Researcher:	Um.. yeah, but, good job, I would say. And I agree that this article as a start was very well structured. And I, I also felt that the script was a bit easier to handle now, for in the former [*script*] too much was too similar, and then it became a discussion if one were to take this or this or this ((*refers to different tag-categories*)) (.) and then these choices were maybe not especially productive.
123	Student B:	Yeah

In Episode 2, Student B scrolls down the article (line 85) and pause to comment on the relevance of the category *Learning type focus*. She claims it is "difficult" for them as technology students and that this category is "just for education". The researcher disagrees (line 86, 88), claiming that in order to be successful with technology implementation one needs to investigate the main activity and goals, which in this course were learning and technology for learning. Student B claims (line 89, 91) that although the category is relevant for this course, it will not be relevant for her other courses. The researcher discover the misunderstanding (line 90, 92), quickly adding that this script is tailored for this particular course, and that the epistemic tagging has to attend to the focus of each individual course.

Episode 3 starts with Student B scrolling past several pages where they only had used the category *Empirical findings* (line 111). Her comment "Here, it was a little more happening" can indicate that she sees variations in categories as more relevant, which raises a question about their task understanding and epistemological framing. The utterance "But I think they often are very clear" (line 113) is ambiguous, but in the context of Student B's utterance in Episode 1, line 4, the statement probably refers to the article text/authors, rather than the tool/script. The last part of the utterance refers to the tool/script—she makes a distinction between the categories that were easy to use, and the ones that "didn't quite fit anywhere". She maintains the tool text dependency framing observed in the first episode. The phrase tags that "didn't quite fit anywhere" indicates that she understands the task to be about finding instances for all of the categories in the script. The researcher does not interrogate further, but instead replies with a confirmative statement[iii] (line 114).

In Episode 4, the final episode concluding the interview, the earlier framing is maintained. The researcher builds on Student B's framing, the tool text dependency, and agrees with her that the text was well structured and hence made the tool easier to use. However, he also emphasizes that the development of the script made it easier to handle.

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Case 2: Tool inquiry focus

The next set of data is taken from another case associated with the students' semester project, where the researcher follows one group of four students. In an outline of their project, the students suggested a redesign of the annotation tool that allowed them to 1) define their own tags, 2) compare their tags with others' tags, and 3) collaborate synchronously in answering the questions presented. Their semester project outline shows that they were aware of the potential conflict between the first and second suggestion for redesign:

> We believe that giving the students the freedom to tag and comment with no constraints would help improve the process of collaborative knowledge creation. However, this change is likely to complicate the information management and organization of the learning tasks, which would be further explored in the future deliverables. (Students' semester project draft)

The tension between individual and shared annotation practices was also addressed by the course-coordinator in his written comment on their semester project draft:

> Allowing students to create their own tags is interesting as it is a topic of research in e.g. end-user development. But you ought to discuss the pros and cons of having user-tailored shared tags in collaboration software like Wiki, as there is a tension between shared knowledge (tags that are understandable to many, possibly provided by a teacher with a set of learning goals behind, but sometimes not relevant for oneself) and private knowledge (relevant for one's own tasks, but not understandable to all, possibly including teacher). (Teacher's feedback)

The semester project proposal together with the teacher's comment constitute the background for the following discussion that took place during the first five minutes of a consulting meeting.

Excerpt 3:

4	Course-coordinator:	It is little bit (.) it is something that is a little bit confusing (.) in your text. I (.) [*inaudible*] what tag should be the starting point? Is it something about questions? I am not sure what you meant about questions [*inaudible*] that was based on question tag. But you are more interested in modifying the tags. Right?
5	Student B:	Okay, so I think before we go down this road, maybe we should explain that we changed our inquiry to this. So maybe it would be better to describe the newer plan, if that's okay. Ehm (.) I was (.) you guys probably haven't seen this [*inaudible*] five minutes ago
6	We:	((*laughs*))
7	Student B:	That's why I didn't say anything. Ehm (.) so (.) that's a document that kind of describe the new, so do you want to read about it, or do you want us to describe it to you?
8	Course-coordinator:	Yes you can describe it. Since we don't have the text
9	Student B:	Okay. Ehm (.) well the first thing we did, was we realized that the problems arise in the province of aggregating peoples' tags if they used different tags is quite problematic, because [*inaudible*] (.) parallels necessarily between the tags that different people develop. So (.) ehm (.) we also (.) no offense Jan Erik, we don't really like the tags (.) not at all (.) because people at the Master level tend to already have developed their own conventions and habits. And they have a (.) we have a way of reading text that works for (.) for us, but (.) ah (.) [*inaudible*]=
10	Student A:	=separate from each other=
11	Student B:	=its separate from each other, and its most likely separate from whatever tags are being given. So we wanted to include a way to engage with the texts that can also facilitate collaborative learning, but (.) eh (.) have it be more open. So instead of having tags where in the mean of a system where students can individually go through the article, and (.) it is kind of like in Microsoft where you can highlight things and can add comments (.) uhm (.) can be able to do that kind of things. And then (.) after everyone has done that divide students into groups of three to five. And have those (.) eh (.) different (.) different [*inaudible*] so have kind of like heat map [*Ref. to visual representation*] eh (.) like all the highlights (.) ehm put together [*inaudible*] which paragraphs have been highlighted by more people than other people, but not necessarily that has to do with a particular tag or (.) ehm (.) scaffoldings, because it is just (.) eh (.) closes the discussion [*inaudible*] more open ended, and (.) um (.)

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One of the other semester project groups proposed a redesign that included a "question tagging" that was used to annotate and ask questions about unclear sections of the articles. The course coordinator has difficulty understanding how this group's focus on questions (cf. their third suggestion for redesign) is integrated with the redesign of the annotation tool. Instead, he understands their framing to be about "modifying the tags" and asks for clarification (line 4). However, based on the written feedback from the teacher, the students revised their original draft—Student B takes charge and suggests that they instead should describe their new plan (line 5).

In line 9, Student B identifies two sources leading to their reframing. Firstly, the problems of aggregating people's tags if they used different tags, secondly, and in her own words, "so, ehm, we also (.) no offense Jan Erik, we don't really like the tags (.) not at all". The discussion continues with the students explaining that their annotations follow personal conventions and differ from each other's. However, this reframing also has consequences for the students' collaborative learning design, since this can no longer be built on a common notation. Hence, they are also forced to develop a new idea for how the individual annotations can facilitate collaborations.

DISCUSSION

The following discussion summarizes the findings by comparing the students' framing in the two cases.

Regarding the *social/positional framing*, in both cases, the students and the researcher/teacher alternate between being the *source* and the *listener*. The exchange of roles appears to be transparent and smooth. The context of Case 2 seems to provide a simpler participation structure that is probably well known from other school activities. However, the experiment and co-learning context in Case 1 enrolls the participants in three different participation structures, constituted by: 1) researcher vs. research subject, 2) technology developer vs. user/customer, and 3) teacher vs. student. In order to connect the activity to the relevant contextual resources and facilitate co-learning, the participants have to maneuver between these structures, identify the relevant resources within each structure, and manage to take each other's perspective. Each of the participation structures naturally involves an exchange of the position as *source* and *listener*. However, conflicts/misunderstandings can easily arise in situations where there is a different understanding of which participation structure is at work and where the participants' role as *source* or *listener* differs depending on the choice of structure. If participants assume the same role, this can prevent either active listening or the presence of an active *source*. We see in Case 1 that the researcher's role as *source* and *listener* also involves disagreeing with students (cf. Excerpt 2, line 88). His framing here is that technology designers, including the students, need to familiarize themselves with the domain they are working with in order to have a positive impact. Hence, when the domain is information and communication technology (ICT) and learning, they should not only explore the technology, but also the learning focus, and how the two foci align. The researcher's role here seems to rely more on his capacity as a teacher and designer than on the traditional research role. His framing also requires the students to take on the role of designers, not merely students or users. Returning to the potential pivotal learning moment in Excerpt 1, line 12—and why this framing did not lead to further discussion after the researcher's presentation of his design ideas in line 13—this might be because the question prompted a shift in the participation structures. Whereas the researcher might have waited for the students to extend their thoughts based on his contribution, the students might instead have perceived the answer as given in his capacity as the designer or teacher and more in order to inform them than to enroll them in further inquiry and co-learning. Hence, they also took on the role of *listeners* waiting for his next move.

The students in Case 1 seem to strive in finding the *epistemological framing* of this experiment (cf. Excerpt 1, line 12). The goal of the script, the true nature of the problem, and what knowledge they need to activate in order to solve the problem are unclear to them. They frame the problem as being about tool text dependency, and that a *predefined script* will not work. However, for the researcher, this frame is just a temporary limitation (the predefined script issue was solved later in the course). Instead, he wants to frame the co-learning more in terms of envisioning a prospective instructional design in which the elementary prototype limitations are solved. However, the students' framing of the design problem to be solved seems to maintain the focus on a *predefined script*, which also makes the tool text dependency framing more relevant. In the context of the research–teaching nexus, it is interesting to observe that instead of students aligning with the researcher's framing, the researcher aligns with the students' framing, which also preserves the rather local focus on contextual resources.

The most dominant *source* of scaffolding for the co-learning in Case 1 seems to be *nonhuman* (i.e., the existing design limitation and students' experiences with it). Nonhuman *sources* also played a decisive role in Case 2, and two sources in particular. The first is, as in Case 1, the *predefined script*. However, the group's thinking in Case 2 transcended to greater extent the local context of a *tool perspective* observed in Case 1—they also made inquiries into the tool's epistemological foundation. A second *source* was the conflict between personalized tags

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and unified tags as a collective resource (i.e., an aspect of the design problem introduced by the researcher and the course coordinator). This *source* possibly constituted an even bigger challenge as these two frames may appear to be incompatible. Aligning the two suggests that they might even have to sacrifice their main idea: the personalized script. Hence, this double framing was not only a *source* for a regular reframing*/re-keying*, but it constituted a *breaking frame*—the grounding and heuristics of the initial frames lend little support for how to frame the new situation (Manning & Hawkins, 1990). The students needed to co-construct a new schema (van de Sande & Greeno, 2012). Initially, they tried to do this by making questions (their third design idea) a bridge between the individual and the collective (cf. private vs. public annotations), but they found it problematic to figure out how questions could make personal annotations a collective resource. In their new framing, the collaborative level exploits the frequency of annotations, building on the annotation of everyone that had tagged the same text passage (visualized through a heat map) rather than trying to exploit annotations related to different categories.

That the opportunity to create their own script was not optimal was salient in both cases' discussions and framing of the technology. However, their further framing differed with regard to using a *tool perspective* versus a *tool inquiry perspective*, in which the last focus signifies that the premises of the tool to a greater extent are made an object of critical inquiry. Facilitating the last focus is important, as it has a greater potential for providing a transcending learning experience (i.e., transcending the logic of the tool to include other potential contexts).

In Case 2, the students' *affective framing* was foregrounded in their epistemological framing, which probably caused them to focus more on the *epistemological framing* of the learner and to use this epistemological framing as a resource for their (re)framing of the tool. In Case 1, the students struggled with the epistemological framing, and their framing aligned with rather than challenged the logic of the *tool perspective*. Hence, their reframing involved a *rekeying* rather than a *breaking frame*.

CONCLUDING REMARKS

This study was conducted via a short-term and a long-term task, was associated with both a *tool perspective* and a *tool inquiry perspective*, and paralleled the researcher's own research. Hence, it provided extended opportunities for the students' research participation and for focusing on research processes and problems. This setting constitutes an interesting area for further investigation. The setting can involve a double framing and methodological challenges, both of which require further research. When the tool is made the object of a critical extended inquiry, which the semester project aimed for, it can change the tool practices (e.g., students' perspectives and motivation toward using the tool, cf. affective framing). A *tool perspective* and *tool inquiry perspective* are in some respects opposites, which implies that in reality, the students were exposed to two contradictory "treatments"; this can make it more challenging to explore the learning process. The embedded emphasis in a *tool perspective* is that the tool somehow aids in accomplishing a task and that the tool's functionality prescribes the relevant framing. It can involve criticism of the tool, but this criticism, for whatever reason, does not manage to transcend the logic of the tool. The *tool inquiry perspective* takes a more critical stand and problematizes not only the functional alignment implied in the *tool perspective*, but also whether this functional alignment is the *only* or even the *most* relevant context for assessing the tool. Hence, the *tool inquiry perspective* extends the *tool perspective* by calling into question the fundamental epistemological assumptions of the *tool perspective*. The *tool inquiry perspective* has more contextual resources at its disposal and greater potential for reframing, but it regularly requires more cognitive effort—students need to explore both the framing of the *tool perspective* and their alternative framing, compare the frames, argue for their reframing, and determine how to achieve it. Where the students can reason within the frame provided by the *tool perspective*, the *tool inquiry perspective* naturally leads to a double framing; here the frames are often conflicting, competing and even incompatible (Hetland, 1996), and the reframing often involves a *breaking frame* (Manning & Hawkins, 1990). Ideally, criticism emerging from the *tool perspective* further leads to a *tool inquiry perspective*. However, more research is required to explore whether, how, why, or why not this happens.

Further research is needed to identify and describe the different contexts and resources participants rely on in their framing, and the challenges of activating these resources (Hammer et al., 2005; Linell, 1998). The above discussion has foregrounded students' framing. To improve the understanding of researcher–student co-learning and co-construction in research-based teaching, future research should also address the researcher's framing and how it affects the students' framing. This can tell us more about the nature of students' research participation (Healey, 2005), e.g., to what extent the students' research is informed by the researcher's framing, or must be considered more as a parallel inquiry.

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REFERENCES

Arnseth, H. C., & Säljö, R. (2007). Making sense of epistemic categories. Analysing students' use of categories of progressive inquiry in computer mediated collaborative activities. *Journal of Computer Assisted Learning, 23*(5), 425-439.

Bateson, G. (1972). *Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology*: University of Chicago Press.

Brush, A., Bargeron, D., Gupta, A., & Cadiz, J. J. (2001). *Robust annotation positioning in digital documents.* Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.

Buneman, P., & Steedman, M. (2001). *Annotation–the new medium of communication.* Paper presented at the Proc. of the WWW10 International Conference.

Chen, C.-J., & Liu, P.-L. (2012). Comparisons of Learner-Generated versus Instructor-Provided Multimedia Annotations. *Turkish Online Journal of Educational Technology-TOJET, 11*(4), 72-83.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Fowler, R. L., & Barker, A. S. (1974). Effectiveness of highlighting for retention of text material. *Journal of Applied Psychology, 59*(3), 358.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*: Harvard University Press.

Griffiths, R. (2004). Knowledge production and the research–teaching nexus: The case of the built environment disciplines. *Studies in Higher education, 29*(6), 709-726.

Hammer, D., Elby, A., Scherr, R. E., & Redish, E. F. (2005). Resources, framing, and transfer. *Transfer of learning from a modern multidisciplinary perspective*, 89-120.

Healey, M. (2005). Linking research and teaching exploring disciplinary spaces and the role of inquiry-based learning. *Reshaping the university: new relationships between research, scholarship and teaching*, 67-78.

Heron, R. L., Baker, R., & Mcewen, L. (2006). Co-learning: re-linking research and teaching in geography. *Journal of Geography in Higher Education, 30*(1), 77-87.

Hetland, P. (1996). *Exploring Hybrid Communities: Telecommunications on Trial*: Department of Media and Communication, University of Oslo.

Hwang, W.-Y., & Hsu, G.-L. (2011). The Effects of Pre-Reading and Sharing Mechanisms on Learning with the Use of Annotations. *Turkish Online Journal of Educational Technology-TOJET, 10*(2), 234-249.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The journal of the learning sciences, 4*(1), 39-103.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*: Harvard university press.

Leuf, B., & Cunningham, W. (2001). The Wiki way: collaboration and sharing on the Internet.

Linell, P. (1998). *Approaching dialogue: Talk, interaction and contexts in dialogical perspectives* (Vol. 3): John Benjamins Publishing.

Ludvigsen, S. (2012). What counts as knowledge: Learning to use categories in computer environments. *Learning, Media and Technology, 37*(1), 40-52.

Ludvigsen, S., & Mørch, A. (2003). Categorisation in knowledge building *Designing for change in networked learning environments* (pp. 67-76): Springer.

Manning, P., & Hawkins, K. (1990). Legal decisions: A frame analytic perspective. *Beyond Goffman. Studies on Communication, Institution and Social Interaction. Berlin, New York: Mouton de Gruyter*, 203-233.

Marshall, C. C. (1998). *Toward an ecology of hypertext annotation.* Paper presented at the Proceedings of the ninth ACM conference on Hypertext and hypermedia: links, objects, time and space---structure in hypermedia systems: links, objects, time and space---structure in hypermedia systems.

Minsky, M. (1974). A framework for representing knowledge. In P. H. Winston, & Horn, B. (Ed.), *The Psychology of Computer Vision* (Vol. Vol. 67, pp. pp. 211-277). New York: McGraw-Hill.

Muukkonen, H., Hakkarainen, K., & Lakkala, M. (1999). *Collaborative technology for facilitating progressive inquiry: Future learning environment tools.* Paper presented at the Proceedings of the 1999 conference on Computer support for collaborative learning.

Novak, E., Razzouk, R., & Johnson, T. E. (2012). The educational use of social annotation tools in higher education: A literature review. *The Internet and Higher Education, 15*(1), 39-49.

Ovsiannikov, I. A., Arbib, M. A., & McNeill, T. H. (1999). Annotation technology. *International journal of human-computer studies, 50*(4), 329-362.

Porter-O'Donnell, C. (2004). Beyond the yellow highlighter: Teaching annotation skills to improve reading comprehension. *English Journal*, 82-89.

Rasmussen, I., & Ludvigsen, S. (2010). Learning with computer tools and environments: A sociocultural perspective. *International handbook of psychology in education*, 399-435.

Rumelhart, D. E., & Ortony, A. (1976). *The representation of knowledge in memory*: Center for Human Information Processing, Department of Psychology, University of California, San Diego.

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Scardamalia, M. (2004). CSILE/Knowledge forum®. *Education and technology: An encyclopedia*, 183-192.
Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The journal of the learning sciences*, *3*(3), 265-283.
Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. *The Cambridge handbook of the learning sciences*, 97-115.
Simpson, M. L., & Nist, S. L. (1990). Textbook annotation: An effective and efficient study strategy for college students. *Journal of Reading*, *34*(2), 122-129.
Strømme, T. A., & Ludvigsen, S. (in review). Students' Work with Computer Simulations: Contrasting Peer-Created Simulation Data Creates Extended Learning Opportunities. *Journal of the Learning Sciences*.
Svennevig, J. (2007). Ikke sant" as a response token in Norwegian conversation. *Interpreting utterances. Pragmatics and its interfaces. Essays in honour of Thorstein Fretheim*, 175-189.
Tannen, D. (1993). *Framing in discourse*: Oxford University Press.
van de Sande, C. C., & Greeno, J. G. (2012). Achieving alignment of perspectival framings in problem-solving discourse. *Journal of the Learning Sciences*, *21*(1), 1-44.
Vygotsky, L. S. (1978). Mind and society: The development of higher mental processes: Cambridge, MA: Harvard University Press.
Wertsch, J. V. (1991). *Voices of the mind*: Harvard University Press.
Wikipedia. (2015, September 4). Experience. Retrieved from https://en.wikipedia.org/wiki/Experience
Wolfe, J. (2002). Annotation technologies: A software and research review. *Computers and Composition*, *19*(4), 471-497.
Wolfe, J., & Neuwirth, C. M. (2001). From the Margins to the Center: The Future of Annotation. *Journal of Business and Technical Communication*, *15*(3), 333-371.

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APPENDIX

Appendix 1

The data sources in the study were the following:

- **Records of earlier courses**: The researcher used this to get a sense of the course and what role the technology could play.
- **Course preparation**: Email correspondence, preparation meeting, and discussions with the course coordinator regarding the content and organization of the course and the implementation of the wiki learning environment.
- **Course introduction**: Introductory presentation for potential students that considered following the course held by the course coordinator and the researcher. The researcher's three roles in this course was introduced: 1) teach on one of the sessions, 2) provide the learning design/platform and assist students and teachers, and 3) research and gather experiences from students and teachers.
- **Students' drafts of their idea for the semester project**: The researcher read, commented and discussed the drafts with the course coordinator.
- **Kick-off meeting with semester project groups**: Observation and audio recording. Mainly, the interaction was between the course coordinator and the students, but the researcher also gave some feedback. Since their project was about the wiki environment that the researcher had designed, the researcher was the expert and a key stakeholder.
- **Students' annotation of an assigned curriculum article**: Observation and video recordings. The researcher conducted informal short interviews with the students about their experience with the tool, their categorization decisions, etc. All of the video recording (eight hours in total) was transcribed and analyzed with the qualitative data analysis software NVivo. Two types of video were recorded: 1) a screen capture of the activity on the computer. This recording made it possible to study in closer detail how different resources (cues and textual resources in the article, category scaffolds, active use of cursor as a pointing device to organize and nominate ideas for talks, etc.) mediated the interactional discourse. 2) A stationary video camera was placed on a tripod so that it could capture the use of other resources, students' body language, etc.
- **The researcher's own reading and annotation of the same article**: To get a better sense of the constraints and affordances of the tool, the researcher tried using the categorization script on the same article before the experiment. In this way, the researcher was able to better relate to the user experiences and potential troubles with the categorization script with regard to each article (the scripts were generic, not tailored to each article—the idea was that the students instead could change the script themselves). In addition, the researcher could compare and contrast the students' tagging with the researcher's own annotation as a more experienced reader.
- **Students' presentation of the article to the class**: The researcher observed their oral and PowerPoint presentations, and got a copy of the PowerPoints.
- **Lectures**: Beside observing the classes and taking field notes, the researcher was also responsible for one of the lectures and played the role of an assistant teacher in the other lectures.
- **Talks with teachers**: Informal talks with lecturers to gain insight into their experience with the course and interaction with the class.
- **Students' class presentation of their semester projects before handing them in for final evaluation**: Draft of the paper. The course coordinator asked the researcher to contribute with two critical questions to each of the four semester groups.
- **Semester project papers**: Copy of the final paper.
- **Student evaluations**: Focus group discussion with the two sensors

Figure 4. Data sources.

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Appendix 2

What follows is the letter that was sent to all of the students. It describes a framing of the technology that can benefit their learning task.

> Hi everyone,
> Thanks for the last seminar. Regarding the TEL course and your participation as a student in the course, I have created a user account for each one of you to access the wiki-based learning design that we will use. I will send the account information in a separate email.
>
> **Semester project**
> It is a long and tricky process to develop learning technologies, and the design is by no means "finished" (in quotation marks to signal that you should question whether a learning design can ever be "finished"), but hopefully, it is finished enough to start using it, experiencing its weaknesses and strengths, and discovering its opportunities and potentials.
>
> We have made the wiki design with its many features the topic for your semester project this year (see http://217.171.199.148/uio/Final+report), thereby giving you an opportunity to experience a learning design, different design problems, and learning design interventions first hand. From a learning perspective in a TEL course, there is probably much to be gained from experiencing a design that is a little unfinished, imperfect, and messy. In this way, the technology becomes more visible in its affordances and constraints, its pro and cons, and its dependences. This can be a motivating and productive starting point for creating design ideas and suggestions for further development and improvements.
>
> Remember, your task is not only to make suggestions for improving the design, but also to base this work on scientific arguments from the curriculum literature and other relevant research. Your knowledge claims about the design need to be rooted in research and scientific reasoning.

Figure 5. *Letter framing the technology.*

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NOTES

[i] The transcript notations are based on the Jefferson system, but they follow a simplified and more accessible version (Strømme & Ludvigsen, in review):

[ ]	Text in square brackets represents clarifying information regarding the discourse.
(( ))	A description inserted between double brackets denotes contextual information.
=	Indicates that there is no discernible pause between two speakers' turns.
?	Rising intonation.
:	Indicates prolongation of a sound.
Underlined:	Emphasis in speech.
(.)	Short pause in the speech.
[…]	Utterances removed from the original dialog.
-	Single dash in the middle of a word denotes that the speaker interrupts him or herself.
--	Double dash at the end of an utterance indicates that the speaker's utterance is incomplete.

[ii] Not all dictionaries address this important distinction, but cf. Wikipedia: "The word 'experience' may refer, somewhat ambiguously, both to mentally unprocessed immediately perceived events as well as to the purported wisdom gained in subsequent reflection on those events or interpretation of them" (Wikipedia, 2015, September 4).

[iii] The original Norwegian phrasing was "*ikke sant*". In line 114, the instance was translated to "yes". Other translations used in the transcript are "indeed" (line 5, 92), "exactly" (line 11), and "you know" (line 96). *Ikke sant* (literal meaning "not true") is a pragmatic idiom traditionally used to *appeal* for agreement: "Du skal bli

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med, ikke sant?" (You are going to join us, right?/aren't you?). Line 96 ("you know") resemble the traditional use; however, today the idiom is also frequently used to *express* agreement in *response* to former statements (Svennevig, 2007). The other instances of *ikke sant* fall into this category. In both uses, *ikke sant* serves to confirm common knowledge, understanding, or agreement.

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