

# "What is 'the Concept'?" Sites of Conceptual Formation in a Touring Architecture Workshop

*Rolf Steier og Palmyre Pierroux*

---

FAGFELLEVDERT ARTIKKEL

**Rolf Steier**

Research Fellow, InterMedia, University of Oslo, Norway.  
rolf.steier@intermedia.uio.no

**Palmyre Pierroux**

Associate Professor, InterMedia, University of Oslo, Norway.  
palmyre@intermedia.uio.no

## English abstract

This article investigates the development of conceptual understanding in adolescents as a trajectory that spans physical and institutional boundaries. The study follows a group of secondary school students as they engage in a series of museum-led workshop activities related to architecture. A sociocultural approach frames our analysis of the structuring resources that are central to the students' emergent understanding of a key architectural design concept over a two-day period.

**Keywords:** Informal learning, multi-touch table, architecture, museum

## Introduction

In recent decades, the museum has been increasingly explored as a resource for the extended classroom of the future. Museums are an alternative arena, a public space that stimulates new perspectives on material culture and scientific phenomena, provides experiences with technologies and hands-on exhibits, and supports forms of learning and social interactions that are distinct from those in home or school settings. Building on this distinctiveness, museum education departments cultivate diverse types of school-museum collaborations, developing an innovative range of outreach programmes that meet curricula at all levels. School field trips – during the day or as a ‘night at the museum’ – support learning in the domains of science phenomena, cultural heritage, and art through guided experiences.

In Norway, there is a long tradition of arranging exhibitions, workshops and other cultural productions that travel to schools throughout the country, ensuring all young people encounters with works of art and other forms of cultural heritage. These touring productions are sponsored at the national level through a cultural initiative programme called *The Cultural Rucksack*, introducing young people to curriculum-related themes and subjects. The programme, for which the workshop presented in this paper was developed, aims to allow students aged six to nineteen years old to ‘become acquainted with and develop an understanding of culture in all its forms’,<sup>1</sup> thereby contributing to the broader cultural literacy skills young people need in today’s global society (Frow & Morris, 1993; Kelly, 1997; Lankshear & Knobel, 2006).

In this article we analyse learning activities on a touring workshop that is being produced for middle-school students (12–15 years old) based on a museum exhibition of contemporary architecture. The aim of the two-day workshop is to support adolescent students’ understanding of architectural design processes and conceptual practices by engaging them in planning a new cultural centre for their town. Key features of the workshop include a multi-touch table, as well as a travelling curator who leads the students’ activities in collaboration with teachers at the visited schools. This means that institutional aspects of classroom practices, i.e., the organization of talk, tasks, and resources (Cazden, 1988; Mercer, 1995) play a central role in an otherwise museum-led activity. As such, the trajectory and organization of the workshop bridge institutional practices associated with what is often termed formal and informal learning (Pierroux, 2005).

Architecture is included as a subject in the Norwegian curriculum at the secondary school level, and students are expected to master understanding of the influence of climate, culture, and social functions on construction types through analyses of form, materials, expression, and symbolism (*The Knowledge Promotion*, 2006). In a full-scale pilot implementation of the workshop, we study the ways in which a broad range of contextual resources mediate and structure the students’ understanding of key concepts in the language of architectural design. We begin by exploring concept development theoretically from a sociocultural perspective, before moving to a discussion of ‘professional vision’ as it relates to architectural concepts in particular. We then present a brief description of the collaborative process used in the development of this workshop, as well as the specific sequencing of the activities of the workshop. After a brief discussion of the research methods used in this study, we present and discuss a series of interaction excerpts that span the trajectory of the workshop.

We pose the following research questions:

*How do disciplinary concepts emerge and develop across the different settings and activities?*

*In which ways are contextual resources and institutional features made relevant in students' conceptual development as they move between activities and across sites?*

We conclude with some reflections on learning in settings in which institutional boundaries may be weakened and overlap, and on the design implications for such settings and activities.

## Mastering and appropriating concepts

In the sociocultural perspective on learning, concepts are cultural tools that mediate human thinking and activity. More specifically, concepts may be described as abstract ideas that allow one to make connections and recognize relationships between thoughts and observations, and are a central means for understanding (Vygotsky, 2004). The mastery of concepts is accomplished through language, or words, associated with a particular scientific domain, which are mainly introduced as terms through instruction in formal learning settings (Vygotsky, 2004). The scientific or disciplinary content of specific words, as signs, renders concepts generalizable as abstractions that can be applied across contexts or even disciplinary domains.

In the interdisciplinary domain of architecture, conceptual terms are used to describe the elements of a design and its envisioned experience. Terminology is used to conceptualize the site, organization of space, use functions, form, scale, and styles or precedents, among other design elements (Schön, 1983). One such concept is contrast, a term that is both specific to professional discourse in architecture and serves as a more everyday term to describe intellectual comparative work more generally. The term contrast is used in architecture to conceptualize form, appraising differences between the shape and geometry of a building, its components, and surroundings. During different phases of activities comprising this study, we observed that contrast became an important concept for one group of students in their design work. Based on this observation, and on the research questions framing our investigation, we focus in this study on the formation of young people's understanding of the function of the concept 'contrast' in relation to architecture.

However, as Vygotsky (1986) explains, the process is not as simple as being introduced to a new word: 'the path from the first encounter with a new concept to the point where the concept and the corresponding word are fully appropriated by the child is long and complex' (p. 152). Moreover, in adolescent concept formation, the content of an abstract concept is 'often linked with the concrete situation that manifests it' (Vygotsky, 2004, p. 439). This challenge is addressed in more recent sociocultural research, which points to the ways in which adolescents struggle with moving beyond the procedural aspects of a classroom task to master concepts in a specific disciplinary domain (Krange & Ludvigsen, 2008; Pierroux, in press). Therefore, we are concerned analytically in this study with the ways in which the concept contrast is introduced in instruction and then mastered and appropriated in various ways across a trajectory of concrete activities spanning a two-day period. As we shall see, the students adopt use of the concept of contrast to give meaning to relationships that they observe in singular settings, appropriating the concept in their design work across settings.

The task for the students in the workshop is to master a few elementary architectural concepts and to apply them in their design work. The tasks are modelled on the expert practices of Snøhetta, an

internationally renowned Norwegian architecture firm that designed, among other projects, the new Oslo Opera House. Extending Vygotsky's theory of concept formation as a process in which terms may be used based on partial understandings, Wertsch (1998) proposes 'mastery' and 'appropriation' as analytical distinctions in empirical studies of meaning making processes. Mastering describes a conscious realization of 'knowing how' to use a concept in a scientific manner and context, taking into account the features of particular sociocultural settings (Wertsch, 1998). Appropriation suggests a sense of identity and at least partial ownership in the use of a word, narrative, or term, 'buying into' its use and thereby making it 'one's own', consciously or not (Wertsch, 1998). As such, mastery and appropriation capture the cognitive as well as the agentic and situated aspects of meaning making. Similarly, in this sociocultural perspective on human and cognitive development, the term 'meaning making' directs focus to the mediated and situated aspects of learning. In this study, mastery and appropriation are applied to analytically account for the processes by which students develop understanding of the concept contrast in architectural practice.

## Mastering professional vision in architecture

Goodwin (1994) uses the term 'professional vision' to discuss the ways in which concepts in expert practices are mastered, explaining that professionals develop 'socially organized ways of seeing and understanding events' (p. 606). That is, experts in a particular domain or community learn to see and make sense of the world in ways that are both specific to that community/profession and develop through this community/profession. In architecture and artistic expressions, for example, volume and form are seen as an integral part of a design's structural logic, which is 'controlled by the primary concept of something to be expressed' (Arnheim, 1969). Visual thinking, Arnheim (1969) explains, demands disciplined concentration, bringing 'organizing powers' to bear on the expression of 'one's vision of the world' (p. 456). This kind of deep understanding of the primary concept in an expression is distinct from an artificial or superficial concentration on mere shapes and colours that renders one pattern as acceptable as the next (Arnheim, 1969). In this study, the aim of the workshop was to provide students with a glimpse of professional vision by engaging them in fairly realistic architectural practices.

Lymer (2009) explores the concept of professional vision in architecture by looking at the practice of 'critique' between architecture students and instructors. Two findings from this study seem particularly relevant to our investigation. The first is a strong relationship identified between learning to perceive and learning to use the language of architecture in a disciplinary way (Lymer, 2009). The second finding is that, for students of architecture, the goal is not merely to perceive as an architect, but to apply this vision to a design process. As Lymer concludes, instruction 'is not only, or primarily, directed at teaching students to see in certain ways, but to employ certain ways of seeing in subsequent doing' (p. 166). The relationship between 'seeing and doing' architectural practice has also been investigated by Schön (1983), who describes the architectural process as one of 'reflection-in-action', where the designer makes or tries a design decision through drawing or modelling, follows through with that decision's consequences, and then responds to those consequences with new action. Schön explains that this 'conversation with the situation is reflective. In answer to the situation's back-talk, the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves' (1983, p. 79). Schön explores this reflective practice in architecture by looking at interactions between an architecture student and a studio master. An important aspect of these expert–novice interactions is the different roles that domain-specific language plays, with concepts used for purposes ranging from describing the experience of being in a space, to exploring the implications

of a particular design decision. In the case of this workshop, we follow a group of young people as they engage in mastering architects' professional vision, language, and concepts in their design work across settings and activities.

## Moving across sites

The students (12–13 years old) were given the main task of designing and modelling a schematic plan for a new cultural centre in their local environment, at a site near their school that had been pre-selected by the research team and the teacher. The task, and the overall organization of students' activities, reflects Snøhetta's characteristic approach, as seen in the design of the new Opera House in Oslo. This means that the students' inquiry and modelling processes are based on the architects' expert knowledge and actual work practices. Modelling expert procedures and processes is a means of scaffolding students as they master knowledge and practices relevant to a discipline, including concepts, ways of talking, social rules, and organizing collective efforts to solve tasks (Brown, Collins, & Duguid, 1989).

Using a 'jigsaw method', each student worked in two different groups in two main activities over the course of two days (Aronson, Blaney, Stephin, Sikes, & Snapp, 1978; Brown, et al., 1993). The entire class, organized as four expert groups, visited the site to carry out research, and to collaborate on their respective tasks on day one. On the second day, the students were regrouped, with experts from each topic represented in new configurations of four 'architect teams'. Each student was an expert in one topic, holding one-fourth of the knowledge needed for the architect team's work planning and modelling a new cultural centre for the site. The architect team 'jigsaw', as a whole unit, thus comprised four areas of expertise.

From the beginning of the activity, when the curator gives an introductory presentation about architectural concepts and the design process of Snøhetta, until the end of the workshop when the students present their designs, the students move through a sequence of physical settings mediated by a variety of material resources, both physical and digital (Figure 1). The activities are described in greater detail below.

## DESIGN A CULTURAL CENTER



Figure 1. Trajectory of Snøkult activities

1. A curator from the National Museum gives a presentation in the classroom about architecture and the Snøhetta design approach. This presentation is made on a projection screen and is controlled through a multi-touch table. The presentation material includes digital renderings and technical drawings, and videos of interviews and work practices.
2. The curator introduces the task, 'plan a new cultural centre for your town'. The teacher divides the class into four expert groups: *Place*, *Environment*, *Use*, and *Inspiration*.
3. In expert groups, the students walk to the pre-selected site for the new cultural centre. At the site, the students work in their respective groups taking pictures and notes, conducting observations, and completing assigned tasks. Each expert group receives a task card, a scale map and satellite image of the site, wifi camera, and other tools needed for carrying out their research, such as compasses and measuring tapes.
4. The groups return to the classroom, where they discuss and reflect on their observations, and prepare a summary of their findings to present to the class. Each expert group selects five pictures from the site to illustrate their presentation, and these are uploaded to the multi-touch table using their wifi cameras. The teacher and curator support this group work. The expert groups' findings are presented to the entire class using the multi-touch table.
5. On the second day, the students form new 'architect teams', which include a representative from each expert group. These new teams collaborate at a table to build a physical model of their cultural centre, bringing their respective expertise to negotiations in the design process. The modelling activity is organized in two phases, with different resources used in each phase. First, the team uses scaled building blocks to represent and organize different space functions on a large-scale (1:250) map of the site. Second, modelling materials such as plastics, papers, and foils that Snøhetta uses are brought into the process. The teams take pictures of their models in

both modelling phases, which are then uploaded to the multi-touch table and integrated into their final presentation.

6. The architect teams collaborate at the multi-touch table to complete a presentation of their plan and design. Using a suite of touch gestures and drawers containing different types of representations, photographs of their models are situated and scaled on background images from the actual site. Features of their design are explained using 'hotspots' that link to short texts and images. Screenshots are taken for the final presentation.
7. Each team presents its design to the class using the multi-touch table and the projection screen.

## Methods

### Data collection and corpus

Data collected during the two-day pilot study consisted of video recordings as well as the artifacts produced by the students (photos, notes, presentations, etc). In the classroom, two video cameras were used to capture the students' interactions and talk while working in different arrangements, including class discussion, small group work, interactions at the site, and conversations during the walk to and from the site. Microphones were placed on each table in the classroom setting, and worn by one member of each student group during the field activity. In addition, an overhead camera was placed above the multi-touch table to capture group interactions. One week following the pilot study, interviews were conducted and recorded with the four architect teams and the class teacher. The corpus comprises the digital and analogue materials produced by the students, 35 hours of video recordings, three hours of interview audio recordings, field notes and still images.

The video recordings were first reviewed and sorted quite broadly, according to the different activities and groups, and then analysed using methods from interaction analysis (Derry, et al., 2010; Hall, 2000; Jordan & Henderson, 1995). Referencing these recordings as well as field notes, we examined the groups' final presentations on day one and day two for instances of conceptual talk. On day one, one group's presentation emphasized the concept 'contrast' in describing its design, drawing analytic attention because of its representativeness of the type of language that real architects use. Instances of 'contrast' talk were then selected, transcribed, and translated from Norwegian. Our aim was to trace and 'unpack' the sequence of activities in which the students mastered understanding of this concept beginning on day one and carrying over to a new group's design work on day two (see Figure 2 below).

### Analytical approach

In the following section, we provide rich descriptions (Geertz, 1993) of the different activities and present excerpts of interactional data from three different physical settings selected for closer analysis. The selection is based on our analytical interest in concept formation across multiple contexts, identifying instances of talk in which the notion of contrast is made relevant in the students' understanding and problem-solving work. We identify three levels of activity to investigate in the data:

1. instances of students' talk, gestures, and social interactions;
2. the mediating role of contextual resources and disciplinary knowledge in students' meaning making
3. the physical and institutional characteristics of the different settings.

Mediating resources include the physical features of the site, social interactions, cameras, tasks, maps, multi-touch table, and modelling materials. By disciplinary knowledge we mean architectural concepts and processes identified as relevant in the curriculum, but also as practised by Snøhetta and introduced by the curator. Institutional features include the role of the teacher and curator, the task and instructional design, i.e., the procedures and structures that scaffold collaboration and concept formation.

## Analysing the development of a concept

To present and explore concept formation during these workshop activities we have selected several excerpts of interactional data from three different physical settings for closer analysis (Figure 2). We present each excerpt as part of the trajectory of the two-day workshop. For each excerpt, we present the context in the form of a 'thick description', the transcribed and translated interactional data, an interpretation of the data, and then an analysis of the excerpt through the three levels described above.

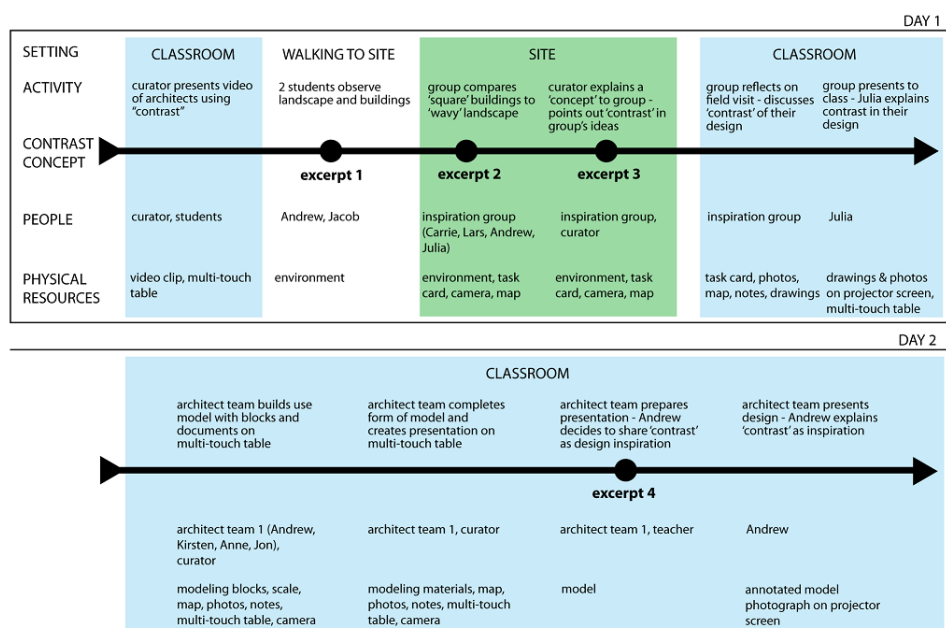


Figure 2. Overview of trajectory and data excerpts

### Day 1. Classroom before site visit

The workshop begins with the curator in front of the class, making a presentation about the planned activities, an introduction to some key architectural concepts, and the work of Snøhetta. She introduces the disciplinary concept of 'contrast', among many other concepts, by referencing a



discussion by Snøhetta architects in a video clip. Here, the architects point to the verticality of a proposed building in relation to the horizontal desert landscape. She then prompts the class for some examples of contrast, using the example of 'girls' in contrast to 'boys'. The students acknowledge understanding of this everyday use of the concept, or what Vygotsky (2004) calls the general and abstract function of the word rather than its specific and particular use in a scientific manner. Her role as instructor is not unlike that of the teacher, and she employs typical classroom discursive patterns and management strategies in her interactions with the students (Cazden, 1988; Mercer, 1995).

## Day 1. Walking from school to site

Two students (Andrew and Jacob) walk toward the site (Figure 3). Andrew is in the 'Inspiration' expert group, and Jacob is in the 'Place' expert group. The Inspiration group's task is to 'observe the surroundings' and 'develop several concepts for the building's design', while the main task for the Place group is to consider the orientation of their building design on the site. The conversation occurs in a transition between the structured pedagogical activities in the classroom and the tasks the students will complete at the site. We enter the conversation after Andrew has commented on the colours of the 'boring buildings' in the neighbourhood, and as they shift to discussing the materials of the buildings.



*Figure 3. Jacob and Andrew walking to site*

<i>Excerpt 1</i>		
1	Andrew:	There you have concrete (...) painted concrete or something like that.
2	Jacob:	See the fences? Green, green, green.
3	Andrew:	No, we aren't going to the houses. We are going to the museum, way down there.
4	Jacob:	(...)

5	Andrew:	We're going to be inspiration. How the design will be. And that kind of stuff.
6	Jacob:	Everyone gets to build a building.
7	Andrew:	What?
8	Jacob:	Everyone gets to build a building. Today, it's just to find out. And then one person comes from each group into a new group. So then maybe me, you (...).
9	Andrew:	But let's 'inspire' the landscape a bit, look here, it goes up and down a lot, a little like the sand. Up here. It reminds me of a desert, if it had been sand.

The two students are observing and describing both the landscape and the built environment on their walk to the site, with Andrew pointing out the materials of the buildings and Jacob observing the 'green' in the environment. Andrew shifts the conversation to the task of the group he will be participating in, the Inspiration group, which he describes as having the job of deciding the design (line 5). Jacob points out that all groups will be designing a building, but that this work actually begins tomorrow, when they are organized in new groups (line 8). Andrew shifts topics again (line 9), observing dynamic variations in the landscape that recall sand dunes in a desert.

Analysing this activity according to our multiple level framework, we see that Andrew and Jacob are 'on task' even though this twenty-minute period presents a break from their assignments. The task frames their looking, but it is through talk, gestures and physical movement in space that the dynamic variations and volumes in the forms in the landscape are perceived. Although the word contrast is never used, they are making comparisons between the physical environment and the built surroundings, and developing understanding of form as content, as something primary and fundamental (Arnheim, 1969). It is this perceptual and comparative work that later becomes key to appropriating 'contrast' as both a relevant concept (Wertsch, 1998) and a specific type of inspirational content to be used in the visual expression of the design (Arnheim, 1969; Schön, 1983). In terms of mediated meaning making, it is clear that the physical environment – this outdoor space – first 'inspires' their attention, and that pointing, gesturing, and referencing the actual physical space creates joint attention and mediates shared understanding. In addition, Andrew's comparison of the hilly shapes in the landscape to the form of sand dunes is most likely referencing several video clips from the curator's presentation in the morning in which Snøhetta architects find inspiration in the sand dunes of Dubai, making resources from the institutional museum-school setting relevant in their meaning making.

## Day 1. Site visit

At the site, the 'Inspiration' expert group collaborates on their tasks (Figure 4). They have been instructed to use the task card, to take notes, and to use the camera to take photographs. They also have a scaled map mounted onto a flat surface, and some markers for writing. The group includes Andrew (from Excerpt 1) and three other students. The task card instructs the students to 'observe the surroundings' and 'develop several bold concepts for the building's design – think about different forms in nature, different types of materials, or forms that can be inspired by local history'. The task card also includes a short story about the history of the site, and poses the question: 'Can the site's history inspire the building's form, style or materials?'

As the group meets up, Andrew takes photographs of the site, while Carrie shares some observations about the 'square shapes' of the surrounding buildings. Observations about the square shapes in the

environment continue throughout much of the group's discussion. After awhile, Carrie reads aloud from the task card a brief text that describes an elder resident's memories of the site when he was a child. His story of sledding all the way down to the site from the neighbourhood above prompts the students to imagine how the site looked in the old days. We enter the data after she finishes reading.



Figure 4. Inspiration group reading task card at site

Excerpt 2		
1	Carrie:	You know, what could be special, for inspiration, is that it has been used for ski stuff, skiing and sledding (...)
2	Lars:	If we're going to have a big building here then it would take like five seconds to run right into it. In any case it isn't much of a hill for sledding anyway.
3	Carrie:	I know.
4	Andrew:	There is no point in a sledding hill, it's way too little. It would instead be better to use what's up there. Maybe the next 'korketrekkeren'. ((a well known sledding hill in Oslo)) (pause)
5	Lars:	Give me the camera.
6	Andrew:	No, no... OK. ((turns and looks around)) The landscape up there is like, very wavy, it looks like a kind of sand dunes.
7	Carrie:	Almost everything around is square... built of squares.
8	Andrew:	The square shapes are there too. I want to take inspiration from that part ((pointing to area)).
9	Carrie:	There are squares over there ((pointing in opposite direction)), there are square shapes on the large buildings. There, there are some... triangles. .

In the first line, Carrie suggests that the sledding story could be used for inspiration. Lars points out that there will not be enough space to sled with a new building on the site, and Carrie acknowledges this (line 3). Andrew agrees and refers to a popular sledding hill that already exists nearby. After a quiet moment, Andrew looks around again, and brings up his 'desert' observation from earlier with Jacob (excerpt 1). Carrie also looks around, observing the many 'square shapes' of buildings in the surroundings (line 7). Andrew continues to turn, looking around, and points to a group of buildings adjacent to the perimeter of the site that can serve as 'inspiration' (line 8). Carrie does not comment on this idea but continues to follow this line of talk and observation, noticing aloud the geometric forms of windows on buildings (line 9).

As in Excerpt 1, the students in Excerpt 2 are engaged in a comparison between the physical environment and the built surroundings. Andrew relates the wavy, sloped hill above the site to both sand dunes and the sledding hill in the story, while Carrie picks up on the observation that buildings in the neighbourhood contain many 'square shapes'. In a sense, they are dialogically creating and narrowing in on the concept of contrast, without explicitly using the word. In Vygotskian terms (1986), their talk and observations form the basis for an understanding of contrast antecedent to the concept. In other words, the students are talking and building consensus, moving between articulations of perceptions and expressions of design visions, yet they cannot express the contrast inherent in their concept without the use of the disciplinary term itself.

For the next seven minutes, the students observe their surroundings and discuss colour, materials, and forms in relation to a possible design. As ideas about relations between square and wavy shapes begin to predominate, Andrew suggests that they write them down. Lars refers to the task card, and wonders aloud about what is meant by 'the concept' they are supposed to produce. Lars suggests that they find the curator to ask about where they should write their notes, and to clarify the task of coming up with several 'concepts' for the design. The task card and the curator are thus institutional resources and features of the activity that are made relevant in the meaning making process. We enter the data as Lars returns with the curator and the teacher after a brief pause.

<i>Excerpt 3</i>		
1	Curator:	How's it going with you guys?
2	Andrew:	It's going good. But should we write?
3	Curator:	Yeah!
4	Lars:	But what is...what do you mean by 'the concept'?
5	Curator:	Have you taken photos?
6	Andrew:	Yes.
7	Curator:	The concept is the idea: what is it you want? Is it supposed to look like a guitar? Is it...
8	Andrew:	No, a little wavy,
9	Carrie:	A wave... because
10	Andrew:	...because up there is a lot of, it looks like a desert, but grass.
11	Curator:	A-ha.
12	Carrie:	A wave...this is like the bottom of a wave

13	Curator:	Yes.
14	Andrew:	And then there are a lot of square, a lot of square forms around here.
15	Curator:	Bravo! ((pats Andrew's shoulder)) Because that is exactly the contrast! Here there are lots of square shapes, and you guys want a wave. Very good. So what you really want is a grass wave. Did I understand you correctly?
16	All Students:	Yes.



*Figure 5. Curator and teacher (far right) talk with Inspiration group at site*

The curator and teacher come over to assist the group and the curator starts by asking how they are getting on (Figure 5). Andrew confirms that they are managing well, but are unclear as to whether they should be writing things down. Before he can pose a follow-up question about what they should use (the task card), Lars asks what is meant by 'the concept' in the assignment. The curator first confirms that the group has followed procedures ('taken photos') related to the task before explaining that the concept is the 'idea', using a guitar shape as an example. She asks them to describe what the building might 'look like', prompting Andrew to say that the forms are not guitar-like but wavy (lines 8–12), and he is supplemented by Carrie. He links the wavy form to observations about square shapes in the vicinity in the utterance 'and then' (line 14). The curator enthusiastically confirms that this is 'exactly' the concept of contrast mentioned earlier in the presentation, and that this is a 'good idea'.

We see that the curator recognizes contrast as a disciplinary concept embedded in their talk and descriptions. By re-introducing the word she makes the concept accessible to them as a resource. Thus in this concrete situation, the antecedent to the concept of contrast is manifested as an actual concept for the adolescents. Although they 'saw' contrast in forms and volumes before, the group has now been given a conceptual tool to use and apply in their professional vision (Goodwin, 1994) and role as experts of 'inspiration'.



## Day 1. Classroom after site visit

Back in the classroom (Figures 6a and 6b), the Inspiration group collaborates on refining a design sketch that was started at the site and which incorporates their ideas of wave shapes and contrast. Although the expert groups were not instructed to begin design work or to draw, the group finishes the sketch, takes a picture of the drawing, and uploads it to the multi-touch table as one of the five pictures that will illustrate their findings. During their presentation, Julia points to the drawing and explains that they have chosen wavy shapes because they ‘want the contrast to the square-shaped houses’, and the curved shapes will be different. ‘Contrast’ is also written on the drawing.



*Figures 6a and 6b. Expert group ‘Inspiration’ prepares and presents their work from the site*

This presentation of the concept of contrast as inspiration to the rest of the class demonstrates the group’s newfound professional vision and validates their expert roles. Julia makes the statement that their group has decided to incorporate ‘wavy shapes’ into their design *because* they want it to contrast with the ‘straight lines’ of the houses in the neighbourhood. This causality – stating that their desire for contrast was in fact their design inspiration – reinforces the interpretation that the group had a notion of contrast before being re-introduced to the word itself.

## Day 2. Architect team prepares for presentation

On the second day of the workshop, the expert groups are split up and reorganized into new architect teams, and we trace the concept contrast as it travels not only across settings, but also across groups of students in a jigsaw constellation. This architect team spends the morning moving between the analogue modelling activities at a table and digital representations on the multi-touch table to construct and prepare a presentation of their model.

As Andrew’s new team (joined by three different expert students) completes its modelling work with materials, the curator stops at the table and notes the contrast between shapes of the two buildings that have been designed for the cultural centre (Figures 7a and 7b). There is a large structure with a softly curving glass roof and a bridge to the entrance, and a second, smaller building with a rectangular shape that houses a skate hall and has a large, curving shape on the roof. The latter building has been designed by Andrew alone, in parallel to the rest of the group’s work on the large building. The students took pictures of the models and worked at the multi-touch table to make their visual presentation. We enter the data after the group has returned to the modelling table to plan the oral presentation of their design to the rest of the class. The models of the two buildings are situated neatly in front of the students (Figure 7a and 7b). Andrew asks what the inspiration is for the large building, and the other students discuss this mainly in terms of materials and forms.

Kristin then lists the different 'use' functions and points to their location in the large model. She points to the skate hall, and Anne says that perhaps Andrew should talk about it, acknowledging his ownership in the design of this structure.



*Figures 7a and 7b. Andrew and Jon discuss inspiration for skate hall at left*

<i>Excerpt 4</i>		
1	Andrew:	What it's inspired by. Use is a difficult thing.
2	Kristin:	Yeah. You can say what it's inspired by. ((pointing to Andrew))
3	Anne:	It's inspired by...
4	Jon:	Sledding hill ((pointing to curved skate ramp shape on the roof))
5	Andrew:	It's inspired by... no, it's not inspired by the sledding hill.
6	Kristin:	Skating? ((pointing to curve shape on roof))
7	Andrew:	This here ((pointing to curve shape on roof)) is a little bit inspired by the sledding hill, this here, and then the rest is inspired by contrast to the other buildings. ((pointing to rectangular shaped building))
8	Jon:	To this? ((pointing to large curved building))
9	Andrew:	No.
10	Jon:	Oh, the others...
11	Andrew:	Yeah.
12	Jon:	...are square shaped.
13	Andrew:	The buildings next to it. No, wait. It's also this smooth form here. ((pointing to skate hall roof))  ((After approximately two minutes the teacher stops by the table and asks about their progress and their design.))
14	Teacher:	Now you have taken photographs and done everything? But what is this here?
15	Andrew:	This, it's a skate hall that provides a contrast to the other building.
16	Teacher:	Contrast how?
17	Andrew:	This is a little curved ((pointing to large curved building)) while this is a square shaped building. And then this smooth form ((pointing to roof on smaller rectangular building)) is in contrast to the buildings around it, but also relates to this one ((pointing back to the curved building)).

18	Teacher:	That sounds really good. That's just decoration? ((pointing to curved shape on top of roof)) The skateboarding hall is in there?
19	Andrew:	Yes. That's decoration. Or, it was actually supposed to used as a sledding hill, but we didn't use it.

In responding to Anne's suggestion that he talk about the skate hall he has designed, Andrew clarifies that he will talk about the 'inspiration' for the design, rather than its 'use' or function (line 1). Anne concurs, acknowledging 'inspiration' as Andrew's expert knowledge domain (line 2). Each of the students then begins to put words to his explanation, focusing on the curved shape on the roof of the building (lines 3–6), but Andrew makes clear that the design is anchored in the concept of 'contrast' (line 7). Confusion arises in his explanation, however, as Jon asks if the skate hall is a contrast to the main building (line 8). Andrew replies no, he means buildings next to it in the existing surroundings. His mistaken, or at least ambiguous use of the concept seems to become apparent to him (both the rectangular skate hall and the surrounding buildings are indeed square-shaped) when he says 'no, wait' (line 13), and points to the curved shape of the roof as also part of the contrast concept.

Two minutes later, the teacher comes over to check on the group's progress and asks for an explanation of the skate hall building. Andrew says that the skate hall is intended as a contrast to 'the other building' (line 15), and when prompted by the teacher to explain (line 16), he now refers to both the curved form of the main building *and* the surrounding neighbourhood houses that contrast with features of the skate hall, but in different ways (line 17).

In this data, we see further evidence of the development of the concept contrast. The students decide that Andrew should talk about his building, but he is very clear that his contribution lies in the concept of contrast as inspiration. This suggests that Andrew both identifies with the concept and with his role as inspiration expert, appropriating its use to mark his personal contribution to the design. At first exhibiting some confusion as to which elements are in contrast to the surroundings and the other building in his interaction with Jon, the teacher's intervention towards the end of excerpt allows Andrew the opportunity to demonstrate mastery of the concept in a more precise and persuasive manner. Throughout the data, the structuring role of the task and the role of the curator and teacher may be seen as central to introducing and scaffolding the students' conceptual thinking, as well as monitoring that the procedural aspects of the task are followed. This finding relates to Vygotsky's (1986) point that scientific concepts are introduced through instruction in formal learning settings, and is well documented across domains in the educational research; students have problems applying disciplinary knowledge in their conceptual thinking without explicit intervention by the teacher or more capable peers (Krange & Ludvigsen, 2008).

Similar to the physical environment of the site, the physical model serves as a deictic resource for the group, as they point and reference elements to clarify and extend previous utterances to reach an understanding of contrast in the design. We further note that the architect team uses the concept of contrast slightly differently from the way it was presented by the inspiration group on the first day, demonstrating the generalizability of the concept. The latter used contrast to relate their design to the natural and built environment, whereas this architect team describes contrast in terms of relations between different features of their design (the skate hall and the main building) and the surroundings.



## Day 2. Architect team presentations

Having built a model and created a presentation on the multi-touch table, the architect teams present their final designs to the rest of the class. In their group presentation, Andrew points to the annotated photograph of their model, explaining that the skate hall building and roof both create a contrast to other buildings in the neighbourhood and relate to the smooth form of the other building.

## Concluding remarks

Notions of the future classroom involve a broader view on learning that extends beyond school settings. Through detailed analysis of adolescents' social interactions while they are simultaneously at school, participating in a museum workshop, and exploring outdoors, this study contributes to understandings of the multilevel interplay between resources and settings that may be made relevant in meaning making.

We found the institutional features of the activities, mediated by the task as well as the curator and teacher, are structuring resources for the students in the different settings. Throughout the two-day activities, the curator assumes the role of primary teacher who introduces and scaffolds the procedural and conceptual aspects of the tasks, assisted by the class teacher. At the same time, the curator brings the museum into the classroom by introducing a new discipline, architecture, as well as new tools and resources, including modelling materials, architectural concepts, and the multi-touch table. She supports the students in interpreting their experiences and observations of forms and patterns, introducing words and concepts to describe their perception of visual expression in the natural and shaped environment. This suggests that in the future classroom, we must not only consider activities and technologies that support students directly in recognizing and appropriating concepts, but also those that allow teachers (or curators) to identify and scaffold meaning potentials and antecedent concepts in students' talk and actions.

We also found social factors between students to be significant for concept formation. We found that one student's interactions in an expert group on the first day of the workshop, in which the group's utterances and observations sequentially construct a shared orientation and sensitivity to physical form, are carried over to inform his role in a new architect team on the second day. This transfer points to the significance of social organization and interaction for students' understanding and identification with concepts across a trajectory of activities.

Finally, we found the physical experience to be a central driver for appropriation and meaning making on multiple levels. The physical tools and digital representations used in the workshop, e.g., cameras, maps, task cards, and multi-touch table, allowed students to record and visualize perceptions and ideas across boundaries. The physical environment of the site in particular served as a visual reference point and source of inspiration in identifying the abstract relationship that would ultimately develop into the students' understanding of contrast. Similarly, the physical models designed by the architect team allowed students to not only visualize, but also manipulate and articulate their ideas in a collaborative and concrete manner. These findings suggest that for boundary crossing experiences in particular, physical surroundings play an important role in the social and cognitive processes of concept formation.

Vygotsky describes the path from the introduction of a new concept to the point where it becomes fully appropriated by the child as long and complex. His reference, however, refers primarily to

formal classroom interactions between a single adolescent and a teacher or researcher. As this study illustrates, the complexity of this path is dramatically increased as students cross social, physical, and institutional boundaries. Analysing such learning situations is important for the future, we believe, as conceptual development is increasingly viewed as unbounded by the walls of formal institutions. By investigating concept formation across contexts, we may also develop a better understanding of how to design learning experiences and technologies that connect school with the museum, home, and other settings.

*This research is made possible through the CONTACT project, financed by The Research Council of Norway. We extend a special thanks to the teacher and students who participated in this study. We thank Anne Qvale and Eva Madshus at the National Museum of Art, Architecture and Design, the architect firm Snøhetta, and the lab staff at InterMedia for close and productive collaboration in the design of Snøkult. We thank Sten Ludvigsen, Alfredo Jornet Gil, Anniken Furberg, and our colleagues in the InterMedia research group CHANGE for comments on this article.*

## References

- Arnheim, R. (1969). *Visual Thinking*. Berkeley: University of California Press.
- Aronson, E., Blaney, N., Stephin, C., Sikes, J. & Snapp, M. (1978). *The Jigsaw Classroom*. Beverly Hills, CA: Sage Publishing Company.
- Brown, J. S., Collins, A. & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32–42.
- Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A. & Campione, J. (1993). Distributed Expertise in the Classroom. In G. Salomon (Ed.), *Distributed Cognitions: Psychological and Educational Considerations* (pp. 188–228). New York: Cambridge UP.
- Cazden, C. B. (1988). *Classroom Discourse. The Language of Teaching and Learning*. Portsmouth: Heinemann Educational Books.
- Derry, S. J., Pea, R. D., Barron, B., Engle, R., Erickson, F., Goldman, R., et al. (2010). Conducting Video Research in the Learning Sciences: Guidance on Selection, Analysis, Technology, and Ethics. *Journal of the Learning Sciences*, 19(1), 3–53.
- Frow, J. & Morris, M. (1993). *Australian cultural studies: A reader*. University of Illinois Press.
- Geertz, C. (1993). *The Interpretation of Cultures*. Hammersmith: Fontana Press.
- Goodwin, C. (1994). Professional Vision. *American Anthropologist*, 96(3), 606–633.
- Hall, R. (2000). Video Recording as Theory. In D. Lesh & A. Kelley (Eds.), *Handbook of Research Design in Mathematics and Science Education* (pp. 647–664). Mahwah: Lawrence Erlbaum.
- Jordan, B. & Henderson, A. (1995). Interaction Analysis. *The Journal of the Learning Sciences*, 4(1), 39–103.

- Kelly, U. (1997). *Schooling Desire: Literacy, Cultural Politics, and Pedagogy*. London: Routledge.
- The Knowledge Promotion*. (2006). Ministry of Education and Research, Norway.
- Krange, I. & Ludvigsen, S. (2008). What does it mean? Students' procedural and conceptual problem solving in a CSCL environment designed within the field of science education. *International Journal of Computer Assisted Learning*, 3, 25–52.
- Lankshear, C. & Knobel, M. (2006). *New Literacies. Everyday Practices and Classroom Learning*. Maidenhead: Open University Press.
- Lymer, G. (2009). Demonstrating Professional Vision: The Work of Critique in Architectural Education. *Mind, Culture & Activity*, 16(2), 145–171.
- Mercer, N. (1995). *The Guided Construction of Knowledge*. Clevedon: Multilingual Matters.
- Pierroux, P. (2005). Dispensing with Formalities in Art Education Research. *Nordisk Museologi*, 2, 76–88.
- Pierroux, P. (in press). Real Life Meaning in Second Life Art. In B. Gentikow, E. G. Skogseth & S. Østerud (Eds.). *Literacy Practices in Late Modernity. Managing Technological and Cultural Convergencies* (pp. 175–194). Creskill NJ: Hampton Press.
- Schön, D. A. (1983). *The Reflective Practitioner*. Basic Books.
- Vygotsky, L. S. (1986). *Thought and Language*. Cambridge: MIT Press.
- Vygotsky, L. S. (2004). Development of Thinking and Formation of Concepts in the Adolescent. In R. W. Rieber & D. K. Robinson (Eds.), *The Essential Vygotsky* (pp. 415–470). New York: Kluwer.
- Wertsch, J. (1998). *Mind as Action*. New York: Oxford University Press.
- 

1 See <http://www.denkulturelleskolesekken.no/oversettelser/english.htm>