Unpacking the feedback process: An analysis of undergraduate students' interactional meaning-making of feedback comments

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In light of a growing emphasis on student-centred learning approaches, feedback is viewed as an activity that has potential to facilitate higher education students' explorations of knowledge contents and practices. However, research shows that feedback does not always lead to the expected student engagement. This qualitative study proposes a feedback conceptualization informed by sociocultural notions, in which students co-construct meaning from the teacher's feedback comments through interaction over time, with each other, the teacher, and relevant resources. Based on an in-depth analysis of undergraduate biology students' discussions of feedback comments, we found that the feedback process takes the form of a meaning-making trajectory students move along by orienting toward and elaborating on both task-specific and general-knowledge content. Thereby, we contribute to a better understanding of what constitutes feedback processes viewed from an interactional perspective and generate knowledge on how to tailor our feedback practices to better address the students' needs.

Keywords: feedback; meaning-making; student learning; social interaction; qualitative research

Introduction

Learning and teaching practices in higher education are showing a growing trend toward employing student-centred approaches. Students are expected to actively explore knowledge contents, problems, and resources that are characteristic to the respective field. In this context, feedback is viewed as an activity that has potential to support students' involvement in such explorations (Jansson 2006). However, research suggests that feedback does not always lead to the expected engagement by students, who often make limited use of the comments provided on their academic work (Evans 2013; Winstone et al. 2016). Among the studies that address this problem, many consider feedback as a product delivered by the teacher, in the form of comments, that students use to enhance their learning and achievements. The underlying assumption is that

whether students make use of feedback is related to the characteristics of the feedback receiver, the sender, or the message. Focus is rarely placed on the way students generate new understandings in relation to the feedback comments.

More recent conceptualizations understand feedback as a process 'whereby learners obtain information about their work in order to appreciate the similarities and differences between the appropriate standards for any given work, and the qualities of the work itself, in order to generate improved work' (Boud and Molloy 2012, 6). By moving the focus away from the teacher's way of providing feedback, such conceptualizations place the emphasis on the students' engagement with feedback, i.e. the way feedback comments are received, understood, and acted upon (Carless et al. 2011; Price, Handley, and Millar 2011). Students are seen as actively engaging in a process that involves making meaning from feedback comments and using this meaning in future work (Jansson 2006). This implies that the comments' meaning is not unilaterally determined by the teacher but is (co-)constructed by the students through interactions and dialogue with each other, the teacher, and the relevant resources, e.g., prior knowledge or material resources (Ajjawi and Boud 2015).

While such dialogical feedback conceptualizations are gaining ground, current empirical research is still largely concerned with measuring effects of feedback by means of the students' learning outcomes and satisfaction (Evans 2013). Evans (2013) showed that only a few studies focus on the feedback process itself and not many employ analytical approaches that make possible to examine how students jointly make meaning of feedback comments and act upon this new understanding. Furthermore, what it takes to make meaning of the feedback comments remains uncertain, i.e., what is the nature of the interactions assumed to be important for meaning-making and how this meaning-making occurs in relation to the knowledge the students are to learn. Our

study aims at investigating what is necessary for student groups to achieve a shared meaning of feedback comments and how these comments can be used. Thus, we analyse the meaning-making process student groups engage in when discussing teacher comments on their collaborative assignments and address the following questions:

(1) How do students engage in interactional meaning-making of the feedback comments addressing their collaborative assignment?

(2) What knowledge content do students attend to while making meaning of feedback comments?

(3) How does the meaning-making unfold over time?

These questions will be pursued through a case study of an undergraduate biology course, in which students had the opportunity to engage with feedback comments on their group assignment drafts from the teacher. The data corpus encompasses recordings of group meetings, during which students discussed these comments, as well as the group's (evolving) drafts. We employ an analytical framework built upon sociocultural learning perspectives and conduct in-depth analyses of the group's discussions and collaborative assignment work.

We first review empirical studies that take a process view on feedback to position the contribution in the field. Next, we elaborate on sociocultural notions of meaning-making and interaction that are central to our analytical strategy. The findings section displays three excerpts illustrating the topics students addressed during their meaning-making activity and how their understanding developed over time and in interaction with relevant resources. We conclude by discussing the study's findings, as well as its contribution and practical implications.

Previous research on feedback as a dialogical process

While most empirical research in higher education still understands feedback as the transmission of a product (Evans 2013), there is an ever-growing number of studies conceptualizing and exploring the notion of feedback as a process. Several focus on the student experience, such as McLean, Bond, and Nicholson's 2015 study, which examined the underlying conceptions of feedback held by students. These ranged from seeing feedback as a one-way message transmission to a more socially situated process. These conceptions differ qualitatively and are assumed to be related to the way students engage with feedback (Marton and Booth 1997). Hounsell et al. (2008) found that students experience feedback as a guidance loop through which they move during their studies. Blair and McGinty (2013) showed that the dialogues during this loop are often experienced as a top-down transmission, in which teachers are telling students the meaning of their feedback comments. Students indicate various aspects that hinder them from initiating a meaningful dialogue with the teaching staff (Small and Attree 2016).

However, few studies have examined the dialogues that take place during feedback processes. An observation study of supervision meetings showed how students reacted with subdued but persistent resistance to critical comments provided on their master thesis manuscripts (Vehviläinen 2009). Students attempting to maintain their own agenda and teachers re-issuing their critical comments characterized these encounters. This misalignment between student and supervisor led to a superficial, defensive engagement with the comments. In the field of medical education, Rizan et al. (2014) studied bedside teaching encounters, in which students were provided feedback-in-action from both the clinician and the patient. The findings showed that students responded best to feedback providers' interaction strategies that enabled students to reach the correct answer with support. Both studies demonstrate that to understand how

feedback can become meaningful, we must scrutinize feedback processes and how they emerge through dialogical interactions between all involved actors.

Other studies have shown that, to make meaning of feedback comments, students need strategies to access the relevant disciplinary knowledge and practices. Eriksson and Mäkitalo (2015) focused on how students are introduced to the genre of a disciplinary field while discussing feedback comments on their assignment outlines with their teacher. The results showed that the way mediational means, such as their outlines, are activated during supervision meetings has an influence on the degree to which students can access the underlying epistemic premises of the respective discipline, such as the typically used genre or ways of reasoning. Similarly, Jansson (2006) focused on group discussions involving students with multi-ethnic backgrounds who tried to make meaning of comments provided on a draft. Using a social practice approach to student writing, this research focused on how students deciphered their teachers' expectations and the institutional conventions of academic writing. They had to access domain-related and procedural meta-knowledge available in the educational setting and through the teacher's voice. These findings emphasize that the meaning-making of feedback comments does not take place in a vacuum but is embedded in a disciplinary context comprising different knowledge contents and practices. Hence, it is important to understand how this plays a role in the students' efforts to achieve a shared meaning of the feedback comments and how this process may generate understanding of disciplinary knowledge contents.

Another research strand focuses on the actual changes made in texts when students engage with feedback comments. Vardi (2012), for example, analyzed how texts changed when students were provided with comments and an opportunity to revise. The findings indicate that the drafts changed in relation to the students'

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emerging understanding of the interplay of the text's form, content, and context and that a draft is a manifestation of the students' understanding of these three elements. Vardi's findings particularly indicate that comments providing guidance on the integration of form, context, and content prove to be effective in producing positive changes. Such findings underline the need to acknowledge that students not only need to make meaning of the comments and the underlying domain-specific knowledge but that they also need to learn strategies to work with that knowledge and represent it in their draft.

Finally, Ajjawi and Boud (2015) explored dialogical approaches' analytical potential in relation to feedback by conducting an interaction analysis of feedback loops between students and teachers in an online environment. Analytically, the study argues for considering the course context, the students' and teachers' actions, the materials, and the timeframe of the process. While building its claims on a limited data corpus, the study illustrates how the analysis of 'enriched' interactions (i.e., complemented by the artefacts involved) has the potential to generate further insights into feedback processes.

The reviewed studies demonstrate how feedback processes can be analysed beyond the study of student experiences. However, the review underlines that there is a stringent need to understand how students engage with feedback comments in their disciplinary context and what processes are involved in making meaning of these comments, i.e., interactions with each other, the teacher, or the relevant resources. Furthermore, we argue that the interactional processes and emerging knowledge work identified as important for this meaning-making unfold over time and that it is essential to examine this temporal aspect to generate a comprehensive view of the process.

Theoretical departure points

Our study builds on the assumption that feedback is a process that starts with the provision of a comment and ends with generating improved academic output, in

between which some form of meaning-making must occur. Coming from this departure point, we follow a sociocultural perspective that views learning as a social process, wherein meaning is co-constructed and negotiated between individuals through interaction and aided by various mediational means (Säljö 2004). This implies that students who are discussing feedback comments are participating in such meaning-making activities, wherein meaning is achieved collaboratively through dialogue (cf. Linell 2009) between various participants, e.g., students and their teachers. Individual contributions and the various available resources mediate this process. Resources can be of material or intellectual nature, such as pre-existing understanding, knowledge provided by teachers, peers, and other sources, or knowledge emergent in the process (Damşa and Ludvigsen 2016).

Another postulate, connected to the sociocultural perspective, is that learning viewed as meaning-making does not take place in a vacuum but within a social, cultural, and historical context. In our study, which is related to a specific knowledge domain, the disciplinary knowledge context becomes highly relevant (Young 2007). The feedback comment can be viewed as a tool to trigger engagement with the specific domain knowledge or practice. This domain knowledge and practice has a twofold function: representing the context wherein meaning-making takes place and providing the knowledge content with which students engage. Thus, every feedback comment has an inherent meaning potential. Meaning is created based on (individual or collective) interpretations of the comment and its underlying domain knowledge. Through their interactions, participants make their own interpretations observable to other participants, and these interpretations become shared resources for meaning-making.

Finally, from the sociocultural perspective, it is acknowledged that meaning-making processes consist of interactional encounters, which unfold over time. To

capture this temporal aspect, we draw on the concept of 'meaning-making trajectory,' as elaborated by Twiner et al. (2014). This trajectory represents the dialogical meaning-making process consisting of moment-to-moment interactions that follow each other over time and are achieved interactionally by the participants as they read, discuss, and act upon feedback comments (Ludvigsen et al. 2010). Methodologically, the concept of trajectory is important because it provides the basis for devising an analytical framework, which allows for qualifying interactional encounters and for making salient the temporal and cumulative nature of the meaning-making as an important characteristic of the students' learning within the given knowledge domain.

Methodology and empirical setting

As part of a larger research project examining pedagogical practices and student learning in higher education, this case study was conducted in a 20-week undergraduate biology course at a large Norwegian university. The course was chosen due to its portfolio assessment design, which included three group assignments and several written feedback comments by the teachers during the semester. The iterative nature of the task and the opportunity to revise and resubmit drafts offered a unique possibility to document the students' work between these resubmission moments. To observe interactional meaning-making in situ, we recruited three student triads who volunteered to record their group meetings and to provide access to their drafts, notes, and feedback comments. All teachers (N=5) and observed students (N=9 out of 27 in total) consented to participate in the study. Individual study or group work generated most of this course's workload.

This study's main data source stems from the audio recordings of student group work. Out of the 36 hours of recorded material, our analysis capitalizes primarily on transcripts (transcribed verbatim and translated from Norwegian), in which the group

members discuss feedback comments among themselves and, at times, with their teacher. Furthermore, interviews with teachers and students, a questionnaire about the student experience, and observations of teacher-organized activities and online activities in the Learning Management System represented background data.

To study the interactional processes in depth and to address our research questions, we focused on one of the three student groups. The group (Anna, Eva, and Paul[1]) was selected because its members met the most frequently to discuss assignments, which provided us with rich information on their work, spanning from the task's assignment to the final deadline. The excerpts are drawn from the group's discussions of the feedback comments provided by the teacher on Group Assignment 1 (GA1). In total, the group met five times to work on GA1, out of which they discussed the comments during group meetings 3-5 (total 3h 50min) and the feedback session (25min; see figure 1). All three students participated in each meeting, except group meeting 4, when one student left the discussion early.

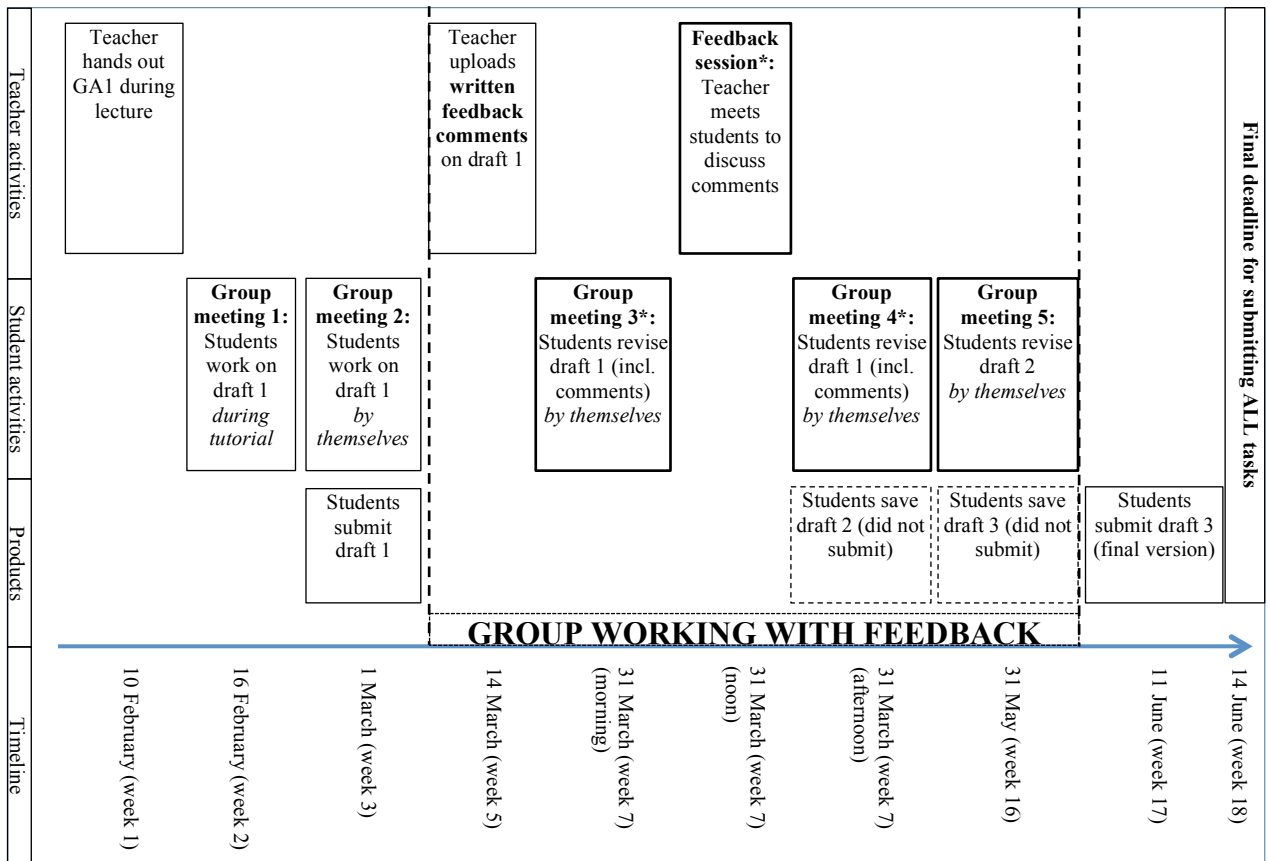[1] These student names are pseudonyms.

Figure 1 (Timeline of activities around Group Assignment 1):

	10 February (week 1)	16 February (week 2)	1 March (week 3)	14 March (week 5)	31 March (morning) (week 7)	31 March (noon) (week 7)	31 March (afternoon) (week 7)	31 May (week 16)	11 June (week 17)	14 June (week 18)
Teacher activities	Teacher hands out GA1 during lecture			Teacher uploads **written feedback comments** on draft 1		**Feedback session*:** Teacher meets students to discuss comments				Final deadline for submitting ALL tasks
Student activities		Group meeting 1: Students work on draft 1 *during tutorial*	Group meeting 2: Students work on draft 1 *by themselves*	Group meeting 3*: Students revise draft 1 (incl. comments) *by themselves*			Group meeting 4*: Students revise draft 1 (incl. comments) *by themselves*	Group meeting 5: Students revise draft 2 *by themselves*		
Products			Students submit draft 1				Students save draft 2 (did not submit)	Students save draft 3 (did not submit)	Students submit draft 3 (final version)	
Timeline				**GROUP WORKING WITH FEEDBACK** →						

Figure 1. Timeline of activities around Group Assignment 1 (GA1); *recordings used in this analysis

GA1 had the theme 'predators and prey' and required solving several domain-specific problems by using simulations and explaining the findings in a 1500-word text. The groups had access to several resources, such as their textbook, lecture slides, a video tutorial, and spreadsheet and word-processing software. Three weeks after the task was assigned, the students submitted a draft in order to obtain written comments and to discuss these during an optional feedback session with the teacher.

Analytical strategy

The departure point for our analytical strategy is the assumption that feedback processes emerge through interactional meaning-making in a trajectory fashion. Such a trajectory

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has its starting point when a comment is first addressed and its endpoint when a final change in the text has been implemented or the discussion ends without any action taken. The trajectory unfolds over time and is generated through discussions and changes in the text during the group meetings. To investigate emerging meaning-making, we focused on interaction episodes as the unit of analysis. These episodes are comprised of the students' talk and the changes made in the draft. Using a thematic analysis (Braun and Clarke 2006), we followed a threefold strategy. First, we used a deductive approach to identify the nature of the students' interactions. The empirically sensitive concepts of *orientation* and *elaboration* allowed us to follow how students addressed and explored different content over time (see Damşa, Ludvigsen, and Andriessen 2013). *Orientation* entails instances where students address new knowledge content, for example by referring to the feedback comment's content, the general domain knowledge, or the aspects of their own text. This allows us to identify the knowledge contents attended to during the meaning-making. *Elaboration* refers to instances that indicate how students are following up these topics, for example when referring to authoritative knowledge sources to support their claims or when making changes in their text. This reveals how meaning is gradually made from the addressed knowledge contents.

Second, to explore the knowledge contents addressed during the interactions, we used an inductive approach to extract the topics students attended to while discussing feedback comments. The emerging topics were summarized into overarching categories that proved to be sensitive to all topics discussed across assignment tasks. This step also entailed identifying all resources and actors drawn upon during these interactions. To increase reliability, both authors analysed a selection of excerpts independently before establishing a common interpretation, which was then expanded to the whole dataset by

the first author. Peer review was also employed by having external researchers compare preliminary findings with interpretations of selected excerpts.

Third, to capture the meaning-making trajectory's temporality, we traced the interactional episodes, knowledge contents, and resources identified in the first two steps chronologically and for each feedback comment. This enabled us to provide a general characterization of the feedback process and how the meaning-making emerged based on interaction and engagement with the knowledge resources. To illustrate the trajectory's temporal unfolding, we selected key episodes that show how the different knowledge and interactional components of meaning-making are closely intertwined and emerge in situ during the group meetings.

Findings

Three illustrative excerpts of key episodes demonstrate how the students Anna, Eva, and Paul are making meaning from one teacher comment on their GA1 draft. The students' graph the comment referred to (Figure 2) shows their attempt to visualize the different food intakes of two predator fish (squares and rhombi).
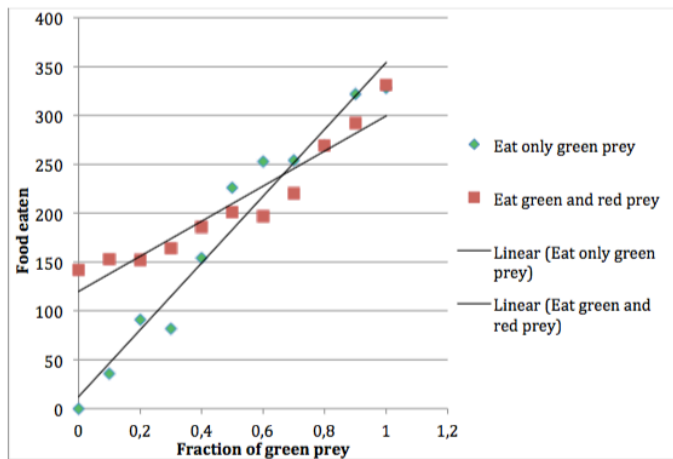
Figure 2: Showing the difference between a predator choosing only the prey with the lowest handling time, and a predator that chooses both preys. Handling time of green prey is 1, handling time of red prey is 5. For this simulation these parameters are constant: attack rate = 1, simulation time = 1000.

Teacher's feedback comment

Comment [1]: Nice figure! Good idea to put fraction red/green on the x-axis. However, is it correct to assume linear relationships?

The three excerpts illustrate the meaning-making processes found across this group's discussions of feedback comments and exemplify the knowledge contents the students explored. Furthermore, they show moment-to-moment interactions through which the group moved from an initial reading of the comment to achieving a shared understanding and, finally, to a representation thereof by changing their draft.

A) Exploring the feedback comment

Excerpt 1: Assuming linear relationship?

During their third group meeting, the three students sat together and discussed draft 1 and the teacher's comments. They had a feedback session scheduled with the teacher later in the day and used two laptops: one had the file with the feedback comment open, the other was used to make changes directly within the draft. The episode began when the students started discussing the feedback comment.

Table 1: Assuming linear relationship? (Excerpt 1)

1	Anna:	Mhm. What did you write there? Nice figure, but …
2	Eva:	Yeah, so this is one of the things we want to ask him.
3	Anna:	Is it correct to assume a linear relationship?
4	Eva:	Yeah, so…so here this is what we did.
5	Paul:	Hmm…I don't know.
6	Anna:	I don't know.
7	Paul:	I assumed it but I didn't think about it.
8	Eva:	Well, the reason that I thought that that was a, I was a little bit…I was thinking about it because it goes like this, but then again it wouldn't be curved because it goes first down and then up again.
9	Anna:	Yeah.
10	Eva:	So it wouldn't be curved like that. So then I thought that the linear was better, a better fit.
11	Anna:	Yeah.
12	Eva:	Yeah, but we should just talk to him about and ask him.
13	Paul:	When I thought about it, it was kind of logical to me that this would be, like a straight line. Like, that I had no, no proof of why...
14	Eva:	Yeah yeah.
15	Paul:	…I assume this. It seems a bit logical, but I don't know why.
16	Anna:	We can ask him and see what he has to say.

The students orient themselves toward three topics during this episode: a) task content addressed by feedback comment, b) underlying domain knowledge of the concept 'linear relationship', and c) strategies to identify relevant knowledge sources. This excerpt begins with Anna reading out loud the comment [line 1, 3], which marks the beginning of the trajectory. The posed question prompts the students to orient their attention toward the task content addressed in the comment by examining their graph [line 4] and discussing its visual representation [line 8 'it goes like this', line 13 'straight line']. While the comment's meaning is not directly addressed, the students show uncertainty regarding whether the teacher's way of posing the question indicates that their assumption of linearity was incorrect or just insufficiently justified. This is visible through a hesitant elaboration that includes a repeated referral to the teacher [line 2, 12, 16] and uncertainty cues in the language [line 8, 13, 15].

The second topic emerges when students start elaborating upon their justifications of why they assumed a linear relationship. To make meaning of the

comment and what it means in relation to their draft, the students orient toward the concept 'linear relationship' and what it means both in the general domain context and in the draft's specific context. This meaning is invoked through the students justifying their accounts of how the graph's shape is related to their assumption of linearity [line 8, 10, 13]. With each statement attempting to explain their assumptions, they orient themselves toward the general domain knowledge of the 'linear relationship' concept and share their understanding of what it means. The students focusing on the line's shape within their graph [line 8] shows they have correctly identified the term 'linear relationship' as referring to a way of visualizing the relationship between two variables. However, none of them elaborates further on the underlying statistical function that is represented by a straight line in a plotted graph.

The third topic students oriented themselves toward was strategies to identify relevant knowledge sources. In the light of their upcoming feedback session with their teacher and their uncertainty about the comment's meaning, the students orient their focus toward how to resolve this uncertainty. The teacher is identified as an authoritative knowledge source, and in several instances, the students elaborate by proposing to request a clarification from the teacher [line 2, 12, 16]. This illustrates how students make strategic (and pragmatic) decisions on how work should be continued and that it is also necessary to engage in strategic discussions when addressing feedback comments. The episode ends with students choosing a strategy that emphasizes their reliance on the teacher's authoritative voice, rather than agreeing upon an interpretation.

Clarifying intended meanings – the teacher's input

Upon the students' request, the teacher provided a concrete answer during the scheduled feedback session and confirmed that their assumption of linearity was correct. However, he challenged the students to include a more scientific explanation in their text, and

gave them access to domain knowledge contents by elaborating on the use of R^2 values: 'You have the possibility to get the value of R^2, which is the square of all the residuals, which says something about, in a way, the percentage of the variation around the line.' Furthermore, he provided strategic advice on how this knowledge could be used to improve the argument: 'You can put the R^2 in the text somewhere and say "we used a linear fit and it has this R^2."' Through this type of guidance, the teacher provides knowledge regarding which strategies are necessary to address the concrete task requirements and how feedback should be dealt with in general.

B) In search of elaboration strategies

Excerpt 2: What needs to be written down?

Excerpt 2 shows an episode from the group's fourth meeting, which occurred immediately after the feedback session with the teacher. One student left early, while the remaining two students discussed the teacher's elaborations and how to address his comments. The students have been revising their draft by addressing all feedback comments one by one and have now arrived at the issue of the R^2 values:

Table 2: What needs to be written down? (Excerpt 2)

17	Eva:	How do we find R^2 for this stuff? Linear, right. Mr. Excel. (*Looks up information on the web, which directs her to website mrexcel.com*) […]
18	Eva:	R^2 value (*Finds out how to calculate the value in the software*). Okay, that's good.
19	Anna:	Yes.
20	Eva:	Do you want to write them down? […] (*Anna dictates R^2 values of all figures in assignment to Eva*)

21 Eva: […] Should we write them in the text or in the the figu...
22 Anna: Ehm
23 Eva: No, we need to write here that we have…
24 Anna: We also need to write that we have used linear…
25 Eva: Yes.
26 Anna: But was it *here* that he said it?
27 Eva: Yes. That…mhm. Because we didn't use it for the other one. There we
         have plotted…
28 Anna: Yes. So, then we write it here.

In this episode, the students orient toward two topics: a) strategies for accessing

knowledge sources and b) strategies for representing knowledge in text. Even though a

different part of the assignment was discussed in the moments before, the dialogue

began promptly with Eva orienting toward their lack of knowledge regarding how to

calculate R^2 values in Excel [line 17]. The students entered a direct continuation of the

previous discussions that took place during the former meeting and the feedback

session. The students had established a common understanding of the issue the

comment addressed (lacking justification of linearity) and its potential solution (provide

R^2 for justification). Their lack of knowledge was immediately alleviated by searching

for and discussing online sources [line 17-19]. After producing a list of R^2 values [line

20], the students moved their attention toward strategies to represent this knowledge in

their text [line 21].

     A shift in orientation away from the general knowledge content of how to

calculate R^2 values and toward their assignment draft characterized the textual

representation strategies. This also implied a shift toward the specific task and course

requirements. In their elaboration, the students discussed several possibilities of how to

represent the meaning made [lines 21-28]. By referring to a teacher's statement from the

feedback session [line 26: 'was it *here* that he said it?'], they oriented toward the

teacher's expectations. This orientation is also reflected in the frequent use of verbs

such as 'should' or 'need'. Only after Eva elaborated on the teacher's input by providing her interpretation of why he had suggested this specific position in their text [line 27] do the students arrive at a shared understanding of how to represent the meaning in the text [line 28]. This shows how the students make meaning of the comment at an intersection between their existing knowledge (represented in the text), which restricts and affords where and how new knowledge can be included, and an assumed ideal representation, which is derived from their general knowledge about how to structure texts and their interpretation of what the teacher has suggested for their final text.

C) Materializing meaning

Excerpt 3: From vague ideas to concrete representations

Excerpt 3 displays a continuation of the students' discussion of how to represent the new meaning in their text, which followed immediately after the discussion shown in excerpt 2.

Table 3: From vague ideas to concrete representations (Excerpt 3)

29	Eva:	Yes. So we write…
30	Anna:	[dictating to Eva]*We used…*
31	Eva:	[saying what she is typing] *We fitted the points to a linear…*
32	Anna:	Yes. [dictating to Eva]*Regression.*
33	Eva:	Ehm…[typing and mumbling to herself] and we can write it this way, squared values are…I would like to make a table out of this, actually. Or is this…?
34	Anna:	Where? For these?
35	Eva:	Because, that's like, how else could you say it, kind of?

36	Anna:	It's nicer with a table, I think, than to only list them. Just make a simple table. [Eva creates a table] […]
37	Eva:	[saying what she's typing in English] *we fitted the points to a linear regression…because it looked like they fit* [laughing]
38	Anna:	Eh…*because*…yes
39	Eva:	[saying what she's typing in English] *Because after our judgment it looked like the better…*
40	Anna:	Yeah. And you can take, because…he, when we asked about it, he said it was fine, kind of.
41	Eva:	*Yes.* [saying what she's typing in English] *because after our judgment, that was the best fit for the points from the simulations […]*

This excerpt shows how the meaning made verbally is transformed through its manifestation into a textual representation. After having arrived at a shared understanding of what is expected from them, the students started elaborating on the meaning made by implementing changes in the existing text. This occurred through several idea-discussion-decision-implementation sequences. For example, Eva suggested making a table [line 33], followed by an elaborating discussion [line 34-36] and a subsequent decision and implementation [line 36]. The way the table is created illustrates how the idea of adding R2 values to the assignment (i.e., providing statistical evidence for linearity) remained somewhat vague until the students were faced with the need to elaborate and concretize it in their text. During their elaboration, the students considered academic standards (e.g., the students know they should write in an academic style) and aesthetic aspects ('it's nicer with a table' [line 36]).

Similarly, the attempts to find formulations that count as appropriate justifications in the local context [line 30-32, 37-39, 41] show how meaning continues to be made while being converted into a representation. Formulating the sentence required the students to revisit the meaning that had emerged earlier during their group meeting and in the feedback session with the teacher. For example, they used terminology [line 31-32: 'fitted points to a linear regression'] introduced during the

meeting with the teacher. After further elaboration — Eva attempting to give a more scientific formulation [line 39] and Anna referring to the teacher's approval [line 40] — the students agreed on a final version. Thus, the students materialized meaning into a representation, which signifies an interactional meaning-making achievement. Figure 3 shows the final changes made in the draft, marking the end of the meaning-making trajectory.
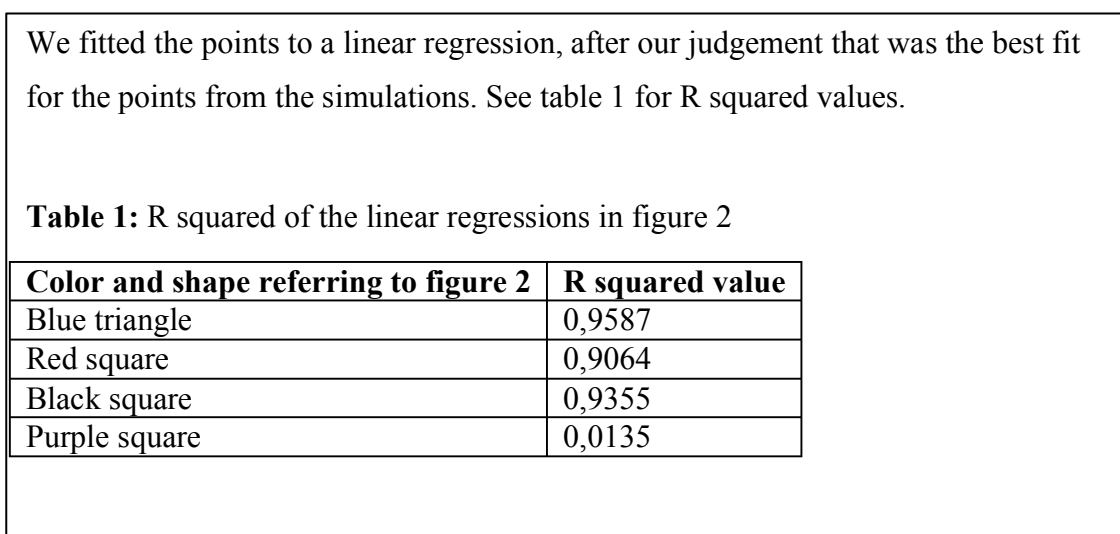
We fitted the points to a linear regression, after our judgement that was the best fit for the points from the simulations. See table 1 for R squared values.

Table 1: R squared of the linear regressions in figure 2

Color and shape referring to figure 2	R squared value
Blue triangle	0,9587
Red square	0,9064
Black square	0,9355
Purple square	0,0135

Figure 3: Students final changes in the draft

Meaning-making trajectories within the knowledge space

This integrative section presents a summarizing description of the students' interactions and the knowledge contents they engaged with while making meaning of feedback comments on their group assignments. Furthermore, we highlight how the three interaction episodes can be understood as constitutive moments of a meaning-making trajectory.

Our findings show a rich variety of interactions that became visible through the ways students discussed with each other or their teacher and through the changes made in the text. These interactions entailed the students *orienting* toward certain topics, e.g.,

by reading a comment, suggesting a new idea, or identifying missing knowledge, which was followed by either a *re-orientation* toward a new topic or an *elaboration* on the former, e.g., by retelling what the teacher had said during the feedback session, providing justifications of their assumptions, or formulating potential responses to the comment. Through these *orientation-elaboration sequences* — or step-wise achievements — the students progressed in their interpretations and in making meaning; these also shaped subsequent interactions. In general, the interplay between the students' ideas and actions, their teacher's suggestions, and the available resources influenced the topics students oriented toward. Resources were intellectual, such as knowledge of concepts or methodologies, and material, such as textbooks or assignment drafts. These resources mediated the interactions and influenced what knowledge contents the students turned to while engaging in discussions, elaborations, and the assignment work.

Determining what knowledge content student groups attended to during this meaning-making of feedback comments involves examining the topics the students addressed over time. In excerpt 1, the students oriented themselves toward the task's content before advancing to the underlying domain knowledge of the 'linear relationship' concept. They also discussed strategies for accessing relevant knowledge sources. This shows that meaning-making requires understanding of the declarative content related to the concrete task *and* of the procedural knowledge and strategies needed to address the feedback comment. In excerpt 2, the students were concerned with strategies for accessing knowledge sources and representing their knowledge in the text. Across the whole data, students tended to shift their focus toward the procedural knowledge once a shared understanding of declarative content had been established. The students also frequently addressed strategies for work collaboration,

communication, and task management, for example when students decided together what feedback comment to discuss next. These general strategic discussions became an important element of meaning-making, as they enabled the group to manage its work in a way that enabled meaningful engagement with the declarative knowledge content.

A two-dimensional model, depicted as a *knowledge space,* can describe these epistemic characteristics of the meaning-making process. This model consists of a *functional dimension*, which discerns whether students attend to declarative ('what') or procedural knowledge ('how'), and a *contextual dimension*, which discerns whether the knowledge is related to the assignment's wider disciplinary and academic context ('general') or to the task's concrete aspects ('local'). Figure 4 provides an overview of this knowledge space, with examples of the addressed knowledge contents that students attend to while making meaning of feedback comments.

[Insert Figure 4 here]

With regard to the question how meaning-making of feedback comments emerged over time, the findings show that the students moved along *trajectories* with a clearly identifiable beginning (first, addressing a comment) and end (making changes in a draft or discontinuing the discussion without change). Each comment had an inherent meaning potential, which initiated the students' attempts to achieve a joint understanding by sharing, discussing, and agreeing upon individual interpretations. The three discussed excerpts show a meaning-making trajectory illustrative for trajectories found across this group's data. The interaction episodes show the group pursuing the 'linear relationship' notion, which was initiated by a feedback comment ('Is it correct to assume linear relationship?') and concluded with a representation of the agreed-upon meaning (representation of linearity through table of R^2 values). This trajectory spanned over time and was characterized by continuity in the elaboration of the meaning made,

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even when interruptions occurred due to location changes or working on other assignments. We found that these trajectories are, overall, characterized by the addressed knowledge contents that are positioned in different sections of the knowledge space and the interactions through which students manage and discuss these contents and move from topic to topic within the knowledge space.

Discussion

This empirical study aimed at generating in-depth insights into the feedback processes related to learning in higher education by underpinning the dialogical view of feedback with a sociocultural learning perspective. The findings provide several important insights into what is necessary for student groups to make meaning of and to work with the feedback comments provided by their teacher. Our analysis generated an account of feedback processes as emerging meaning-making trajectories, along which student groups move to pursue a shared understanding. They do so by orienting toward and elaborating upon different knowledge contents, which can be positioned in a two-dimensional knowledge space comprised of declarative and procedural knowledge, both in the concrete task context and the wider disciplinary context. Students' interactions with each other, their teacher, or the available resources mediate how students move in this knowledge space.

The knowledge space that students operate in is a central aspect of our findings, as it is central to understanding the complexity of what students must consider when making meaning of feedback comments. They not only need to make meaning of the comment itself but also of the underlying domain knowledge and strategies for working with that knowledge. This substantiates the claim that feedback processes are situated in a disciplinary and academic context (Young 2007). The declarative and procedural knowledge the students co-construct during this process is not only locally relevant for

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improving the current assignment but helps in advancing the students' understanding of their discipline and in affording more advanced meaning-making processes in the future. This complex interdependence of meaning-making of the feedback comments and the underlying domain knowledge is in line with Eriksson and Mäkitalo's (2015) findings, which showed how supervision dialogues around feedback comments provided students with access to the discipline and its underlying epistemic premises and practices. Our study provides an in-depth insight into the moment-to-moment interactions through which students explore these epistemic aspects (i.e., knowledge contents, methods, and norms; see also Damşa and Ludvigsen 2016) that are specific to the biology domain by discussing feedback comments. Students not only need access to the wider domain knowledge content but must learn strategies for working with that knowledge, for example by finding ways to represent it in their assignment drafts. This study has made clear that, for students to access the knowledge and strategies necessary to engage in making-meaning of feedback comments and solve the task, resources such as pre-knowledge, clear task descriptions, or trustworthy knowledge sources must be available. This notion adds to the existing literature (Ajjawi and Boud 2015) by arguing for considering the resources activated during feedback processes and the process through which this happens. Hence, our study highlights aspects similar to Vardi's (2012) findings, in that the students' understanding evolved based on feedback comments and on the opportunities to process them through discussions and draft revisions. In revising their drafts, the students materialized the meaning potential inherent to the feedback comment in a step-wise manner, contributing to the gradual meaning-making.

This study also provided insight into the way students took a position of problematizing the feedback comment's meaning and co-constructing it in a dialogue

with the teacher instead of simply accepting it. In line with McLean, Bond, and Nicholson's study (2015), this suggests an underlying conceptualization of feedback as a process of developing understanding that requires a particular engagement from the student side. The students involved the teacher in their quest, as both a dialogue partner and a knowledge resource. Thus, our findings expand Jansson's (2006) work showing that students are not only engaged in deciphering knowledge provided by their teachers but are generating their own interpretations and ideas, contributing to an enhanced meaning and adding meaning to the baseline understanding provided by the comments. Navigating the knowledge space happens in a bottom-up manner, as students are constructing meaning together and are creating 'new' knowledge contents, taking responsibility for the meaning-making process.

Students expecting explanations of the feedback comments and the teacher providing minimal explanations and prompting the students to find solutions on their own indicates a delegation of responsibility to the students with regard to the meaning making. While our study was focused on examining and illustrating the way the students approach the meaning making process, analyses also hinted at that the responsibility for this meaning making is negotiated. These negotiations also play an important role in facilitating the teacher's understanding of the students' needs in relation to meaning-making. This offers further interpretations for Vehviläinen's (2009) findings of student-teacher misalignment occurring during supervision meetings, which might be related to their diverging understandings of what roles each had to play in that interaction. This supports also the idea that the feedback comment should not be considered a message transmitted from teacher to student but rather as a resource that can expand or limit access to the knowledge space within which students move. In this context, the way feedback comments are formulated has a considerable influence on the

way meaning-making emerges. By providing indications of what knowledge content students must consider to make meaning, comments become valuable mediating resources themselves.

Methodologically, this study provides an empirical substantiation of the micro-level interactional mechanisms of the feedback process that goes beyond previous empirical depictions of feedback from a dialogical perspective. Claims about these dialogical processes often remain at a conceptual level (Evans 2013; Price, Handley, and Millar 2011) or are only approximated through self-reported data from students or teachers (cf. Hounsell et al. 2008). This study moves the unit of analysis beyond the self-reported experience with feedback by using observational data and by employing an analytic strategy that focuses on enactment, as well as exploring the emerging talk and knowledge products.

This empirical investigation focused on the analysis of material from one student group, following a case study approach. We acknowledge that the empirical substantiation of the meaning-making of feedback comments is limited because of the nature of this approach and that, possibly, other aspects characterizing this process might emerge from analyzing more groups' data. By focusing in-depth on the activities of one student triad, our primary aim was to provide detailed descriptions of the examined interactions and processes. Following Roschelle's (1992) stance, we argue that a case study's value lies in its potential to "clarify the meaning and import of a set of ideas […], [to] attract attention to problems that have been overlooked, and [to] create awareness of powerful theories that have not been fully tapped" (p. 268). On this basis, we argue that this case study and our moment-to-moment analysis allowed for providing an illustrative substantiation of the assumptions laid out at the study's outset

and for enabling us to identify the characteristics of interactional meaning-making that extended beyond the local context of this specific case.

The study also generates valuable insights at the conceptual level. Construing feedback as a meaning-making process, in which interaction, knowledge, resources, context, and time interplay, offered an opportunity to: a) generate empirical substantiation of how these combined elements lead to meaning-making and b) contribute enhanced insights to the emerging reconceptualization of feedback as a process viewed from a dialogical, sociocultural perspective. Identifying and characterizing the knowledge space in which various interactions lead to meaning-making and generating an account of how meaning-making unfolds as a trajectory are aspects that enrich this conceptualization and open avenues for new empirical examinations.

Implications for practice and further research

From an educational practice perspective, this study's findings confirm the idea that feedback processes should be designed as dialogue between participants, with the teacher contributing to the students' meaning-making (Boud and Molloy 2012). It should not be assumed that students engage deeply with feedback comments, or that making meaning of these comments and acting upon them is a straightforward process. Beyond engagement with new knowledge contents, which is a challenge in itself, this requires access to appropriate resources and familiarity with strategies of task management and collaborative work. Providing students with resources to engage in (interactional) meaning-making of comments and with guiding structures that enhance this joint endeavour should be considered when developing student-centred learning environments.

This study's findings clearly identify new avenues for future research. One aspect that requires a further in-depth examination is the way pedagogical perspectives can help design learning situations that enable students to engage in meaning-making of feedback comments, including the relevant conditions and resources. One other relevant topic is the role(s) teachers play in the (interactional) process of making meaning of feedback comments. Our study indicates that much depends on the teachers' approach to formulating comments and whether they are open to dialogue rather than dominating the meaning-making process, on how students position themselves in the interaction with the teacher, and on how proactive they are in inquiring about new meanings. Hence, whether teachers are authoritative knowledge sources or instead equal partners in the students' interactional meaning-making is an important question to address.

Our study has contributed empirical insights into the complexities surrounding feedback as a process of meaning-making. The study's findings make a clear case for feedback being conceptualized as a process that is generated through students' dialogue and interaction with peers, the teacher, and the relevant resources. Students are the main actors in this interactional endeavour, which gradually unfolds over time and by means of students navigating in knowledge spaces and attending to knowledge related to the underlying domain. The study highlights the importance of approaching feedback as a process that enhances learning through dialogue and productive use of knowledge resources, and which fosters a space that allows for engagement and interaction between different participants.

their valuable comments on the manuscript and the participants in the study for allowing us to gain insight into their work.

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