



How to teach know-how? Corrective manual demonstrations in teaching construction work



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ABSTRACT

Drawing on 20 h of video data from a vocational school construction site, this conversation analytic paper analyzes corrective demonstrations that target the skilled use of task-relevant tools in the context of learning manual work. With narrated demonstrations, the teacher shows the students how to skillfully use the tools and guides their vision to see how the material outcome should be interpreted in materially complex tasks. Orientation to the students' emerging expertise shows in how corrective demonstrations are built on participants' existing procedural understanding that is redirected by means of corrective demonstration. A crucial element in these multimodally designed demonstrations is tool transfer that marks the beginning and the end of the demonstration sequence.

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1. Introduction

A construction site is a workplace characterized by manual and physical labor that demands highly specialized skills, such as operating machines and handling tools. Honing these skills requires training, often in the form of vocational education or apprenticeship. During the training, the future construction professionals acquire knowledge ranging from the properties of different building materials to how to organize the work logically and efficiently. Complementary to this propositional knowledge – the *know-that* of construction work – construction workers need procedural knowledge of how to execute the work tasks – the *know-how* of construction work – that they acquire through executing the work and accumulating experience. Know-how concerns, for example, knowing how to physically execute the task of plastering, or understanding whether a tool operates correctly by the sounds it emits.

In teaching expert skills in physical tasks, teachers convey not only factual knowledge but also how to practically accomplish a task. A common instructional practice is to use demonstrations that showcase the specific way a task is executed (Zemel and Koschmann, 2014). By trying the demonstrated activity out, the students can start building expertise, which involves “development and transformation of skills to meet the specific requirements of a particular, conventionalized practice” (Arminen and Simonen, 2021: 579). In the context of physical labor, “getting the body to act in certain ways”

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(Lindwall and Ekström, 2012: 42) is crucial to learning how to master such practice. In this study, by detailed analysis of interactions between a construction work teacher and his students, we will focus on how the teacher helps his students to master tasks that involve understanding what to do with one's body: how to use different tools and how to understand working with different materials.

Our data come from a small construction site where students from a vocational school for adults practice trade-related skills under the supervision of one of their teachers. In the context of training novices in physical and manual labor, the teacher as an expert is responsible for assessing the student's bodily conduct and the material outcome of the work (Lindwall and Ekström, 2012). Furthermore, the students orient to the teacher as a source of feedback (Nieboer et al., 2019). If the teacher considers some aspect of the work problematic, they “may adjust and reshape the learner's actions, forms of participation, and understandings” (Arminen and Simonen, 2021: 584). This can be done, for example, by corrective demonstration (Ehmer, 2021; Evans and Reynolds, 2016; Keevallik, 2010; Lindwall and Ekström, 2012), which entails taking departure in the learner's work and by manually demonstrating an adapted or alternative way of accomplishing the same task.

This paper analyzes *corrective demonstrations* that target the skilled use of task-relevant tools in the context of learning manual work, thereby contributing to our understanding of how manual know-how is instructed. Using multimodal conversation analysis, we focus on sequences in which the teacher corrects aspects in a student's ongoing work by means of manual demonstration. We will argue that corrective demonstrations inherently build on the less experienced participant's existing procedural understanding, which is then redirected by focusing on a detail that the more experienced participant deems missing from the less experienced participant's understanding of the procedure. In addition, the analysis illustrates how the participants orient to the skilled use of tools and materials as an essential part of construction-specific manual know-how.

The structure of this paper is as follows: First, we describe how demonstrations and corrective demonstrations are interactionally organized based on previous research. This is followed by a brief outline of our data. In the analysis, we focus on two excerpts in which corrective demonstration becomes relevant after a problem in executing a previously instructed task has been identified by either the teacher or the student. Finally, we discuss our findings in light of the role of corrective manual demonstrations in teaching manual know-how for materially complex tasks.

2. Demonstrations and corrective demonstrations

Demonstrations are a central resource for teaching skills that involve doing something with one's body (Ehmer and Brône, 2021). They have been studied, for instance, in the contexts of crocheting classes (Lindwall and Ekström, 2012), sports training (Evans and Reynolds, 2016; Råman and Haddington, 2018; Råman, 2018), dance classes (Ehmer, 2021; Keevallik, 2010, 2013, 2014), dental education (Hindmarsh et al., 2014), surgical education (Zemel and Koschmann, 2014), and cooking (Stukenbrock, 2014). Demonstrations are routinely used in instruction of manual tasks to convey as many multimodal aspects (e.g., handling and manipulating of tools and materials) as possible (Ehmer and Brône, 2021; Zemel and Koschmann, 2014). Instruction can be understood more generally as a practice of teaching, or as a social action that makes a complying second action relevant (see Lindwall et al., 2015). In this paper, we look at demonstrations as an instructional practice (Ehmer and Brône, 2021), and as instructing actions that make the re-enactment by the instructee relevant. That, in turn, makes relevant the instructor's assessment (Zemel and Koschmann, 2014).

Earlier research on demonstrations shows that demonstrations are highly structured social activities in which verbal, embodied, spatial, and material aspects are finely coordinated (Ehmer and Brône, 2021) to allow the instructed person to obtain a close picture of how the activity is accomplished (Goffman, 1974). Demonstrations are often both linguistically and materially set up in a way that the instructed participants have visual and auditory access to the demonstrated activity (Evans and Reynolds, 2016; Lindwall and Ekström, 2012; Råman, 2018). For example, in budo classes, shared interactional space is created by the teacher 1) positioning themselves in a jointly witnessable location, 2) verbally signaling the end of the practicing activity and 3) the beginning of the teaching activity (Råman, 2018). The beginning of the teaching activity is verbally signaled by a “teaching projector”, which is typically a verbal description of what will be demonstrated (Råman, 2018). This is then followed by a verbal pre-beginning element (*elikkä* in the Finnish data and so in the English data, Råman, 2018) that, in turn, projects the embodied demonstration (see also Stukenbrock, 2014 about so as a projector in German and Lindwall and Ekström, 2012 about *så* in Swedish demonstrations).

The verbal pre-beginning element is followed by the demonstration itself. Through talk and segmented embodied demonstrations, the instructed technique is broken down (Råman and Haddington, 2018). This kind of parsing allows the instructor to highlight details of the demonstrated activity with “phase-clarifying actions”, such as pointing gestures and narrating speech (Råman and Haddington, 2018; see also Lindwall and Ekström, 2012). In phase-clarifying actions, the verbal part is integrally tied to the embodied actions through pace and timing, and the linguistic design is characteristically indexical (Keevallik, 2010; Lindwall and Ekström, 2012; Råman and Haddington, 2018). For instance, German deictic *so* ‘like this’, coupled with the demonstrated action, can constitute the explanation of how the action is completed (Stukenbrock, 2014).

As the demonstration is performed for the instructed person to understand what to do with their body, the next step of learning the skill is the instructee mimicking the activity with their body. These enactments provide learners with experiential access to the demonstrated actions (Zemel and Koschmann, 2014). An attempt to accomplish the demonstrated activity not only allows the instructed person to practice the task but it also makes their understanding of how the activity is done publicly available (Evans and Reynolds, 2016; Lindwall and Ekström, 2012; Stukenbrock, 2014; Zemel and Koschmann, 2014). The instructor monitors the performance of the instructee, and monitoring and assessing can result in the instructor ratifying what the instructed participant is doing, or the bodily conduct may be adjusted by the means of corrective demonstration (Evans and Reynolds, 2016; Keevallik, 2010; Lindwall and Ekström, 2012; Råman and Haddington, 2018).

In institutional instructing settings, assessing and evaluating are typical practices for the instructor to guide the instructees' work. For instance, in teaching the mastery of the surgical process, the supervisor closely monitors and assesses the work and intervenes, if necessary (Nieboer et al., 2021, 2022). Autonomy is considered an important didactic principle in teaching the mastery of the surgical process, but the supervisor must be constantly ready to restrict the instructee's autonomy to ensure the optimal patient outcome (Nieboer et al., 2021). In terms of autonomy, the corrective practices range from suggestions for what to do next to verbal or manual intervention, and finally to the supervisor stopping the ongoing work and taking over the instruments so that the instructee continues as an assistant (Nieboer et al., 2021, 2022).

Orientation to the evaluative practices shows not only in the feedback the instructors give but also in the way the instructees orient to receiving feedback. Evans and Reynolds (2016) describe how powerlifters sometimes initiate correction by seeking feedback at the end of their lift. The instructed person may also seek feedback during their attempt at executing the instructed action. This can be done, for example, by inviting the instructing person to witness the bodily action or by asking clarifying questions while doing the work (Lindwall and Ekström, 2012; Nieboer et al., 2019; Stukenbrock, 2014). Thus, although it is the instructor's right and obligation to provide a corrective solution, corrections can be initiated by both parties, and corrective work is accomplished mutually.

Corrective demonstrations have been mostly studied in the context of physical training (Ehmer, 2021; Evans and Reynolds, 2016; Keevallik, 2010, 2014) in which they have been found to follow a structure similar to demonstrations in general. The instructor first sets the frame for corrective demonstration, then, accompanied by verbal explanations, reenacts the incorrect performance, and demonstrates the correct way of doing the activity (Evans and Reynolds, 2016; Keevallik, 2010). After that, the participants return to the practice and try to adjust their actions according to the demonstration – or they may do so already during the demonstration (Ehmer, 2021).

When the expert skill in question includes manipulating physical objects, as in the case of crocheting, the development of the manual skill may not only show in the way the manual action is executed but also in the material outcome (Lindwall and Ekström, 2012). Thus, the error does not necessarily have to be bodily quoted (cf. Keevallik, 2010), but it can be pointed out in the outcome, and the physical product can be also manipulated by the instructor. Lindwall and Ekström (2012) describe physical intervention as a corrective practice (see also Nieboer et al., 2021). By entering the “manipulatory sphere” (Mead, 1938: 167–172), the instructor joins the physical activity and assists to accomplish a part of it to demonstrate the correct conduct. Lindwall and Ekström (2012) point out that the instructor cannot complete the task, but the instructed person must embody the correct conduct for the sake of learning. In general, the materiality of the project makes it possible for the instructor and the instructee to adjust their actions in accordance with each other, and together gradually reach the aimed result (Lindwall and Ekström, 2012).

As described above, corrective demonstrations that aim at addressing an issue in learning a manual skill seem to slightly differ from corrective demonstrations in the context of physical training. In instructing manual tasks, corrective demonstrations typically are manual demonstrations that target the use of tools and materials. In this article, we explore corrective manual demonstrations by describing their typical structure and analyzing how the skilled use of tools and materials are instructed with them.

3. Data and method

The data that form the basis of this study consist of video-recordings from a small construction site. The site, a detached house under renovation, is a construction site with contractors renovating various parts of the house. At the same time, it is a site at which students from a vocational school for adults can practice the skills that they learn at the school's workshops. The students thus participate in a form of “experiential learning” (Zemel and Koschmann, 2014: 163) in which both the execution of work tasks toward finalizing the renovation project as well as learning the trade are acknowledged and accepted parts of the situation. Four to six students at a time came to the site to work on the basic renovation and construction tasks, such as plasterwork, painting, and sanding. The students worked under the supervision of their teacher who is a construction professional.

Two to three members of our research team¹ followed the group for seven out of eight days at the site. The purpose of the research – an investigation of the interactional practices at a multilingual workplace with focus on manual labor – was explained to the participants, and written consent to video-record at the site was secured. We took a group-ethnographic approach to the data collection, i.e., all researchers video-recorded the work and noted their

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observations down in written fieldnotes. We collected a total of 20.5 h of video recordings and produced roughly ten pages of fieldnotes.

At the beginning of each day, the students were briefed about the tasks that needed to be done, and jobs were distributed. Most of the time, the students worked individually, and they often worked on the same or similar tasks for several days in a row. The teacher instructed the tasks and otherwise circulated between different students to answer possible questions and supervise the progression of the commissioned work. The setting thus allowed us to observe institutional instruction of manual and physical work, and our continuous presence and recording at the site made it possible to observe the progress of the work and make sense of the general practices of teaching and learning.

Using multimodal conversation analysis (Mondada, 2019) to analyze the data allowed us to scrutinize the relevant sequences in detail and to better understand the situations in which corrective demonstrations, as a means of teaching know-how, occur and how they are interactionally organized in the given complex physical and material environment. Our analysis is based on a collection of 12 instances of corrective manual demonstrations in which a more experienced person, typically the teacher, demonstrates a technique or the use of a tool to a student. In these cases, either the teacher or the student notices a procedural problem in the ongoing work, which is then rectified by the teacher through a corrective demonstration.

The data are presented in two ways: First, we show the general setup, the participants' orientation toward each other, and the relevant material objects and tools in form of a graphic transcript (see Laurier, 2014). Second, we present a more detailed textual transcript following Mondada's (2018) conventions for multimodal transcripts in order to highlight both aspects of the material ecology as well as the sequential unfolding of the interaction between the participants.

4. Corrective manual demonstrations in teaching know-how

A common way of teaching a new technique in vocational training for construction work is to demonstrate it, accompanied by verbal description. In the studied data, the students learn different aspects of renovating walls, which include mixing substances for plastering, plastering and sanding the walls, and finally priming and painting them. All those subskills are taught at different phases of the work and demonstrated individually, according to each student's work progression. A new skill is usually taught after the teacher has assessed the former phase to have been completed and that the student has sufficiently acquired the embodied knowledge related to the previous task (see Nieboer et al., 2021).

After the initial instruction, the students are typically left alone to work on the instructed task. The teacher makes rounds between the students and gives them feedback based on what he observes. Giving feedback normally includes the teacher entering the room where a student is working and inspecting the work and the material outcome. Feedback on the work can be very minimal, such as a verbalization *hyvä* 'good', often coupled with a gaze toward the ongoing or just-finished work. *Hyvä* routinely functions as a signal to the student that the work is either going well and should be continued the same way, or that the task is completed, and the student should move on to the next task that teacher then instructs (see Huhtamäki and Grahn, 2022). Furthermore, the teacher's presence and attention open an interactional space for the student to ask for advice.

In the following, we will analyze two extracts from the collection that on the one hand illustrate the common structure of corrective manual demonstrations and on the other hand showcase the different ways corrective manual demonstrations occur in our data. In the extracts, corrective demonstrations have a different relationship with feedback and assessment: In the first extract, the teacher initiates giving feedback, and in the second one, feedback and assessment are solicited by the student. The corrective manual demonstrations typically target different areas of know-how, depending on if they are initiated by a teacher or a student. In the first extract, the corrective demonstration focuses on refining a detail in the previously instructed technique, as the teacher assesses there to be an issue in understanding how the physical activity should be done and why. In the second extract, the corrective demonstration addresses the understanding of what kind of technique to use, based on the interpretation of the material outcome of the work. We show how in both cases the student's existing know-how serves as the point of departure for the corrective demonstration as we analyze how the participants' orientation to emerging expertise in learning manual work is organized through verbal, embodied, and material resources.

4.1. Correcting a detail in technique

In the first excerpt Tuomas, a student, is sanding a wall in a room. Pasi, the teacher, passes by the room as part of his normal round to assess the individual students' work. He seems to react to the sound of sanding as he changes his trajectory from walking away from the room. He first turns his head and then his whole body to enter the room (Fig. 1, panels 1–2). When he comes in, he positions himself within Tuomas' field of vision and starts to inspect the wall with his gaze (Fig. 1, panel 3). In that way, Pasi makes his presence and assessing activity visible to Tuomas, who acknowledges Pasi with a brief gaze toward him before resuming his work (panel 4). Thus, both participants orient to Pasi's ongoing visual inspection as unproblematic and as part of their usual routine.

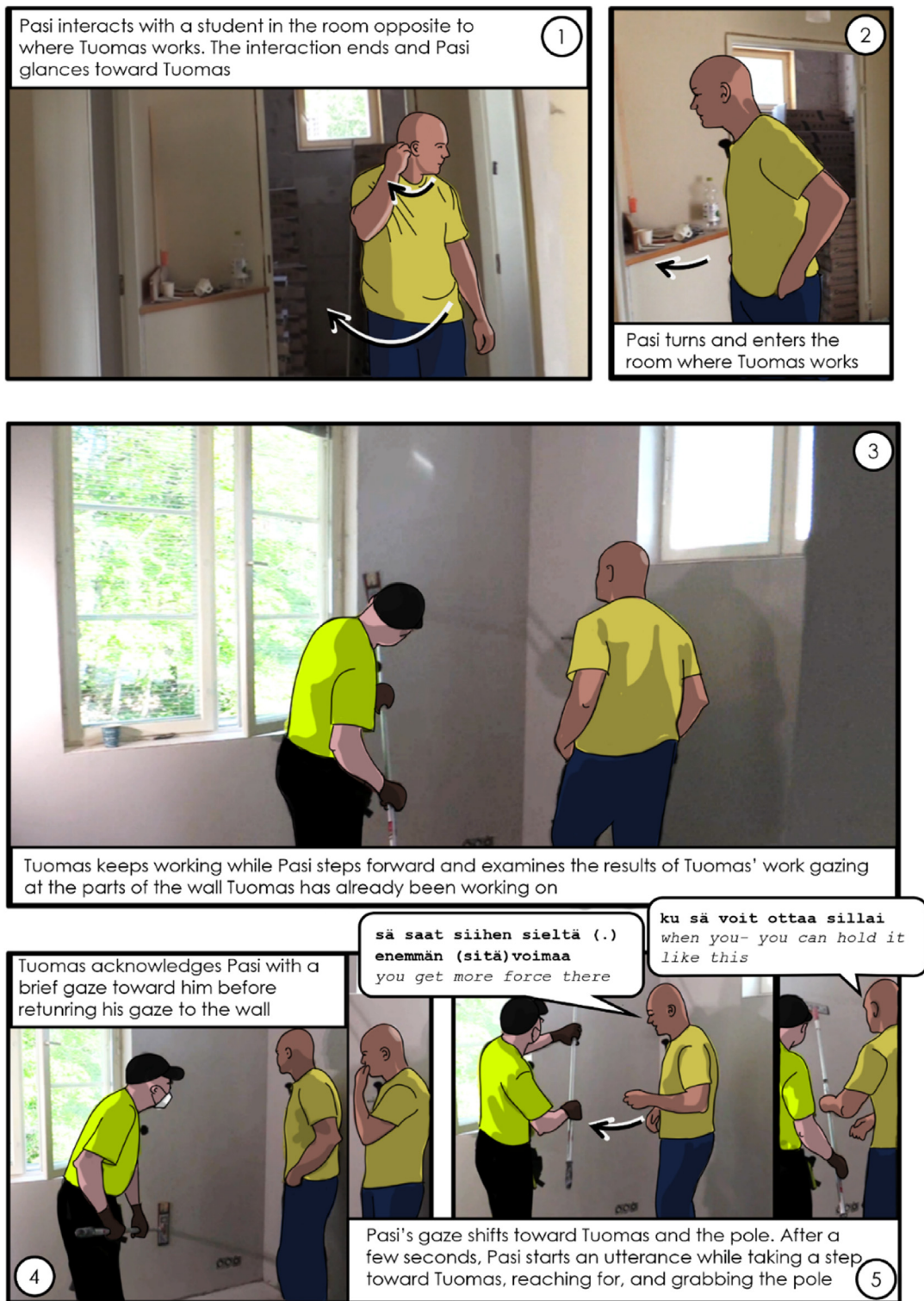


Fig. 1. Pasi enters Tuomas' space, inspects his work, and initiates a corrective demonstration.

During the inspection, Pasi first looks at the wall for an extended period of time (panels 3–4) before he shifts his gaze to Tuomas' handling of the tool, a telescopic pole sander (panel 4, second part). Tuomas does not join the inspection nor does Pasi invite him to join. Following the visual inspection, Pasi initiates a corrective demonstration targeted at Tuomas' sanding technique and handling of the tool. He sets the demonstration up with a teaching projector in a form of a suggestion for how to make the work more efficient (panel 5) and by stepping closer to the wall while reaching for the pole, as also depicted in Excerpt 1-1.

EXCERPT 1-1

```

01 PAS sä saat sii%hen sieltä (.) ene%mmän (sitä)      %/[voimaa
    you get more force there
        %steps twd tuo-----%reaches for pole-%grabs pole
02 TUO                                               /[ymh
                                                /stops sanding
03 PAS [ku sä] %/voit ottaa sillai
    when you- you can hold it like this
        %pulls pole twd himself
04 TUO [(hnh)]
    /lets go of pole
05      (1.3)

```

Pasi's suggestion in lines 1 and 3 in Excerpt 1-1, in combination with his step forward and reaching for the pole (line 1) is oriented to by Tuomas as an upcoming correction. The suggestion is formatted as a conditional statement, but Pasi's movement and manual action convey that the statement is not a mere suggestion but a preparation for addressing a problem. Also, Pasi's verbal reference to using more force – in relation to what Tuomas has been doing – (“enemmän voimaa”, Excerpt 1-1, line 1) suggests the same. When Pasi enters Tuomas' manipulatory sphere, Tuomas suspends the sanding and holds the pole at hip-level for a moment before slightly nudging it over to Pasi who grabs the pole simultaneously.

What happens next is an essential phase in preparation for corrective manual demonstration in the data: As the students are working on the actual tools needed for executing work, the tools need to be transferred from the student to the teacher, for the teacher to be able to demonstrate how to use the tools to better execute the work. An embodied request for the tool (line 1) stops Tuomas' manual activity and by handing the tool to Pasi, Tuomas surrenders his autonomy of the task to Pasi and takes a role as observer and recipient of the upcoming demonstration (see Nieboer et al., 2021).

Fig. 2 documents the tool transfer in detail. Panels 1 and 2 show Pasi reaching for the pole while uttering his turn, thus already projecting an upcoming demonstration. Tuomas takes a step forward, toward Pasi's outstretched hand. Pasi then grabs the pole and Tuomas lets go of it (see also line 3 in Excerpt 1-1 above), thereby accepting Pasi's projected corrective demonstration. With the corrective demonstration, Pasi shows Tuomas how the hands should be positioned on the pole to apply more pressure to the pole in sanding. The start of the corrective demonstration is depicted in panel 3 where Pasi places the sander on the wall.

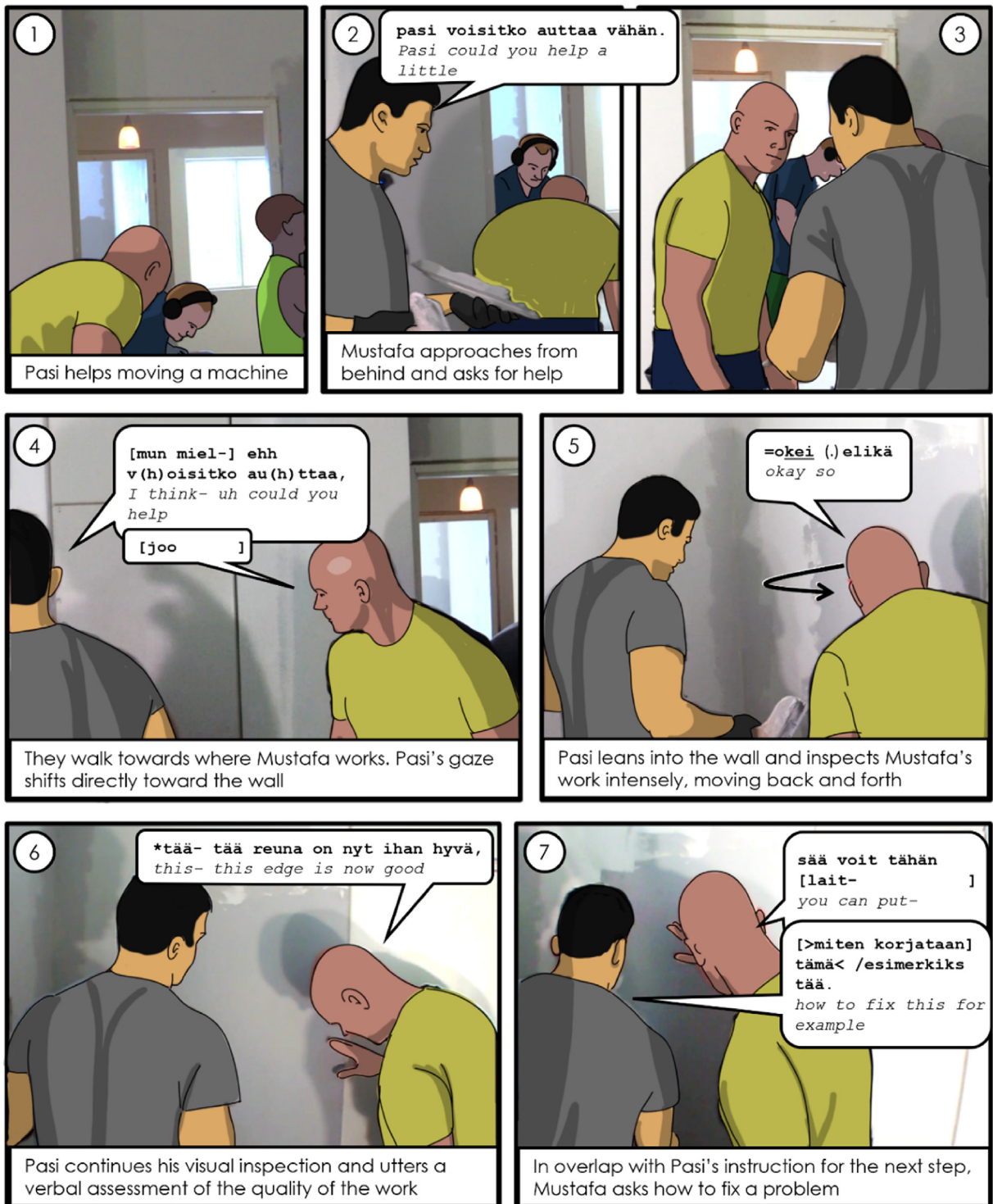


Fig. 3. Mustafa approaches Pasi for help; Pasi inspects and assesses Mustafa's work.

EXCERPT 2-1

- 01 MUS *pasi* *voisitko auttaa /vähän.*
Pasi could you help a little
 >>walks up to *pas* /turns to walk twd wall-->
- 02 (.)
- 03 MUS [*mun miel-*] *%ehh v(h)oisitko au(h)ttaa,/*
 I think- uh could you help
reaches wall/
pas %looks twd wall and starts turning twd it
- 04 PAS [*joo*]
 yes
- 05 PAS *joo,=*
- 06 MUS *=män en tieidä.*
 I don't know
pas reaches wall%
- 07 *% (1.4)*
pas %looks at wall-->
- 08 MUS *(vielä.)=*
 (yet)
- 09 PAS *=okei*
- 10 PAS *elikä *tää- tää reuna on nyt ihan hyvä,*
 so this- this edge is now good
*points at different spots on wall-->
- 11 PAS *älä tee siihe enempää mitään=**
 don't do anything more to it
-->*
- 12 MUS *=m[kei?]*
- 13 PAS [*ja,] tota:*
 and
- 14 (.)
- 15 PAS **sää voit tähän [lait-*]*
 you can put-
 circular pointing----
- 16 MUS [*>miten korjataan] tämä< /esimerkiks tää.*
how to fix this for example
/crouches down and comes up
with a down-up stroke of
taping knife→

Pasi starts to visually inspect the work already as he approaches Mustafa's workspace (Excerpt 2-1, lines 3–6). Pasi reaches the wall in line 6, and in line 10 he starts to routinely comment on Mustafa's work without Mustafa having specified what his problem is. In line 10, Pasi produces a verbal pre-beginning element *elikkä* and then goes ahead to give a positive evaluation on the edge of the wall Mustafa has been working on. Typical of routine assessments, Pasi begins with a positive evaluation which is followed by a prompt for the next step (see Koschmann et al., 2011), in this case a directive for not to work further on the assessed area (line 11). That is directly followed by the beginning of an instruction for what to do next (lines 13 and 15). This forward-orientation to the next task by Pasi implies that he deems Mustafa's work as sufficient to progress (see also Zemel and Koschmann, 2014).

At the same time, Mustafa points at a spot on the wall, which is followed by a turn in line 16 that interrupts Pasi's instruction. In his turn, Mustafa repeats the request for help and now specifies the problem. He does that by asking 'how to fix this, for example' and by doing a down-top stroke on the leveling substance on the wall, with the taping knife in his hand. The specification of the problem is thus produced in fine coordination between verbal, bodily, and material resources. Mustafa manipulates the material and demonstrates what happens when he executes the work with the technique he has learned. The physical action produces the problem visibly in the manipulated material, and the verbal expression 'for example' generalizes it beyond the immediate physical outcome and unique bodily action.

Mustafa's bodily-verbal explanation makes not only the problem but also the limits of his manual know-how visible: Although he understands that the outcome produced with the technique mastered by him is not desired, he does not know how to interpret the material outcome in terms of what to do next. In line 17, Pasi produces a change-of-state token *aa* (see Koivisto, 2015) and as a solution, he starts to introduce a new technique (Excerpt 2-2, line 19). Meanwhile, Mustafa has continued to spread the putty on the wall, which Pasi now interrupts with a gesture (lines 19–20), coupled with a verbal account (line 20). It is notable that, up to this point, Pasi has aimed at steering Mustafa's work verbally and only now he interrupts Mustafa's manual action and reaches for the tools Mustafa has been using (line 22). Thus, up until this point Pasi has oriented to Mustafa's know-how as sufficient for continuing the work himself and with the help of verbal instructions only.

EXCERPT 2-2

17 PAS a::

18 (1.1)

19 PAS nyt- joo *>nyt kato levittelet tähä/ (.) tasoitteet=
 now- yeah so now you spread putty here
 *raises hand-->
 mus -->/

20 PAS *=tä^s o iha< oikee %määrä.*
 here is the right amount
 looks at wall-->%
 palm twd wall-----

21 (.)

22 PAS ni sää %voit ottaa sel (.) %*leveemmä lasta=
 so you can take the broader knife
 %gz behind-----%gz back twd wall, starts reaching for
 mus' tools*-->

Pasi's following verbal instruction in line 22 is formatted as a suggestion 'you can take the broader knife', and simultaneously, he reaches for Mustafa's tools. Mustafa hands the tools over to Pasi without objection, thereby orienting to the upcoming demonstration. With the tool transfer, Pasi's verbal instruction expands into manual demonstration during which he introduces a new use for the 'broader knife' (see Fig. 4).

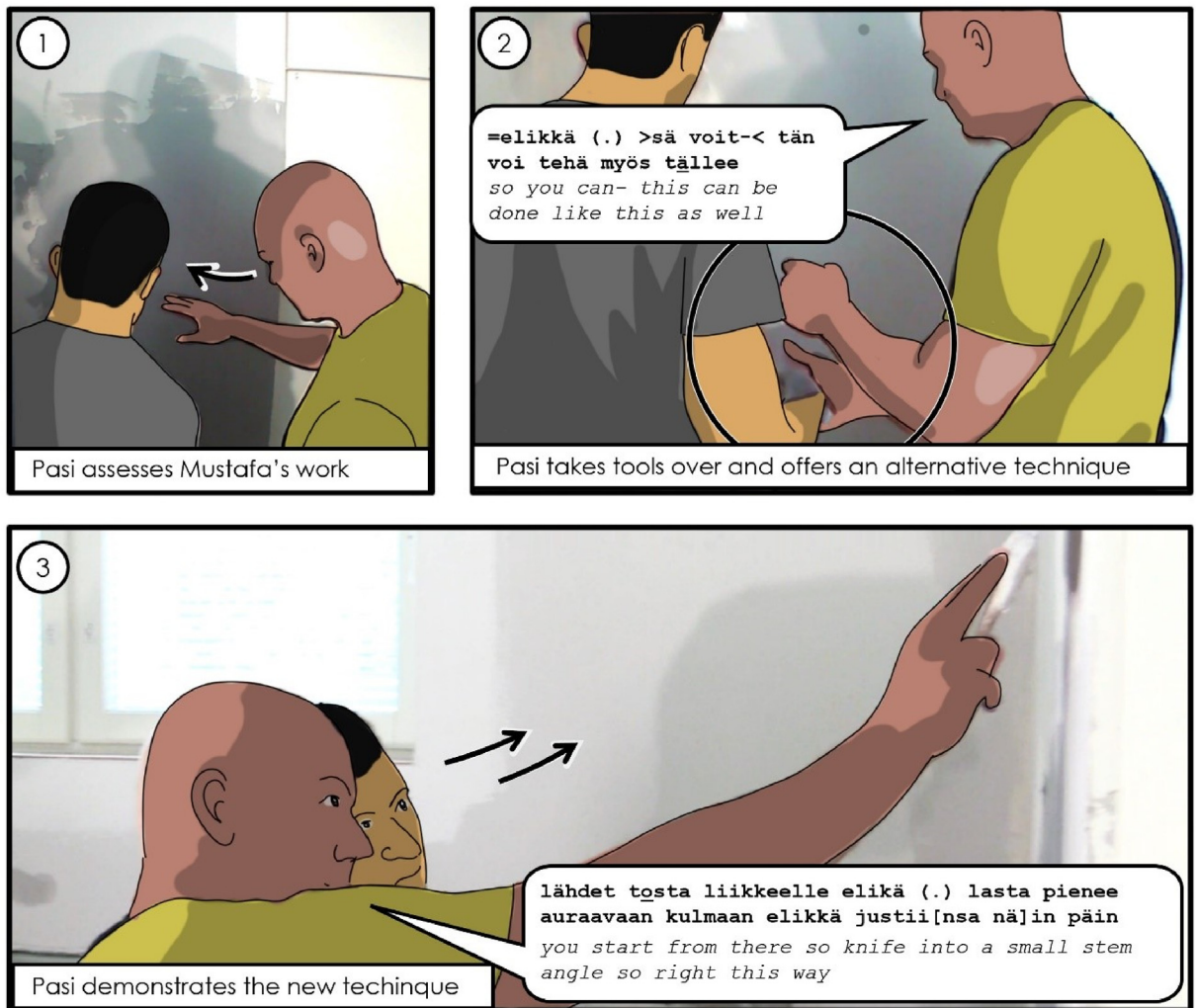


Fig. 4. Snapshots from the corrective demonstration. (1) Pasi points out positive aspects of Mustafa's work, (2) Pasi offers an alternative, (3) Pasi demonstrates the new technique and narrates the process.

Pasi's utterance in line 23 (Excerpt 2-3, Fig. 4, panel 2) can be analyzed as a teaching projector (see Råman 2018), a verbal description of what will be demonstrated: *tän voi tehdä myös tälleen* 'this can also be done like this'. The formulation, with a modal expression *voi* 'can' together with *myös* 'also' suggests this to be an alternative way of doing the leveling, not a correction of the work that has already been done. Thus, it indicates that the upcoming demonstration builds on Mustafa's existing expertise and manual know-how (see Råman and Haddington, 2018; Stukenbrock, 2014) by looking forward to the next phase of executing the task, for which Mustafa needs a new technique.

EXCERPT 2-3

23 PAS =elikkä (.) %>sä voit-< tän voi tehdä myös tälleen%
 so you can- this can be done like this as well
 -->%takes over MUS's tools-----%

24 (0.5)

25 MUS oke:,

26 PAS %eli: tota: (0.7) näi
 so like this
 %cleans RH knife-->

27 (3.9)%
 pas -->%

- 28 PAS lähdet %tosta liikkeelle eli%kä %(.) lasta pienee
 you start from there so knife into a small
 %raises RH knife-----% %knife hovers, pas angles it in
- 29 auraavaan kulmaan elikkä justii[nsa nä]in päin
 stem angle so right this way
 different directions%-->
- 30 MUS [okei]
- 31 PAS sit vaan% %tasane- tasane (.) veto tänne alas
 then just an even even stroke down here
 presses knife to wall% %draws knife evenly down while crouching-->>
- 32 (0.7)
- 33 MUS mm-hy
- 34 PAS tästä näin
 from here
- 35 (1.6)
- The teaching projector is followed by a verbal pre-beginning *eli näi* ‘so like this’ (line 26) that projects the embodied demonstration, beginning in line 28. Next, Pasi prepares the knives for applying a new layer of putty, narrating the procedure as he goes (lines 28–31). Pasi demonstrates in several iterations the specific angle at which the knife should be held (Excerpt 2-3, lines 28–29 and Extract 2-4, lines 42–43). Only after a verbal receipt from Mustafa (line 33), Pasi makes a stroke from the high spot on the wall all the way down to the bottom.
- In what follows, Pasi explains the technique in detail, while he demonstrates it (Excerpt 2-4, lines 36–40). In lines 42–43, he begins, both verbally and with a depictive gesture, to add another detail to the technique. This is interrupted by Mustafa in line 44.
- EXTRACT 2-4
- 36 PAS tossa% (.) tosta päästät niinku irti
 here here you let go
 -->%
- 37 MUS kei.=
- 38 PAS =sit yrität nostaa ylimääräsen tasotteen tohon (.)
 then you try to lift the leftover putty there
- 39 toiseel lastaan ja täältä (0.8) %alhaalta vastaan tästä näi.
 on the other knife and from here from below back
 %demos same procedure bottom-up and
- 40 (1.7) %
 pas cleans knife%
- 41 MUS %okei=
 pas %raises up-->
- 42 PAS =sama homma% %(.) ku sä lähet tosta vetää uuteen kertaan
 the same thing when you start
 -->% %raises RH imitates leveling movement off the wall%-->
- 43 PAS meet pikkusen tohon noin pääl[le]%
 you’ll go a little on top of that
 -->%
- 44 MUS +[ei mut] (--) ku mä aloitan
 no but when I start
 +points at different points on wall-->
- 45 siellä (.) +sit jotain täs (.) +semmonen (.) tapahtu+u (.) tää.
 there then something here this happens this
 +holds point-----+circles spot-----+

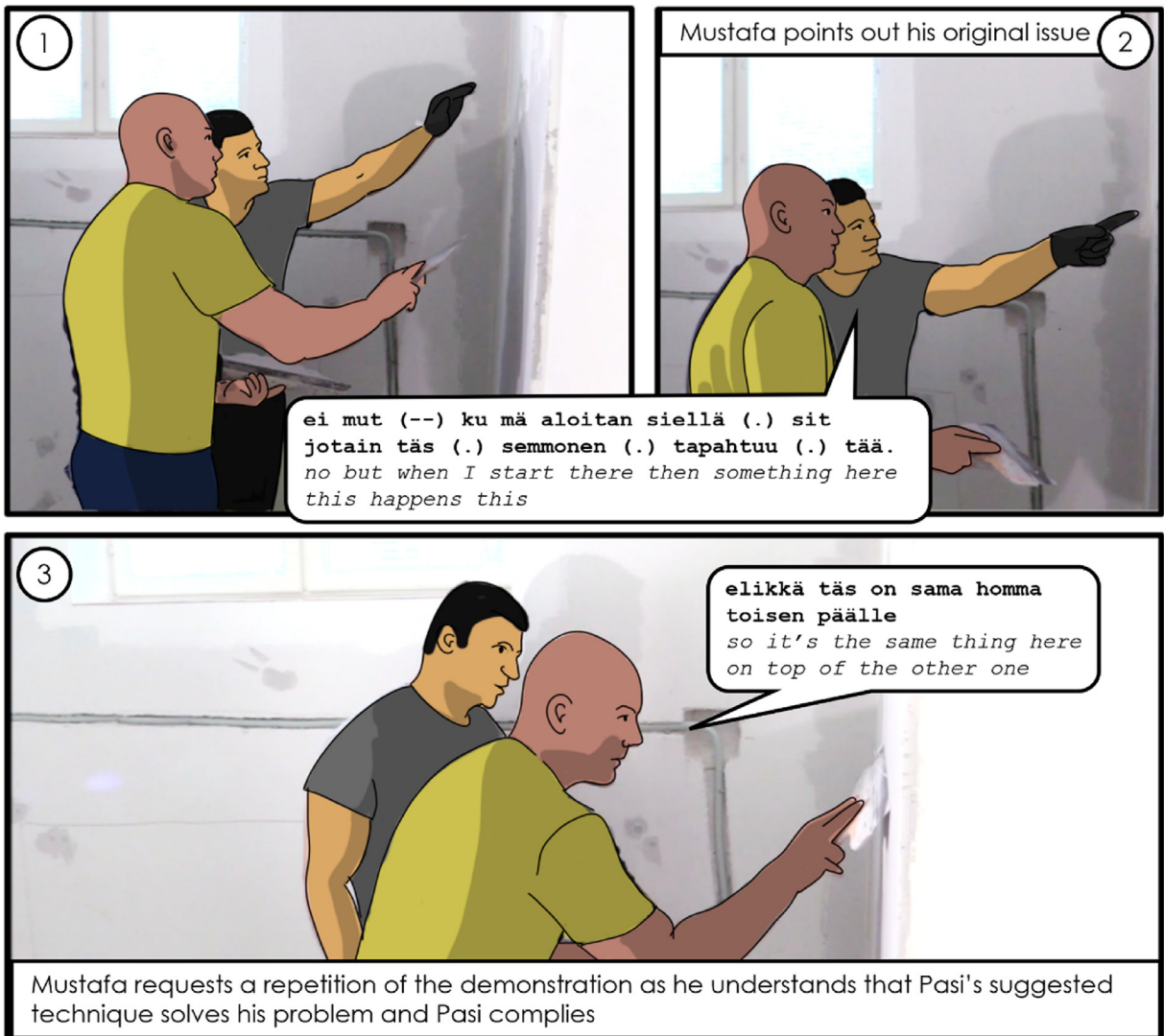


Fig. 5. Mustafa returns to his original issue; as he realizes that Pasi's suggestion solves his problem, he requests a repetition of it.

Subsequently, Pasi demonstrates the new technique one more time. This time, the verbal part of the demonstration is more minimal (Excerpt 2-5, lines 53, 57, 60), as both participants orient to it as a repetition of the previous demonstration. In line 62, Mustafa accepts the demonstration and Pasi hands the tools back to Mustafa, thereby concluding the demonstration. This time, too, Pasi walks out of the room after the demonstration, leaving Mustafa to practice the technique alone.

EXCERPT 2-5

53 PAS %elikkä täs on sama homma % %toisen päälle
so it's the same thing here on top of the other one
%raises knife and angles it% %slow down stroke-->

54 (1.7)

55 MUS °aa°

56 (2.2)%
pas -->%

- 57 PAS %näi (---)
 like this
 %swiftly removes knife and cleans it-->
- 58 MUS °e:ho.°%
 pas -->%
- 59 (.)
- 60 PAS %täältä tulee taas (.) alhaalta,
 here it comes again from below
 %short down-up stroke from bottom%-->
- 61 (1.6)%
 pas -->%
- 62 MUS %kei.
 pas %raises up
- 63 / (1.0) % (0.6) / % % (0.8)
 mus /nods-----/
 pas %gaze twd mus, nods-% %hands tools back to mus%-->
- 64 MUS °okei°
- 65 (2.1)%
 pas -->%

This example illustrates how corrective manual demonstration can be used for guiding the student to better understand the material they are working on. The demonstration follows a request for help to address a problem the student has identified. As shown in the analysis, the teacher and the student orient to the outcome differently, based on their different levels of expertise in plastering the wall. The student draws on his embodied experience in executing the task he has been previously instructed in, whereas the teacher orients to the bigger project of plastering the wall. As a solution, the teacher offers a demonstration for how to use the familiar tool differently.

In general, the participants' orientation to each other's expertise and know-how is complex and negotiated across the entire sequence. The student turns to the more experienced participant for help, as he recognizes where his manual know-how ends. However, he later challenges the relevance of the solution provided, as he sees a misalignment between the issue he introduced and the demonstration that should solve it. In his demonstration, the teacher takes departure in the embodied knowledge the student has already acquired and teaches a new technique to address the issue in the material outcome that cannot be addressed with the previous technique. This initial mismatch of what the participants take as the student's problem is gradually interactionally resolved (Koole, 2012). With the demonstration, the teacher works to reorient the student's focus, which finally happens when the student understands the purpose of the demonstration and requests a repetition of it. Thus, the participants gradually and collaboratively close the gap in know-how through a multilayered demonstration of a new technique which will solve the student's issue also in the future.

5. Discussion and conclusion

The skilled use of tools is an essential part of manual know-how required for construction work. In this article, we have shown how corrective demonstrations can be used for teaching manual know-how in vocational training for construction work, especially in terms of the use of task-relevant tools. The purpose of demonstrations is to transform the implicit, practical knowledge into explicit, conceptual knowledge that can be bodily practiced and acquired, so that it gradually turns into manual know-how. Corrective demonstrations, more specifically, inherently build on the less experienced participant's existing procedural understanding that is redirected in the way the more experienced participant deems necessary for a satisfactory outcome. In our analysis, we have shown how in corrective manual demonstrations manual actions, verbalizations and orientations to the materiality of the project are finely coordinated to enable experiential access to the task.

In the data, corrective demonstrations are part of the evaluative work done by a construction work teacher at a site which is both a real worksite as well as a learning context. The demonstration either happens as part of the teacher's inspection routine or it becomes relevant by a student's request for assistance. As the teacher arrives at the student's workstation, he visually (and sometimes haptically) inspects the work. Based on his assessment or through a negotiation with the student, he initiates the corrective manual demonstration, which typically follows the structure presented below.

1. teacher enters the student's space
2. teacher's assessment of student's ongoing work
3. teaching projector: verbal suggestion or alert
4. tool transfer from student to teacher
5. teacher's narrated demonstration
6. optional: repetition/specification of the demonstration
7. tool transfer from teacher to student
8. student trying out the demonstrated technique

Corrective demonstrations have a dual orientation to the student's manual know-how. On the one hand, by means of corrective demonstration the teacher addresses an issue the student has in executing a previously instructed task. Based on the teacher's assessment, the student has not yet acquired sufficient procedural knowledge related to the practiced skill, which can manifest both in the student's handling of the tools, and in the material outcome of the work. By focusing on a detail that the teacher sees missing from the student's understanding of the practice, he aims to reshape the embodied understanding of the procedure and thus contribute to the growing know-how.

On the other hand, corrective demonstrations are built on the student's existing procedural understanding that is redirected by means of corrective demonstration. Orientation to the student's emerging expertise shows in how the teacher takes departure in the student's work. For instance, teaching projectors are typically formulated as suggestions for alternative ways of executing the action. Thus, the teacher acknowledges the existing know-how and builds on it. Especially when the corrective demonstration is prompted by the student presenting an issue in their work, the teacher first explicates what the student has done correctly and only after that introduces an alternative way.

Corrective manual demonstrations are a common practice for the participants at the site and are oriented to as such. Even though the verbal format that initiates the demonstration may take the form of a noticing or suggestion, the students orient to them as upcoming opportunities to learn: They position themselves so that they have an unobstructed view to the demonstration, and they hand the tools over to the teacher. Tool transfer is an essential part of the corrective demonstration, as the teacher takes over the student's work momentarily and makes the student an observer of how to correctly execute the manual task. During the corrective demonstration, the teacher draws the student's attention to the physical details of how the bodily action is coordinated in relation to the tools and materials of the manual activity in question. Tool transfer back to the student signals that the demonstration is over, and that it is the student's turn to execute the task as demonstrated.

In teaching manual work, corrective demonstrations can be aimed at addressing a problem identified either in how the manual action is executed or in the material outcome of the work. What to do with one's body, what to see and feel, and how to handle tools and materials is an essential part of learning construction work. This development of manual know-how requires not only practicing new techniques but also getting feedback on the outcome of the work. This is done by a detailed verbal evaluation, during which the teacher guides the student to interpret the material outcome by focusing on and pointing out different visual and haptic aspects of it, thus training the student's professional senses. Corrective demonstration is a practice that extends feedback into instruction targeting a specific aspect of the work that should be done differently. Thus, corrective demonstrations orient both to the student's existing embodied knowledge and to developing the manual know-how further.

The practice of correcting by demonstrating is not unique to teaching and learning construction work, but corrective manual demonstrations are a crucial instructional tool in learning manual work. Our paper merely scratches the surface of instructional practices at sites where experiential learning takes place: What other practices related to the materiality, know-how, and the participants' bodies are used in this kind of complex material environment? While we mostly remained on the level of instruction as a situational practice, longer instructional projects working toward developing a specific skill, such as plastering, could additionally contribute to our understanding of the construction site as a place at which learning takes place.

Declaration of competing interest

None.

CRedit authorship contribution statement

Hanna-Ilona Härmävaara: Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Nathalie Schümchen-Schram:** Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis, Data curation, Conceptualization.

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