

Constructivism in architectural design education

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INITIATIONS



PRACTICES OF TEACHING
1ST YEAR DESIGN IN ARCHITECTURE

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Constructivism in Architectural Design Education

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Abstract

The set-up of the first-year courses in architectural design at Eindhoven University of Technology (TU/e) has, in recent years, shifted from general design assignments ('design a building for given requirements on a given site') to assignments divided into clear consecutive steps, each aimed at particular operations in the design process – and, accordingly, from a teacher-centered to a student-centered approach. This allows the students to slowly but steadily build a coherent collection of skills, which together form the skill-set and experience needed for the complex operation of architectural design. This has been done based on two ideas, on the notion that design is a complex and open-ended skill, and on constructivism as a theory of learning. The first of these ideas has been elaborated by multiple authors, for example by Donald Schön in *The Reflective Practitioner*. The second idea, that of constructivism, is based on the work of Jean Piaget and Lev Vygotsky, which says that learning is the active construction of meaning by the learner. Learning happens when the learner is confronted with new understandings about reality that are in conflict with his or her prior knowledge, and because of this is forced to reconstruct his mental representation of the world. In a constructivist course the role of the teacher changes to being the facilitator for this process of constructing meaning. In the first-year design courses at TU/e, 'scaffolding' for the students has been provided with sketch workshops, a set of categories to help to explore different possible solutions, and a sequence of themes as a framework for the course (space – sequences of spaces – light – sightlines – façade composition – structure - material – detail). To make this approach effective the didactical idea should be made explicit to the teachers, and reflection should be well-integrated in the set-up of the course.

Keywords

education / architecture / urbanism / constructivism / reflection-in-action / design / design process

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1. Introduction

The set-up of the first-year courses in architectural design at Eindhoven University of Technology (TU/e) has, in recent years, shifted from general design assignments - 'design a building for these requirements on this site' - to assignments divided into clear consecutive steps, each aimed at particular operations in the design process. This has been done based on two ideas, the notion that design is a complex and open-ended skill, and on constructivism as a theory of learning. The two architectural design courses in the first year of the bachelor curriculum at TU/e will be discussed below from the point of view of these two ideas. The questions which will be discussed are whether this approach would benefit from being applied in a more radical way, and whether – and if so, how - it should be made explicit to the students.

The first year of the three-year bachelor program at the department of the Built Environment at Eindhoven University of Technology is mainly a general introduction to the entire field of the built environment, and to engineering in general. Next to basic courses, which every first-year student at TU/e has to follow, the first year courses of the department give an overview of its four units: next to architecture and urbanism, these are urban systems and real estate, structural design, and building physics and building services. This has as a consequence that the amount of time specifically dedicated to architectural and urban design is relatively limited in the first year: 7 ECTS of the total of 60 - about 12% of the credits of the first year program. This specific design education takes place in the two courses which will be discussed below. Both courses, *BAU Studio 1* and *BAU Studio 2*, are project courses, in which students work on more or less realistic design assignments, in small groups, the result being an individual design. The first assignment, in *BAU Studio 1*, lasts a mere four weeks, the second, *BAU Studio 2*, has eight weeks.

2. Design as a complex, open-ended and sophisticated skill

In his book *The Reflective Practitioner* Donald Schön contrasts the model of what he calls 'Technical Rationality', the scientific way of working in which theoretical knowledge precedes action, and variables are always controlled and preferably only changed one at a time, with the way *practitioners* work, who operate in situations which are complex and cannot be controlled as if in a laboratory-like setting, situations in which it is impossible to isolate variables and assess the influence of each individual variable unequivocally. These are situations of "uncertainty, instability, uniqueness and value conflict" [1, p. 50]. The practitioner is not acting from outside, but he himself is part of the reality he is acting on, and with his actions, this reality changes. According to Schön, the way practitioners approach a situation like this is by first forming a hypothesis about it, and then testing the validity of this hypothesis by (hypothetically) applying it in an experimental way. Applying and testing, or action and reflection, happen simultaneously: Schön calls this *reflection-in-action*. Practitioners base their hypotheses on their knowledge of previous examples which are similar to, or have characteristics in common with the situation at hand. Often this is *tacit knowledge*, and the selection of these previous examples happens intuitively. The kind

of situations practitioners have to deal with are therefore complex – many variables change at the same time –, open-ended – depending on the hypothesis, the course the experiments take and the way the variables influence each other, the outcome will be different –, and sophisticated – dealing with these situations requires experience and skill. Two of the practices Schön uses convincingly as examples for his argument are architecture and urban planning.

In *Making Explicit in Design Education: Generic Elements in the Design Process*, Elise van Dooren et al. elaborate, starting from Schön's observations, and using findings of many more authors on the subject, a generic framework for the design process. Made explicit, this framework can be used for design education. The framework consists of five elements: design is done by *experimenting* and *exploring*, uses *hypotheses* or *guiding themes*, works on different *domains* or *work fields* simultaneously, needs a *frame of reference* or *library* (of possible solutions), and has its own *laboratory* (in case of architecture the visual language of sketching and modelling).

If design is indeed complex, open-ended and sophisticated, the question is how it can be taught.

3. Constructivism and learning in small consecutive steps

Constructivism, as a theory of learning, says that learning is an active construction of meaning by the learner. Learning happens when the learner is confronted with new understandings about reality that are in conflict with his or her prior knowledge. With the effort of bringing the knowledge already present in accordance with the new experiences or knowledge, the learner constructs new meaning, which he adds to his view of the world. New stages in the development of the learner are understood as “constructions of active learner reorganization” [3, p.11].

The theory of constructivism is about cognitive development, and generally seen as being founded on the work on the cognitive development of children of Jean Piaget, Swiss psychologist (1896 – 1980), and of Lev Vygotsky, Russian psychologist (1896 – 1934). Generalizing, the emphasis in Piaget's work is on the stages of cognitive development, and, later on, how cognitive development takes place, by *assimilation* (fitting new experiences to already present knowledge), *accommodation* (adjusting the current structure of knowledge to be able to fit in new experiences) and *equilibration* (balancing the opposed effects of assimilation and accommodation). Vygotsky's work emphasizes the role of language and the importance of social interaction in constructing meaning – interactions with other human beings are internalized to form new mental constructs. Vygotsky says that learning happens in the *zone of proximal development* (ZPD), which spans the distance between the current state of development of the learner and the level he could potentially reach “through problem solving under adult guidance, or in collaboration with more capable peers” [4, p. 86].

Constructivist education should therefore be *active* – it is the learner who actively constructs new meaning, and who is responsible for his own development, *constructing* – in the sense

that the learner must build new knowledge on prior knowledge, *cumulative* – development is adding new knowledge to prior knowledge, and *goal-oriented* – learning happens most effectively if the learner knows that he will gain from it [5, p. 277].

Typically, education in architectural design by means of practical project assignments has many characteristics of constructivist learning already – and it is, because design is a practical activity, particularly well-suited for a constructivist approach. It is active, constructing and cumulative because students have to actively construct their own solutions to the problem given, and they have to construct new knowledge from what they experience in doing this. It is goal-oriented as it is very clear what the purpose of the activity is. It is learner-centered as the outcome of the project will be individual and the role of the teacher can only be to guide the student through the process needed to get to a solution – this solution is not predetermined by the teacher. It is challenge-based: the student will only reach the goal by working actively on a solution. Working in a studio provides the social environment in which sociocultural meaning can be constructed in dialogue with peers and teachers.

Apart from emphasizing the active role of the learner, constructivism also suggests that effective learning should be done in well-determined steps: these steps should build on each other, should not be too big (as each step has to be connected to the knowledge, or skill, gained in the prior step) and should, in order to be goal-oriented, be tuned to the exact new knowledge or skill which has to be gained. A well-determined succession of steps can, in that sense, act as a ‘scaffold’: the steps provide a ready framework or model for the process needed to complete the assignment. This tuning has been attempted in the two first-year design courses mentioned above, based on the notion of design as a complex, open-ended and sophisticated skill.

4. First first-year architectural design project at TU/e

The first experience with architectural and urban design for students starting at the department of the Built Environment of TU/e is short: about two days during four weeks, eight days in total, are devoted to a first small architectural design project in the first semester of the bachelor program – other subjects covered in the same 10 ECTS course are planning and real estate, structural design, building physics and drawing and digital media – the course is explicitly a general introduction. The assignment is structured as a typical design assignment in a nutshell: the first week is devoted to first sketches and the analysis of the context and the list of requirements, the second to explorative sketching and generating design variants, the third week is for refining and elaborating material and detail, the fourth is for presentation and processing feedback. This division in four steps may already be seen as a scaffolding framework to facilitate constructivist learning, but this is not different from typical design assignments at TU/e.

Two elements in the framework of the assignment are more specific. The first is the start of the work of the students at the first studio meeting of the course. The very first thing the students do is a pressure-cooker style sketch workshop: in one and a half hour the students have to make first very quick sketch proposals, considering at least positioning, massing

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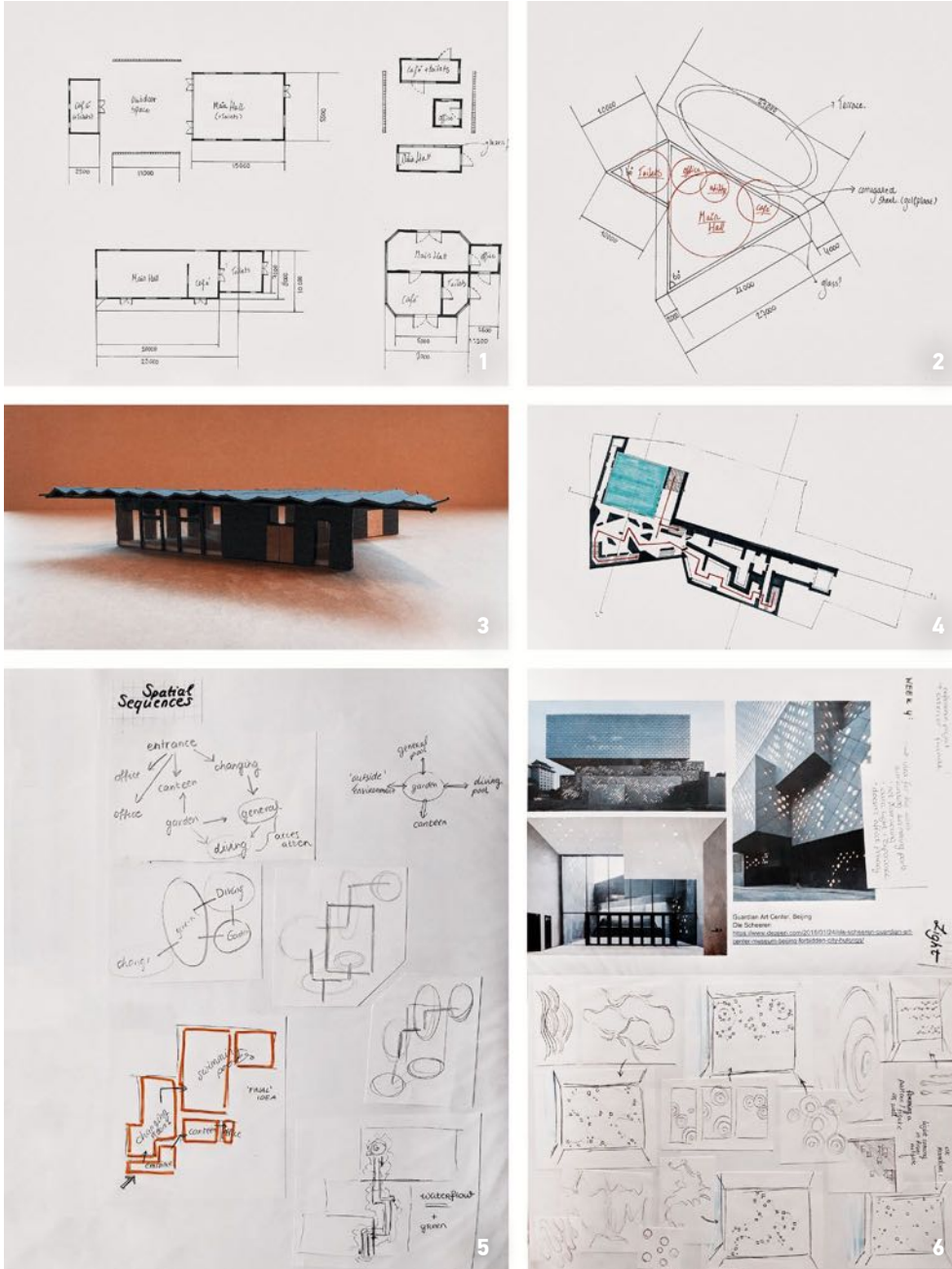


Fig. 1: Variants of the lay-out of plans - Fenne Jansen
 Fig. 2: Abstract lay-out of the final plan - Fenne Jansen
 Fig. 3: Model of the final result - Fenne Jansen
 Fig. 4: Sequence of spaces - Babette van Tilborg
 Fig. 5: Sequence of spaces - Lieke Diederer
 Fig. 6: Studies on light - Lieke Diederer

and possibly the overall organization of the plan. This is meant to confront the students with all things uncertain and unclear about the task they will have to perform – in constructivist terms, to confront them with all aspects for which their current skill and knowledge does not have solutions yet, as to challenge them and ‘open’ their minds for new knowledge.

The second is a set of categories given to the students in the beginning of the second week, as a guide for generating variants, or alternative solutions. The categories are taken from *The Place of Houses* by Charles Moore, Gerald Allen and Donlyn Lyndon and give four principles for fitting a building to its context (merging, claiming, enfronting and surrounding) and six principles for organizing plans (rooms linked, rooms bunched, rooms around a core, rooms enfronting the outside, a great room within, and a great room encompassing). This is to help the students to generate variants, and to provide them with three of the building blocks of the skill of designing seen as complex and open-ended: that design is done by exploring (in this case: with variants), on different domains (in this case: context and lay-out of the plan) and with a frame of reference (in this case: one of the many possible categorizations).

One example of student work with these categories can be seen in Fig. 1. In this stage the variants are still very basic. But apparently the exercise triggered thinking about the organization of the plan in more abstract categories, which can be seen in Fig. 2, after four weeks resulting in the design shown in the model seen in Fig. 3.

5. Second first-year architectural design project at TU/e

The second design project takes place at the end of the first year. This time the project has eight weeks and 5 ECTS, which is entirely for the architectural and urban design project (students who decide to specialize in another direction – planning and real estate, structural design, building physics – do other assignments, however with the same program and the same site). This time, the steps in the framework of the project are not about how to organize a design process in general, but take urban and architectural aspects as guiding themes. The aspects are, consecutively: *space* (‘start with the design of the most important interior and exterior space), *sequences of spaces* (again interior and exterior), *light* (‘determine how light, natural and artificial, enters your building’), *sightlines* and *façade composition*, *structure*, *materials*, and *detail*. These aspects are formulated as abstract categories on purpose, to ensure reflection on an abstract level.

So again the structure of the course is designed as a ‘scaffold’ to help the students to construct their own knowledge and skill – their own meaning for the material they discover. In relation to the view of design as a complex, open-ended and sophisticated skill, the steps in this case are aimed at making *domains* explicit, and at building a *frame of reference* – a personal library of possible solutions for all kinds of design problems. The element of exploring and experimenting is incorporated in the steps themselves – if all went well the students learned in the first project how to explore in order to find design solutions.

The illustrations show the way the students worked with the given steps (no final results are shown). In Fig.4. the question to think about sequences seems to have triggered an

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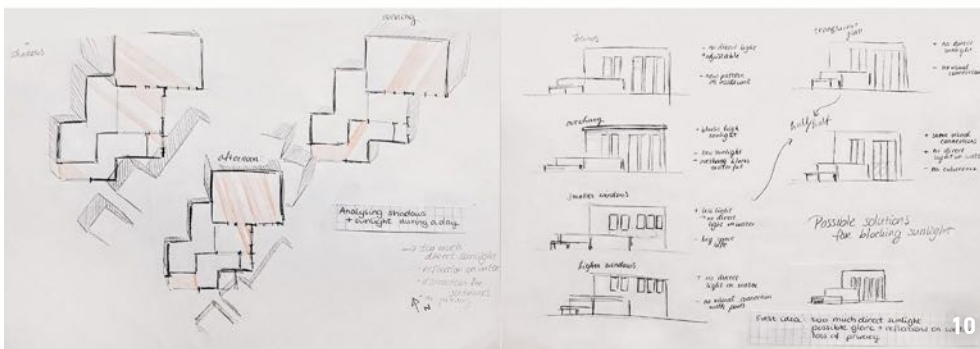
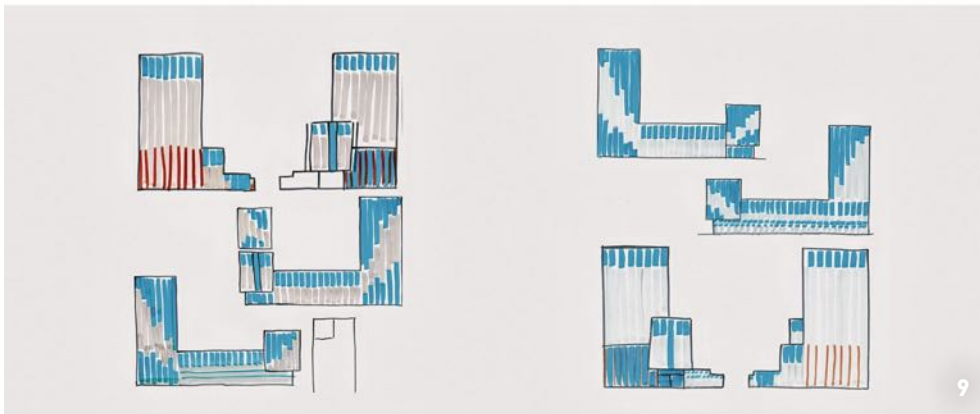
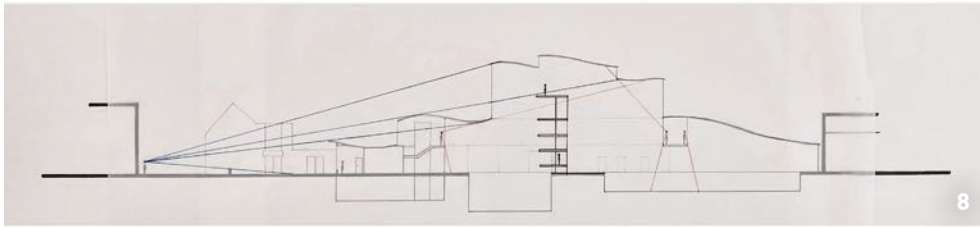
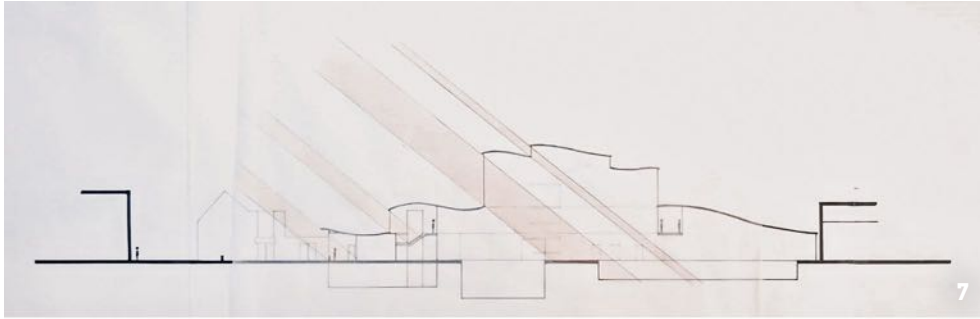


Fig. 7,8: Studies on light and sightlines – Jeruël Schut

Fig. 9: Façade composition – Camille Kleibergen

Fig. 10: Light and façade composition – Lieke Diederer

idiosyncratic solution. A way of thinking that stays closer to the organization of the program is shown in Fig. 5.

Two examples of students working on light show that this aspect too can be approached in many different ways, Fig. 6 and 7. Fig. 8, from the same design, shows sightlines. The fact that the students first worked on light and sightlines apparently gave them clues about façade compositions, as can be seen in Fig. 9 and 10.

6. Discussion

The first question to address here is whether this approach would benefit from being applied in a more radical way. This question arises because there seems to be a tension between, on the one hand, the strictness suggested by the structure in well-determined steps and, on the other hand, the (individual) freedom needed for a constructivist approach, where the learner constructs his own new meaning, which he therefore has to be able to construct individually. This freedom also seems to be needed for the complex and open-ended character of the design process, which needs exploring, and hence the freedom to do so. As it is now in the two projects, the freedom teachers and students take seems to prevent the constructivist set-up to be exploited to its full potential. But if a more radical application would mean that the steps of the framework would have to be followed more strictly, the structure would probably become too much of a straight-jacket. As a constructivist approach is learner-centered by definition, an improvement of the effectiveness of the courses might very well be found in teachers being more aware of their role in such a set-up. A pitfall for design teachers can be to concentrate on the actual design (with the risk that the teacher only imposes his own convictions), instead of on the skill of designing (in which case the teacher is more of a facilitator, as he should be in a constructivist set-up). In the end, the goal of the education is not the quality of one particular design a student makes, but the acquisition, by the student, of the *ability* to make *many good designs*. A more radical approach has to be found at the side of the teachers.

The second question is whether the courses would benefit from making the didactical ideas behind them explicit to the students. From a constructivist point of view one could say that this would improve the extent to which the courses are goal-oriented: it would make the goal of the courses more clear. But the goal of the courses is not insight in didactics. And as the scaffold of the didactic structure is only there to help the learner to construct his own meaning, the scaffold itself is of no importance for the learner to know. As the goal of the courses is to acquire the skill of designing, making this *skill* explicit would be very beneficial. Donald Schön already emphasized the importance of reflection. And the reflection should not only be about the design at hand, but also about the methods used: only then tools to solve future design problems are internalized. The same is true from a constructivist point of view: when the learner reflects on *how* he constructed new knowledge and skills, when this is made explicit, retention - the soundness of the newly formed structure - will be much better. Again, the teacher has a role in this: he has to make these things explicit, and include reflection on what has been done in the tuition. Peer-reviews could serve the same purpose, as reflecting on the work of peers of course help to make own considerations explicit too.

As learning is development, and reflection and making explicit are driving forces for development, the two first-year courses in architectural and urban design at TU/e will benefit from making the didactical ideas more explicit to the teachers, and from a better integration, in the set-up of the courses, of reflection and making things explicit.

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