# Developing the construction sight: Architectural education and technological change

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## ABSTRACT

The general thrust of this study is exploratory. With an interest in the development of competence, and, the achievement of professionally purposeful action – as this is done by way of digital technologies – the study exploits the details of a single collaborative design/learning activity among students of architecture. The provided analysis aims at informing the discussion on the role of technically mediated visual reasoning for the emerging professional vision of the to-be architects. By demonstrating the performance of visually complex actions and events – events and actions that could not have occurred outside the particular medium used – the study raises some principled issues. The first issue pertains to the problem of separating the analytical work made by the students from the tools and other resources that enable this work. The second issue concerns how the use of the technology generates new ways of *seeing*, *showing* and *doing* architecture.

## KEYWORDS

Visual representation • visual communication • perception • design • architecture • education • ethnomethodology

## INTRODUCTION

In the last three decades, there has been a growing interest in the ways representations are used in human activities, and how they help to organize knowledge and shape perception. Representations are not only regarded as adding and clarifying information, but also as serving as an inseparable part of understanding and, thereby, as transforming the practices in which they are used (Ivarsson, 2004; Wartofsky, 1979). A clear example of this complex

relationship between perception and these historically developed modes of knowing comes from Goodwin (1994), who followed the professional activity of archaeological field excavations. He shows that the archaeologists have specific routines through which they create what he refers to as a *professional vision*, which consists of socially organised ways of seeing and understanding events emerging from the distinctive interests of this particular social group. One part of the archaeologists' work takes the form of the production of graphical representations of the excavation site. And, according to Goodwin, 'the practices clustered around the production, distribution and interpretation of such representations provide the material and cognitive infrastructure that make archaeological theory possible' (1994, p. 626).

The study reported here takes architectural education as its point of departure. In contrast to a scientific practice such as archaeology, architects do not begin with a pre-existing world to be collected, processed and represented. On the contrary, one can observe somewhat of a reverse process, which starts with abstract underspecified notions that – by way of the work of architects and other professionals associated with the construction industry – evolve into large concrete material structures. While natural scientists study and render their domain of scrutiny (Goodwin, 1994) *meaningful* by way of representations, architects make use of representations as communicative and *creative* instruments. Throughout history, architects have devised a set of tools through which ideas for future constructions can be developed and communicated. Two of the most central tools are (floor) *plans* and (building) *sections.* In addition, there are also *elevations*, *scale models*, and *perspectives* (Wakita & Linde, 2003). These representational tools have become so deeply intertwined with architectural practice that it is hard to imagine this profession existing apart from them. Especially the use of plans and sections could be understood as the current baseline of architectural practice. In order to pass through the educational system, students of architecture must show that they master these forms of representation.

In what follows, I will argue from a position that accepts an interdependency of professional competence and representational technologies. That various tools and associated techniques are constitutive of the architectural profession will be taken as a point of departure for the remainder of this discussion. *How* this is done, however, is an open matter, and, possibly subject to considerable change. While the forms of representing architectural designs (i.e. plans and sections) are remaining the same, the possible means towards these ends are increasing. Where the architects would previously use only transparent sketch-paper, pens and different rulers, they have for the last three decades also been able to construct their drawings with the aid of computers. At first, these CAD programs were not much more than digital drawing boards. In the last few years however, there has been an increased availability of programs that also make it possible to simulate and visualise pending designs with high fidelity.

The interests of this study lie in the development of competence as observed during education, and in particular, the achievement of professionally purposeful action by way of digital technologies. To paraphrase Goodwin; if the practices clustered around the production, distribution and interpretation of *architectural representations* provide the material and cognitive infrastructure that make *architectural design* possible, what are the implications of the current shift, within education, in the use of two-dimensional drawings to interactive three-dimensional versions? How does the use of these new tools interact with, and perhaps reshape, the specific abilities students develop during their training? These latter questions should be understood as initial queries that have informed the approach to the studied site, and their settlement is beyond the scope of the present study.

The general thrust of this paper is exploratory. By exploiting the details of a single collaborative design/learning activity, in which the participants draw on resources historically unavailable within educational practice, I aim at two things: First, rather than presenting a number of cases or episodes on a more superficial level, the analysis is grounded in a close description of a single episode. This provides for an in-depth understanding of the studied activity unattainable by most methods. With this understanding in view, I want to call into question the commonly made separation between tools and skills. Second, the very *demonstration* of the performance of visually complex actions and events that could not have occurred outside this particular medium raises some principled issues. These issues pertain to the role of technically mediated visual reasoning for the emerging professional vision of the studied to-be architects.

## A LEARNING PRACTICE OF ARCHITECTURE

The reported research comes from a larger exploration of the creative and envisioning possibilities offered by representational technologies. It is grounded in a study of design and problem-solving activities among students of architecture. To create a background from which to perform detailed analyses of the work of students and educators, a one-year ethnographic study was carried out at a school of architecture. At this site, students going through their second year were followed from autumn to spring. In addition to the participant observations and discussions with the students, a number of video recordings were made. The choice was to capture situations where groups of students, either alone or in the company of a supervisor, discussed various designs and how to further develop them. In sum, about twenty hours of such naturally occurring design conversations have been documented.

The course, from which a short sequence is analysed here, was called 'Building One' with the subtitle 'Detail and Whole'. The general purpose was described as a 'training in the skill of controlling the character of a building by working through its details'. The course comprised seven weeks of full-time studies. Through literature studies, case studies and lectures, the students

were supposed to develop a repertoire of aesthetic and technical approaches, solutions and principles for the detailing of buildings. A second part of the course was applied architecture. In the preceding course, the students had been working mainly on the floor plan of an apartment building. Features connected to the façade, materials and construction were only specified at a very general level at that point. In the current course, however, the students were instructed to use the plans made previously and further specify the constructional design. They were thus supposed to produce more technically correct construction drawings this time.

There were a few different tasks assigned to the students attending the course, but the one I will focus on had to do with the construction of a *building section*. For those readers ill-versed in architecture, a brief explanation is in order: A building section shows what a structure looks like when cut vertically by a cutting plane.[1] The general purpose of the building section is to provide both architectural and structural information. This information is very important for construction supervisors and the craftsmen who build the actual building. Building sections show the construction of the wall, as well as the way in which structural members and other features are joined to it. A further pedagogical advantage connected to the drafting of building sections is that the very process reveal flaws in the structural integrity of the building (Wakita & Linde, 1994, 2003).

The formal task was described as follows: *construct a building section of the students' earlier design, on a scale of 1:20*, which should be presented as a printout from AutoCAD. This short formulation of the task implies a whole range of specific knowledge, which is obviously not part of the actual formulation, but rather of the practices of fulfilling the task or of architectural practice itself. More specifically, the students would have to deal with what is meant by a *building section* and what the *scale 1:20* actually means in this context, especially in connection to the task of producing a *printout*. At the beginning of the course, the students did not know how to carry out the task in an acceptable way or even what the task actually implied. Even though they were very well aware about the concept of building sections and had drawn previous versions themselves, the demands on them were now greater than before. Issues that became topical in relation to their efforts to understand the task were, for instance, what level of detail to work with, or the balance between using pre-made commercial solutions vis-à-vis inventing new ones.

Not knowing how to proceed or what would be reckoned as valid solutions, in relation to the work undertaken, were recurrent themes in the discussions between the students, and could probably be seen as general features of many project-based educational practices. Nevertheless, at the end of the course, most students presented projects that were regarded as more or less acceptable. A general aim of the research project, then, has been to understand how competences of this sort developed in the students' work and discussions.

The computer programs the students used in their work on the task were mainly AutoCAD for drafting their design and, in addition, some groups used the 3D modelling program called SketchUp (version 5). SketchUp is software used to create, modify and share 3D models. It is said to be easier to learn than other 3D modelling programs in that it has a simplified toolset, a guided drawing system and a clean look and feel. Furthermore, the original group of developers allegedly envisioned developing 3D design software that would make design exploration accessible to everyone by building on a few design principles:

> Allow designers to *draw the way they want* by emulating the feel and freedom of working with pen and paper in a simple yet elegant interface.
>
> Enable the user to have *fun*.
>
> Be *easy* to learn and use.
>
> Enable designers to play with their designs in a way that is not possible with traditional design software. (SketchUp, 2007)

The issue concerning the validity of these claims, made by the company behind SketchUp, does not need to be addressed here. What is interesting is what role the program was given in the interaction between the students. The use of SketchUp was not something that was required of them, and, it was not necessary to solve the task. All the students were instructed to hand in a printout from AutoCAD. Still, several groups took what on a superficial level could appear to be a detour. The initial interest of the analysis was to unravel why this was done.

## Analysing and representing computer mediated interaction

While much design research still relies on coding schemes and protocols (Lawson, 2004), the current study is inspired by *ethnomethodology* (Garfinkel, 1967, 2002; Livingston, 1987) and *conversation analysis* (Sacks, 1984; Sacks, Schegloff, & Jefferson, 1974; Schegloff, 2007) in line with an evolving tradition of ethnography of design practices (Büscher, 2001, 2005; Crabtree, 2001, 2003; Dourish & Button, 1998; Murphy, 2001, 2004). The task of ethnomethodology and conversation analysis has been described as to 'uncover, describe, and analyze the ways in which social order is ongoingly produced, achieved, and made recognizable in and through the practical actions of members of society' (Psathas, 1995, p. 66).

The ways in which interaction is sequentially organised has been thoroughly documented and analysed, predominantly in relation to naturally occurring conversation. As pointed out by Schegloff (2007), how these issues are appropriately described in non-conversational settings of talk-in-interaction is

a matter of empirical inquiry. This remark could be seen as more in line with the later developments in ethnomethodology, the so called *collection of hybrid studies of work and science* (Garfinkel, 2002), where the interest is 'directed to locating a particular discipline's domain-specific details of lived work.' (Garfinkel & Liberman, 2007, p. 7). In this 'collection' of studies, there are several that deal with visuality and technology, but I will only briefly mention three examples.

Mondada (2003) describes a number of procedures in laparoscopic surgery and shows in what ways the visual materials are constitutive features of this occupational practice. Greiffenhagen and Watson (2009), within the domain of human-computer interaction, explore the question of how the identification and remedying of items on the screen is socially organized. And, finally, Nishizaka (2000) who, in his description of three teenagers playing a computer game, demonstrates 'how seeing is organized in the spatiotemporal arrangement of bodies and conduct within which the participants display and manage their orientations to the ongoing activity' (p. 105).

What is common to these three studies is their extraordinary dedication to the detailed visual aspects of the work that the studied participants orient themselves towards. However, the very facts one wants to *descriptively exhibit* (Garfinkel, 2007), also pose the biggest obstacles to this – what we could also call – analytic re-presentation. It is not without difficulty that the temporal *and* spatial arrangement of bodies, conduct and other events are transformed into the fundamentally spatial (non-temporal) arrangement better known as 'a page'. In addition, after the authors have carried out this work, the reader is left with the non-trivial task of unpacking or reconstructing the events as they appeared in the first place.

The same problem also arises in the case of the current study, since much of the work studied is in the form of dynamic restructurings of a visual field. To represent how these events, which I aim to show, functioned as important steps forward in the design/work, all in line with the three studies mentioned, I have adopted a mode of representation not commonly associated with academic writing. This mode, or style, is directly copied from comics. Comics, as a medium, is sometimes referred to as *sequential art* (Eisner, 1992; McCloud, 1994), and, as argued elsewhere (e.g., Ivarsson, 2007; Lindwall & Ivarsson, in press), I believe it to be a promising candidate for descriptively exhibiting *image work*.[2]

## ANALYSIS

As already pointed out, the analysis builds on a single case. It covers one continuous sequence with the duration of almost one minute. The selection of this particular minute was neither based on its uniqueness in relation to the larger corpus, nor was the selection random. In the recorded materials, the students are working interchangeably with AutoCAD, SketchUp, and pencil and paper.

Not surprisingly, the intensity with which constructional and/or design matters were attended to varied throughout the sessions. The selected sequence shows a stretch of interaction in which the participants used SketchUp as a means to establish a shared understanding of how to proceed with their task. In addition, there is not much else going on during this sequence; focus is continuously kept on one issue. As for its typicality: In the corpus there are numerous instances similar in kind, but there are also records of periods when not much interaction or design work was going on. From this background, the sequence was selected with the expectation that it would serve as a good illustration in relation to the aims of the study: That is, it can show a new mode of interaction and how this is coupled with a specific piece of technology.

Two group members figure in the sequence. They belonged to a group of four students who were working on the same task for the seven-week duration of the course. The two students are working in front of a single computer placed in a room with several other workstations. Anders (sitting on the left) is the one controlling the mouse and keyboard, and hence the one responsible for everything that happens on the screen. Anders is also, for the duration of this sequence, the one who talks the most. This specific setup, manifested as an asymmetry in the turn-taking between the two students, will be utilised as a methodological resource. Since Anders could be seen as the one in control of the situation, the utterances provided by Daniel give us, as analysts, a good indication of how Daniel is making sense of what Anders is trying to do. Sacks, Schegloff and Jefferson terms this the 'proof procedure' (1974, p. 728) for the analysis of turns. According to the authors, 'It is a systematic consequence of the turn-taking organization of conversation that it obliges its participants to display to each other, in a turn's talk, their understanding of other turns' talk.' (ibid). Daniel's responses to Anders' conduct thus show how well coordinated the two students are in relation to the work they are carrying out.

On this particular day, they have been working with the task in AutoCAD and SketchUp by turns for close to two hours. When we join them, they have just finished drafting one detail in AutoCAD and turn to something else. In Panels 1:1 to 2:4 Anders and Daniel open up a new point for discussion. The design discussed represents four freestanding buildings connected to each other by external galleries. There are short gangways that run from the galleries and reach some of the apartments. The proposed building is made up of seven equal storeys with an additional penthouse. The unfolding discussion, then, concerns both the relation between the typical gangways and the possibly deviant penthouse gangway and at what place the students should make the section cut.

Panels 1:1 to 2:4 provide the immediate backdrop to the subsequent work with SketchUp, which will be more thoroughly analysed. To sum up, a specific location is established and while it is momentarily 'empty', this space should be filled with the appropriate arrangement of lines. This has to be carried out in accordance with the norms and standards of the profession and in

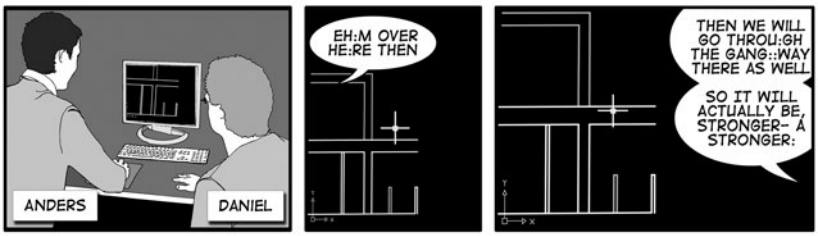


**Figure 1** Panels 1:1–1:3.

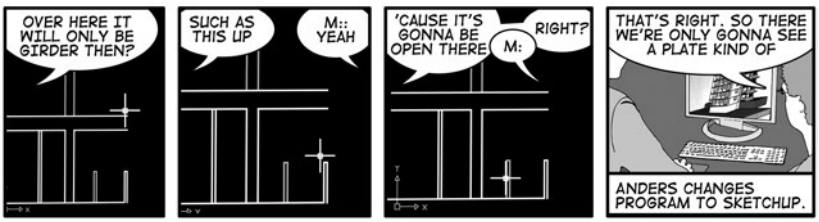


**Figure 2** Panels 2:1–2:4.

line with their previously specified design. The talk used clearly refers to the represented content as they use terms such as 'gangway', 'girder' and 'plate'. Still, there is a clear uncertainty about this as can be heard in questioning intonations and some slowly paced utterances. In panel 2:4, Anders switches from AutoCAD and opens their model (created in the previous course) in SketchUp.

In Panels 3:2 to 4:3, Anders positions one part of the model in the centre of the screen, zooms in and then rotates the model a bit further. This sequence of actions is not commented on by either participant, but it should be seen an immediate response to their previous talk, as it serves to make visible approximately the area that they had just been discussing when working in AutoCAD (Panel 1:2 to 2:1). Also the fact that Anders does not explain his move to SketchUp and that Daniel does not comment on this, might suggest that this move 'fits' into what they are trying to do, and that they are currently on the same page.

In Panel 4:3, Anders starts to say 'We're going to make the section precisely' and as he lingers on the word 'precisely' (Panel 4:4) he slowly moves the cursor along a specific surface. At the bottom of the current view, this continuous surface represents the outside of the penthouse wall and further up it then turns into a gangway railing.

Zooming, panning and rotating are basic actions in SketchUp. They are used to navigate in the digital environment and the idea is that you move the position of a simulated camera. Similar to how a filmmaker can guide the visual attention of a viewer, by zooming in on an object, the zoom can become a conversational move in a situation like this. When two or more people share

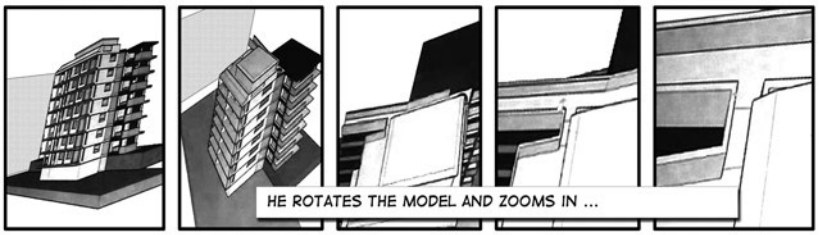


**Figure 3** Panels 3:1–3:5.

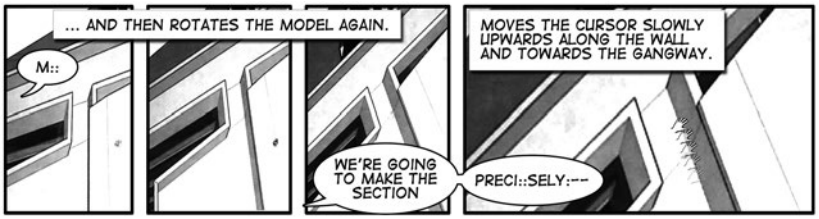


**Figure 4** Panels 4:1–4:4.

the same visual field, the zoom could be seen as a form of attention-focusing action. It does the same job as a pointing gesture in that it specifies an area of interest. How wide or narrow that area is depends on the level of the zoom. For more minute indexing actions, however, it is more common to use fingers, pencils or, as in this case (Panel 4:4), the mouse cursor.

The cursor is itself interesting as an indexing resource because, unlike say an outstretched index finger, the cursor is always present in the visual field defined by the screen.

What happens in Panel 5:1 is that Anders questions a part of their current design. He says: 'actually this one shouldn't be here', and simultaneously he makes a small zigzag motion with the cursor. He then adds, 'that's a bit awkward'. The zigzagging is thus one method for turning the ambiguous object of the cursor into an act of pointing.

Daniel responds (Panel 5:2) and says 'for sake of the section or what' using a rising intonation. Here Daniel displays his (non)understanding of Anders' previous utterance. He does so by including a possible candidate (the section) for the alleged problem.

Anders seems to accept Daniels' proposal by expanding it by saying 'actually we're going to make the section, through that wall'. At the same time (Panels 5:2 to 6:5), he changes the view in the program by moving the 'camera' backwards and further down. The referent of 'that wall' should be understood as not the most visible wall (the one extending in the x-y plane, i.e. from the centre to the right), but the wall that continues into the gangway railing (i.e. the one extending into the picture along the z or depth dimension). With the current line of sight, this wall is now barely visible.


**Figure 5** Panels 5:1–5:3.


**Figure 6** Panels 6:1–6:5.

In my ethnographic observations from the computer-equipped studios, one frequent view that the students have when working with their 3D models of various buildings seems to be from a distance and slightly from above. Seen in relation to our daily contact with buildings this is an unusual position to be in and this view more resembles the relation one would have to a physical scale model. If we were to characterise this kind of visuospatial relation to the design/object and give it a name the semantics of the word 'overview' provide us with a suitable candidate.

At other times, there will be certain details that are under scrutiny and the students will move in on the object and more or less take the position of a resident. In the case represented by Panel 6:5, one could also say that they take an inside perspective in relation to the projected *section cut* – the line of sight (or put more precisely, the vertical line provided by the y-z plane) is overlapping the extension of the discussed future section cut.

What is interesting here is the ease with which they change the view and look at the models from different angles and distances. Seen in relation to earlier technologies, it takes almost no effort to produce this perspective from inside. To provide a historical contrast, it is worth mentioning the so-called modelscopes, optical devices that emulate an eye-level perspective of a physical scale model. With these instruments, architects can look inside small models and get visual information that is not directly available from the outside. Yaneva (2005) analyses the use of such a device in an architectural office run by Rem Koolhaas and stresses the importance this tool is given in the design process. By using the modelscope, the architects are said to generate new information about the building, which, in turn, enables them to 'conceptualize it with more detail, clarity and precision' (p. 874).

> As Kunlé's eye inspects the interior space of the model, the eyes of the others are looking in the direction of the scattered things around the model, without fixing their glances. They are waiting for their turn. While anticipating Kunlé's reactions, they encourage him, 'ouyaou, ouyaou', as if they were able to see inside the model along with him; as if they collectively shared the result of his inspection. (Yaneva, 2005, p. 874)

What should be clear from this short example, however, is that Kunlé's co-workers do not collectively share the results of his inspection. Whatever additional qualities this device affords, it will not provide visual information that is public and immediately available for further gesturing and design discussions. Any inspection, or rather series of inspections, has to be sequentially coordinated between the architects by other means, be it verbally, in the form of gestures or through the use of drawings.

In contrast, any projection of a three-dimensional building onto a two-dimensional surface (screen or paper) entails, by convention, a single viewpoint. This in turn, enables multiple parties to 'enter into' exactly the same point in space at the same time. In relation to collaborative design and work, this unification of time(s) and space(s) shows a close resemblance to a parallel discussion about the role of graphs as 'conscription devices' in scientific practice.

> Graphs constitute a shared interactional space that facilitates communication because of their calibrating effect on what can be taken as shared, and what has to be negotiated when it becomes obvious that it cannot be taken as shared. (Roth & McGinn, 1997, p. 99)

In a similar vein, the more general notion of the 'externalized retina' (Lynch, 1985, p. 222), displays this interest in how scientific practice is often organized so as to produce visible records that subsequently can be collaboratively worked on. With this point in mind, we return to the analysed sequence that serves as our empirical case.

What immediately follows in Panel 7:1 is a reference to one possible design option – the location of the penthouse wall. Anders says, 'depending on where we have it' and simultaneously he makes a few small horizontal cursor movements. Here, we can observe how the cursor movements superimposed on the currently fixed view define the parameters of variability – the location of the wall is under consideration, but they are not about to apply any drastic changes. This is mainly a design problem[3] and not so much a constructional issue.

At this point, Anders and Daniel have established two topics, which, in turn, comprise two interacting variables with immediate consequences for the resulting section. Those are, first, the location of the wall and second, the placement of the section cut.

What is at stake here is what kind of output they will get from this specific combination of wall/section placement. Will the discussed gangway railing show up in their final building section? Or will it only be a blank spot,

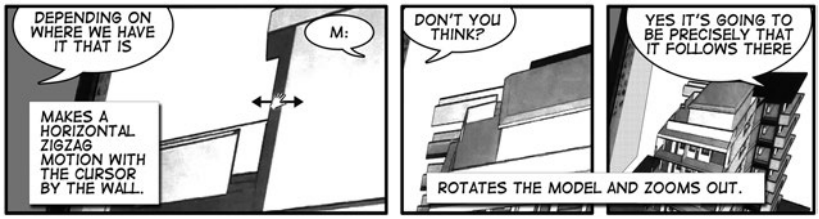


**Figure 7** Panels 7:1–7:3.

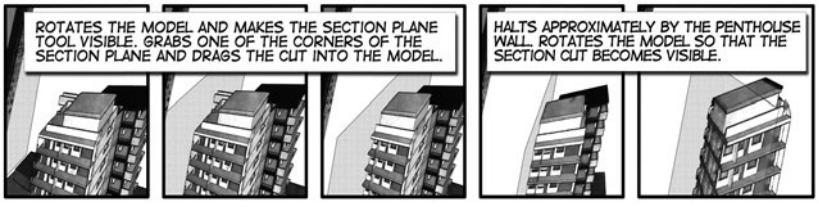


**Figure 8** Panels 8:1–8:5.

and hence fail to communicate that something should indeed be built there? According to Daniel 'it's going to be precisely that it follows there.'

So far, all talk in SketchUp about the section has been in relation to an 'absent' or 'imagined' building section. However 'precise' they can be about this, there is still a certain amount of conjecture that has to be dealt with, in order for them to create a material building section. In Panel 7:2 Anders starts a new movement (rotation and zoom) in the environment, which ends in Panel 8:2. As a result of those movements, the section plane tool is now visible. This tool was already sitting in the model but it was not observable due to their previous field of view. In Panel 8:3, Anders grabs one of the corners of the section plane tool and starts to drag it into the model. He then halts approximately by the penthouse wall. As the tool touches the model, it gradually removes those parts of the structure and creates a section cut, which is highlighted in red by the program. At this point however, the actual section surface is not visible and in Panels 8:4 to 8:5 Anders rotates the model back again.

The work with making the section plane tool visible, dragging it into the model and then restoring the previous field of view has been a silent sequence of actions carried out by Anders. In Panel 9:1, however, he responds verbally to Daniel's 'yes it's going to be precisely that it follows there' (Panel 7:3). This temporarily brings us to a somewhat more technical discussion based on some of the findings in the field of conversation analysis.

Anders says 'eh: well that depends'. This turn comes a whole eight seconds after Daniel's previous utterance. In many settings of talk-in-interaction, the participants would hear such a long silence as a break in contiguity and treat it as something that could itself be subject to inspection (Schegloff, 2007). The way that this silence is managed here, however, reveals something


**Figure 9** Panels 9:1–9:3.

about the organization of turn-taking for this specific (non-primarily conversational) setting.

Even though Daniel's utterance (Panel 7:3) does not allocate a next speaker, this is how it is treated, or responded to by Anders (Panel 9:1). The 'eh: well that depends' both operates backwards and projects its future qualification. It has the form of a response to the previous talk rather than to the temporally more adjacent string of actions (Panels 7:2 to 8:5) that has produced the new layout on the screen. This could itself be seen as a possible break in contiguity. However, the word 'depends', as heard in this sequential environment, anticipates some subsequent form of expansion, something to come next.

This 'next' (provided in Panel 9:2) is where the talk and action again are woven together. Through the work previously performed by Anders, they now have joint access to a visual representation of a possible section cut, given the current location of the wall and the current position of the cutting plane. Anders uses this visual display and points, now with his hand, at the penthouse wall as he says, 'we haven't real- *really* decided'.

The analytical points to make in relation to this particular sequence of events are twofold: Firstly, it seems as if the participants are operating with a certain 'suspense of relevance' with regard to the sequential organization of talk and action. This could be a consequence of, or a prerequisite for, the exploratory design work that they are conducting. For the time being, however, this is merely to be regarded as speculation and something that needs much more empirical evidence.

Secondly, and more directly related to the progression of the design-in-interaction, what is shown here is how Anders produces a new semiotic field, or interactional ground, from which they can continue their discussion *differently*. The particular case of the section cut could be regarded as a form of 'material hypothesis', analogous to a sketch, but as we will see next, it is also endowed with dynamic qualities.

In Panels 9:3 to 10:1 focus is shifted from the penthouse wall to the gangways. Anders continues by changing the position of the section plane

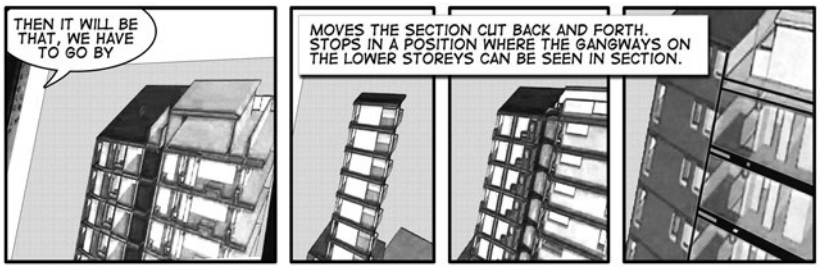


**Figure 10** Panels 10:1–10:4.

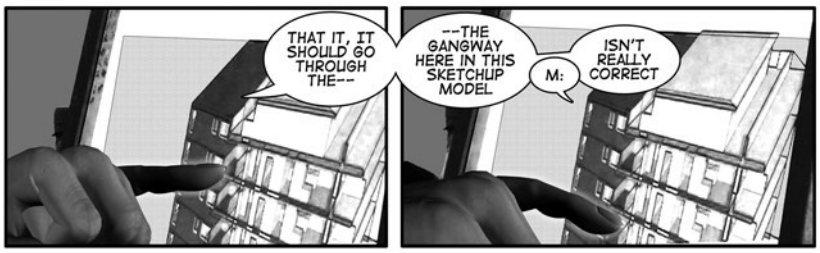


**Figure 11** Panels 11:1–11:2.

tool. He moves the section cut back and forth and finally stops in a position where the gangways on the lower storeys can be seen in section.

In Panel 11:1, Anders starts to talk about the building section but then interrupts himself and in Panel 11:2 he spells out an incongruity in their design ('the gangway in this SketchUp model, isn't really correct'). At the same time, he keeps his finger over the troublesome area.

In Panels 12:1 to 12:2, this incongruity is further specified. The manner in which this specification work is accomplished, however, calls for close attention. Anders keeps his finger pointing at the area where one of the gangways can be seen in section. Using his other hand on the mouse, he then alters the location of the section plane tool and coordinates these movements with the utterance 'it should go through there'. As the word 'there' is uttered, the cut is moved, whereby the gangway pointed at is no longer seen in section. In this specific instance, talk, gesture and actions in the interactive environment are delicately coordinated so that a distinct point in empty (virtual) space can become publicly seen.

In Panels 13:1 to 13:3, a similar procedure is carried out. This time, Anders does not use his finger, only talk and digital actions, and the gangway/cut location is now related to the penthouse wall. The utterance 'precisely so it will go through that wall' is accompanied by the movement of the section cut. This is sequentially organized so that when the word 'that' is uttered the specific wall in question also becomes visible. It appears, however, only for the duration of 0.6 seconds. Seen as a public offer, as something to be seen and noticed by


**Figure 12** Panels 12:1–12:2.

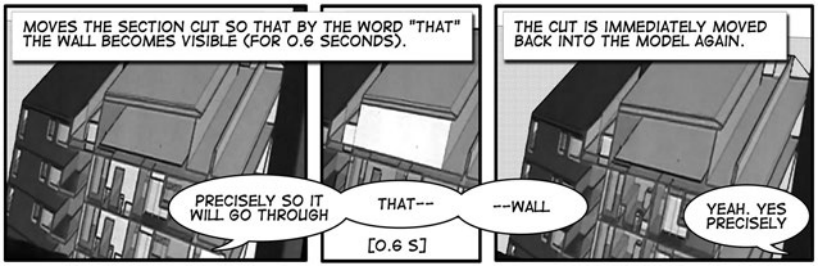


**Figure 13** Panels 13:1–13:3.

the other participant, this is not a very long time. Nevertheless, the response by Daniel (Panel 13:3) displays his understanding of Anders' suggestion.

## DISCUSSION

The opening theme of the discussion aims to get a grasp of *what* is happening in the studied activity? This question, in turn, raises the issue of *who* is doing the description; a matter bearing on what claims are warranted.

In the studied sequence there are no *formulations* (Garfinkel & Sacks, 1970) made by the participants about the activity; in the sense that the activity itself features in the conversation as something to be commented, explicated, summarized or characterized. To provide this kind of contrast, I will quote one anonymous reviewer, who has furnished a disciplined-tied characterization of the same activity. In the following I will treat this description as a secondary piece of data and relate it to the primary.

> Being an architect trained 35 years ago I can see that the tasks the students work with are exactly the same now as before. The difference is the tools they use. The formerly used tools were transparent sketch-paper, pens and pencils and different rulers, scale-rulers and triangles. The physical construction of the drawings, plans, sections took very much longer time with those old tools. That is the most flagrant difference. (anonymous)

The 'things' the students are working on, is, from a professional perspective, seen as being an architectural task (i.e. 'drafting a building section').

This does not mean that it would be obvious to *anyone* what the students are doing. On the contrary, most laypersons would have a hard time following what kind of work that is taking place through these discussions. Nevertheless, and most relevantly, for members of architectural practice, this work *is* recognized as an architectural-specific activity. Had the activity *not* been recognized as such, these students would face serious trouble in continuing their educational careers.

This first observation entails the question of how this recognisability is accomplished? The precise answer to this question is only found in the *actual work* performed by the students. It is through the details of their lived work that these students demonstrate their membership as students of a kind. A less accurate, but still a seemingly functional descriptive proxy for this work is the analysis together with the provided images (the only material the anonymous reviewer have had access to).

For sake of the ensuing argumentation, I will provide an even more generalized description of the activity, knowingly of the fact that this will further distance us from *just how* the work was carried out: One could point to the managed issues of 'how to produce a *section*', 'what to *show*', and 'what will *show up* given a specific placement of the section', as constituting the orderliness of the students' work that renders it architecturally relevant. These later descriptions are practical *glosses* (Garfinkel & Sacks, 1970) that help us communicate about this studied activity. They do not, however, give any insights into the work that itself is necessary in order to recognize the actions as those that they are designed to be. It requires some domain knowledge in order to see how the unique sequencing of actions fit into – and by their very ordering build up – a *certain type* of activity. But recognizing the actions as belonging to an already known type of activity could possibly obscure one's view on what supplementary work the actions could accomplish.

## Seeing-showing-doing architecture

Evidently, the anonymous reviewer regards the 'the tasks the students work with [as] exactly the same now as before'. In my view, the critical term here is 'exactly', and its use calls for closer inspection. The way the task was set up bears close resemblance to how it could have been done 35 years ago. The difference between drawing lines in AutoCAD and working with rulers, pencils, and paper is a real difference, but both activities also share a number of features; perhaps so many features that the new and old tasks could be considered 'the same'. When it comes to how the task *was carried out*, it is quite another matter.

The actions shown in the analysis could hardly have been executed without this specific technical infrastructure. To separate the analytical work made by the students from the tools and other resources that enable this work only seem to undercut our descriptions and devalue any possible understandings that might arise from such descriptions. The use of the section plane tool is perhaps the best illustration of this point. This tool serves as more than

just a visual aid. It enables a new way of making the work of reshaping the design visible-intelligible-recognizable (c.f., Mondada, 2003). To break this down further, the management of the section plane tool generates new ways of *seeing*, *showing* and *doing* architecture.

'Seeing' is affected in several ways. One could say that an aspect of what the section plane tool does is to replace the eye of the professional architect looking at a floor plan trying to find where to draw the section cut. It is, in part, this professional way of seeing that is challenged by this new tool. Furthermore, the section plane tool offers not a suggested building section for *one* but for *all* floors simultaneously. For larger structures, this could dramatically restructure the amount of work one would have to put in to extract the kind of visible records that the building sections comprise.

By the term 'showing' I refer to the collaborative aspects of the interaction. The section candidates, provided by SketchUp, are by no means satisfactory as final products. They still lack the precision and detailing that would render them valid candidates. Nevertheless, their materiality can be operated on and referred to by deictic gestures. The displayed surface can be utilized as a temporarily shared object whose properties can be discussed and evaluated. This is of course not a new practice in itself but rather the cornerstone of collaborative design and design reviews (c.f., Schön, 1983). What is new here, is an additional class of actions that integrate or fuse (Nemirovsky, Cornelia, & Wright, 1998) gestures in the real world with reconfigurations of the digital model, in order to highlight for someone else, to *show*, some specific feature. An example of this mode of visual communication is the work performed in the panels 12:1 and 12:2. In that instance, the well-timed delivery of *talk*, *pointing gesture*, and *restructuring of the visual field* is specifically that which enables a mutual orientation to a single point—an empty point with a unique location in the three-dimensional space of the working model.

The 'doing' of architecture is also made differently when working with the section plane tool. The individual and collaborative viewings of the tentative sections provided by SketchUp, is only one part of a longer iterative process, wherein the more detailed building section is gradually being drafted in AutoCAD. Thereby, the overall decision-making process, whatever preceding work that informs the placement and extension of each and every line in the AutoCAD file, could also be seen as altered. Furthermore, being able to see a building section, or rather many versions of them, before choosing where to place the cut seems to have consequences not only for the resulting section itself, but also for the design as a whole. The students sometimes discuss alterations of their design on the basis of temporarily displayed building sections.

## CONCLUSION

By way of a detailed analysis of a single case, I have provided one demonstration of a mode of communicative action that, in my view, requires certain

technological set-ups. Take away the tools, and you change the very conditions under which the actions can be reproduced. The question then, is, if the existence of this particular action-tool complex is in any way consequential for the developing profession?

Within the domain of design research, there is a longstanding debate on *what* and *how* designers know (Lawson, 2006; Schön, 1983; Simon, 1969) or, as expressed by Cross (2001), what make up the 'designerly ways of knowing'. In comparison to such elegant designations, the things that occur throughout the empirical illustration might look trivial, particularly if considered as individual actions. What we need to take into account, however, is the fact that it is through the chaining of talk and actions like these, that the students construct a line of reasoning that involves a number of design decisions and by which they eventually solve their task.

The empirical case does not, of course, tell the whole story. It covers only *one* minute of a process that takes weeks to accomplish. Given that, we cannot extrapolate information on what these particular students, or any other for that matter, are learning. If the term 'learning' should be used at all in relation to this kind of data, I would prefer reserving it for evaluations of much longer stretches of interaction. But even though the illustration provided here is short, it is still informative as to how a number of architecturally relevant events are produced, achieved and made recognizable in and through the practical actions of the two students. This, in turn, sheds light on the possible roles of different technologies in the organization of architectural design work. The ways the studied technologies are used in this example indicate, that what can take place is, a *reorganization* of the overall activity. Compared to the work that was necessary 35 years ago a number of steps can now be skipped and less time has to be spent on certain tasks. There is a changed division of labour between humans and technologies. One interesting question that arises is what the remaining time is spent on? A preliminary answer has to be that students seem to be going over a greater number of reiterations involving changes and evaluations of their designs. Ultimately, if the architectural profession will regard the products, produced by students who adopt such a way of working, as in any way enhanced or as less thought-out, that remains to be seen.

## NOTES

1. This vertical slice however, does not need to be made along a straight line. Several slices can be merged into a single composite slice in such a way that this slice is still as informative as the sum of its original parts.
2. For a discussion of image work, see the special issue of *Visual Studies 18*, ("Image work," 2003).
3. As such it should have been managed in the previous course. However, the students did have the option of reviewing their previous solutions as long as this work did not become too far-reaching.

## Conventions used in transcripts

. A period indicates a stopping fall in tone, not necessarily the end of a sentence.

, A comma indicates a continuing intonation, not necessarily between clauses or sentences.

? A question mark indicates a rising inflection, not necessarily a question.

: Colon(s) following a vowel indicates an elongated vowel sound. Multiple colons indicate a more elongated vowel sound.

- A single hyphen indicates a halt, abrupt cut-off.

-- Double hyphens indicate *latching* – i.e. no interval between the end of a prior and start of a next piece of talk.


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