Learning from Planning Practice and Research

– heuristic tools for cognitive apprenticeship[1]

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Abstract

Architect planners and urban designers traditionally acquire their professional skills through apprenticeship – learning from masters. The unreliability of professional judgment and the existence of competing worldviews and professional paradigms have been presented as reasons, however, to seek a broader and stronger scientific basis for planning. One expression of this is a requirement for "evidence-based planning", which by some is interpreted as a more frequent use of large knowledge bases, expert systems and computer modelling. This paper questions this as the only way and argues for the use of *heuristic* tools as an *intermediate* method; between imitating masters and relying on scientific knowledge, for developing professional skills through *cognitive apprenticeship*. Educational experiments at the school of Spatial planning, Blekinge Institute of Technology have been using software tools to help students visualize, construct and analyse chains of arguments in real planning cases. The outcome of these experiments forms the basis of a discussion of how heuristic tools for cognitive apprenticeship, potentially applicable to planning, generally, can help developing professional skills in planning and urban design.

Developing professional skills – apprenticeship or research?

How do architects and planners acquire their professional skills? A traditional answer is: by apprenticeship, learning from masters (Linn, 1998, Lundequist, 1995, Schön 1983). Tasks are presented to the beginner, which represent typical difficulties of the profession, but in an elementary form. The architectural student starts by designing a small weekend hut and goes on to more complex building tasks.

Apprenticeship is practiced in many fields. The skilled craftsman; a carpenter, a welder, learns rules of thumb, imitates a master, and practices patiently to achieve satisfactory results. But apprenticeship is also common in educated professions; e.g.doctors, engineers, architects, who want to apply scientific knowledge as guidelines for action. They are, nevertheless, also dependent on a professional context, the guidance of more experienced colleagues, who know what scientific knowledge to apply, and when; who can communicate and reflect upon this in a professional discourse, or "virtual world" (Schön, 1983), the acquisition of which is part of the apprenticeship.

There is a problem, however, with apprenticeship. Professional knowledge is not reliable. Buildings rot, bridges collapse, money is wasted on huge and useless projects, patients die or become sicker after medical treatment. (Dawes & Hastie, 2001, Gigerenzer, 1999, Hall, 1982, Parkin, 2000, Rolf, 2008). Professional decisions are inconsistent and experts often show unfounded over-confidence in their judgments (Plous, 1993).

Professions usually reserve the right to decide what is good practice, with the result that young professionals sometimes learn only how to repeat the mistakes of older colleagues. But there are also legitimate reasons for the unreliability of professional judgment. Professionals often deal with complex, non-deterministic social systems, where the feedback of actions taken is delayed (Rolf, 2008). Social problems in modern housing estates, for example, take a long time to emerge and are difficult to relate to the physical design of buildings and urban structure (Öresjö, 2004).

Another indication of the lack of reliable basis for professional judgment is rivalry between different paradigms. In the field of architectural education, there are several competing views of how architects should be trained. Diaz Moore (2001) identifies four main pedagogies through study of debates on architectural education. It is difficult to see what kind of evidence would show that one pedagogy is better than the other.[2]

This uncertainty has led to demands for a broader and stronger scientific basis for professional judgment. Britton Harris was a pioneer, who already in the 1960s developed computer models for use in spatial planning. In his view, goal conflicts, great costs and often irreversible consequences mean that planning decisions cannot be left to the individual judgment of professionals, however qualified. (Harris, 1997). Formal models, preferably computer models, are needed to verify the consequences of recommended actions. Healey (1997) objects to this view that formal models reflect fixed problem-framings and hinder continuous mutual learning. They also tend to favor certain types of goals and measures, which are easier to model in quantitative terms than others, for example infrastructure investments, as compared to social and esthetic qualities of the built environment.

Recently, the demand for "evidence-based planning" has followed the trend in the social and health sectors in the UK and revived the debate on what is relevant knowledge for planning (Davoudi, 2006). According to her presentation, an *instrumental* interpretation of "evidence" assumes a too simplistic, linear relationship between research and policy. It predictably calls

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[2] "Pedagogy" according to Diaz Moore, refers to "all those practices that define what is important to know, how it is to be known and how this production of knowledge helps to construct social identities". (op.cit:61)

for the development of huge databases, expert systems, computer models to underpin policy decisions. Davoudi questions the usefulness of this interpretation. There are many indications that decision-makers, in fact, do not want more knowledge about the issues. It makes decision-making more complicated. An acceptable reason for this may be that more information often makes it more difficult to discover patterns and efficiently frame the problem, (Rolf, 2008).

Davoudi lists additional arguments against the instrumental use of knowledge: experts are not always impartial but have self-serving, professional agendas. Ideology and vested interests tend to demand knowledge that supports established worldviews and past decisions and suppress opposing evidence. Instead she advocates an *enlightenment model*. The purpose of scientific research is rather to "illuminate the landscape within which policy decisions have to be made. The emphasis is on providing a deeper understanding of the conditions within which different interventions might be effective." (Davoudi, 2006:16)

Rolf (2007a) makes a distinction between *conceptual uncertainty*, which might be reduced by Davoudi's enlightenment model and *epistemic uncertainty*, which is usually addressed by instrumental rationality.

In view of these uncertainties, how should complex planning problems be handled? There is often "a problem in finding the problem (Schön, 1983).

Rolf (2007a:6) lists a number of dimensions involved in problem solving: What is the problem? On what factors does the problem depend? What is the form of dependency? What is the strength of the dependency? What are the facts on which the solution of the problem rests? Three of these dimensions involve conceptual uncertainty and two epistemic uncertainty, which shows the need of *conceptual clarification*.

Heuristics – simple tools for a complex world

So what should young professionals do? They cannot always trust their masters, and may not have access to sufficient scientific knowledge to guide them?

Rolf (2008) identifies a group of *intermediate* methods, between what is called "strong" methods; used by professionals with expert knowledge of their fields, who quickly can reduce complexity by identifying relevant features of a problem. The problem with these methods is the need to trust professional authority, with risks pointed out above, and difficulties in teaching these methods to ignorant beginners. "Weak" methods are general, based on scientific knowledge and provable by deduction. They are valid, open to all, but difficult to apply to specific cases.[3]

Heurestics is an intermediate method, relying partly but not completely on domain knowledge. Heuristics elaborates on *representations* in order to support the process of inquiry, connecting problem formulation to final decision. "Thus, heuristic methods are directed at managing processes." (Rolf, 2008: 6, after Polya, 1957). [4]

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[3] It should be noted that in both cases, the issue of conceptual uncertainty remains. Policy and goals may still be vague, so it is not clear how the knowledge gained by different methods should be applied.

[4] Heuristics is an important part of current cognition research. The role of framing and presentation was highlighted, for example, by Tversky & Kahneman (1981) and Tufte (1983). Mathematically equivalent alternatives are accepted or rejected according to their form of presentation. Important information from statistical data may be overlooked because of an inefficient presentation. Examples of heuristics within the field of planning, are found in the presentation of "Strategic Choice Approach", in Friend & Hickling (1987) and Strömberg (1986).

The concept of heuristics provides support for what is called "cognitive apprenticeship" (Collins et al. 1989). Cognitive apprenticeship focuses on learning the right *method* rather than on producing an acceptable *outcome*. The result of the apprentice's efforts may have weaknesses, but if the master can verify that the apprentice is applying the right method, there is hope for improvement.

An example from architectural education is "sketching", an example of, "reflection in action" (Schön, 1983). The student is instructed to make several "design experiments", working in the "virtual world" of sketching on onion-skin paper, evaluating the outcome, learning from it, modifying it in an iterative process that simultaneously develops the understanding of the problem, and the possibilities to solve it.

Heuristics thus focuses on useful ways to *conceptualize* and *represent* problems.

Rolf et al. have developed versatile software tools towards this goal, to help represent and analyze problems of *argumentation*, *negotiation* and *decision-making*: Athena Standard, Athena Negotiator and Athena Impact Analysis (Rolf, 2006).

Athena Standard has been used for a number of years in the Master program of Spatial planning at Blekinge Institute of Technology, to help students develop professional skills by means of cognitive apprenticeship. The setup and outcomes of these experiments are described below.

Educational experiments in training architect planners

An educational problem at Spatial planning, Blekinge Institute of Technology, has been to modify a "professional culture" that seems to be adopted rapidly by planning students. Early enough the students learn what seems to be the "code" of the profession. It is about synthesizing multiple requirements into an attractive design for improving urban environment and public space,

such as an urban renewal scheme, or a proposal for a residential or workspace area.

As in most schools of architecture and planning, the emphasis has been on innovative and attractive spatial arrangements that potentially solve several problems, functional and technical goal conflicts, while also satisfying esthetic requirements. Arguments are mainly used to support the selected solution. Self-critical evaluation is rare, students are also reluctant to criticize fellow students' proposals, even when teachers include such moments during the review.

The "professional culture" as perceived by students seems to be one of *consensus*, *collaboration* and the innovative *creation* of spatial arrangements that will satisfy multiple interests.

But planning is also *conflict*, and needs *analysis* of arguments for and against planning proposals (Törnqvist, 2006). Planners need the ability to construct and evaluate *hierarchies* of argument. Some factors are more important than others. One cannot rely on simple, linear reasoning, suitable for presentation and persuasion; this alternative is good, this is bad, because… Analyzing chains of arguments is important for reducing both conceptual and epistemic uncertainty, (Rolf, 2006).

It is significant, that according to Diaz Moore (2001), only one of his four pedagogies for architectural training lists *competitiveness* and *critical thinking* as characteristic of student roles. Two emphasize *collaboration* and one, *individual dependence on a master*.

During a number of years, there have been two series of educational experiments in the Master program of Spatial planning at the Blekinge Institute of Technology, both intended to strengthen the ability of the students critically to evaluate opposing views on planning issues.

Analyzing argumentation in real planning cases

The first series of educational experiments has taken place in the second year, in a course, training students to design workspace areas. It introduces the students to planning tasks that are: (a) not immediately familiar to them, but demands absorption of technical and legal information about the spatial demands and restrictions concerning industrial and commercial location, and (b) are characterized by conflicts of interest; for example, employment opportunities vs environmental concerns.

In order to train students in understanding and analyzing these conflicts of interests, the *Athena* software has been used in analysis of argumentation in real planning cases involving industrial location, which have been appealed, and finally decided by the government (*Bättre plats för arbete*, 1995).

In the latest version of these exercises, the students were asked to evaluate the arguments in a case, where a municipality presented a detailed development plan (*detaljplan*), which allowed densification of an old, culturally valuable workers' settlement, adjacent to a polluting industrial plant. The planning conflict concerned on one hand the interests of residents and the municipality to make room for a sufficiently large population in the area as a base for commercial and social services, and on the other hand, protecting the cultural values of existing buildings and avoiding that more residents would be exposed to industrial pollution,.

The teachers prepared a list of twelve arguments, for and against densification of the area that had been presented by the relevant authorities: the municipality, the County Administrative Board (länsstyrelsen), the National Board of Housing, Building and Planning (Boverket), the Environmental Protection Agency (Naturvårdsverket).

The students were divided into three groups, each provided with a different medium of representing and analyzing the case. All students were asked to evaluate the arguments according to their *acceptability* and their *relevance* to the case. They were supplied with a guide, helping them to evaluate the arguments in these terms. For example, the views and arguments of the National Board of Planning, Housing and Building in a planning case are obviously *relevant*. This authority reviews appeals of planning cases and for that reason its opinions must be given considerable weight. The *acceptability*, or credibility, of the arguments, depends on the factual basis for them.

Five groups of 2-3 students used a simple listing of the twelve arguments in a *Word* format. Ten groups were asked also to structure the arguments *visually* with the help of two computer programs; *Athena Standard* and *Mind Manager*.

Planning as debate

In the fourth year, a course in Planning theory introduces the students to the international, academic discussion about spatial planning; how it is practiced, and how it should be practiced. Texts discussed in seminars would be used in writing a final essay.

The literature seminars in this course were to begin with rather ineffective. Many students did not read the texts in preparation, but relied on the teacher to guide them toward thoughts that were important in the essay, in order to pass. Several attempts have been made since then to stimulate a debate on opposing theoretical positions found in the literature.

Results
Analyzing argumentation

In all three representations, *Word, Athena* and *Mind Manager*, nearly all students succeeded in evaluating the different arguments and reach a conclusion that was consistent with this evaluation. In thirteen groups of fifteen, this decision was also the same as the government had taken.

One group, using *Word,* recommended the opposite decision. It turned out that they had neglected strong counterarguments to their position, strong according to their own evaluation. Their reasoning, therefore, was inconsistent, an example of the frequent case, that it is not lack of knowledge but the use of this knowledge that leads to fallacious conclusions.

Another group, using *Athena*, shrewdly identified vagueness in some of the presented arguments. A decisive factor according to their analysis was how many residents would in fact be affected by industrial pollution after densification.

The official arguments indicated that the number would not be greater than before, but this was not perfectly clear. The group properly concluded that more information on this issue was needed before a decision could be made.
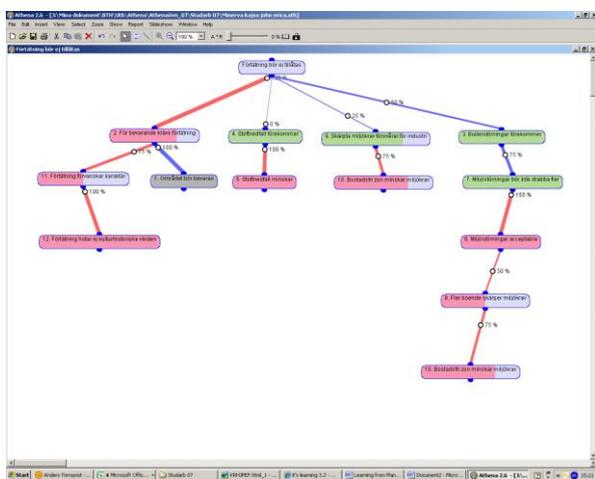
Tree of arguments in Athena.
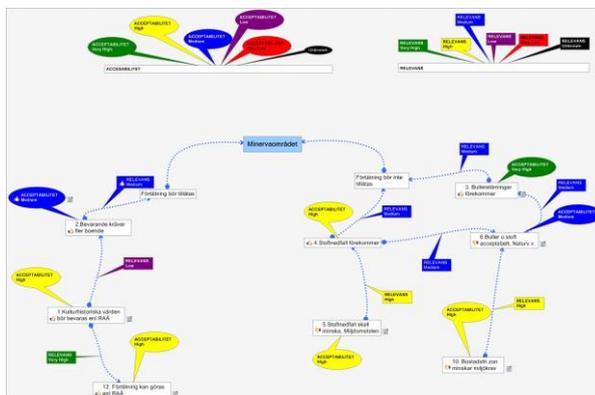
Argument structure in Mind Manager.

The visualization programs, *Athena* and *Mind Manager*, turned out to have both strengths and weaknesses. One weakness pointed out by several groups was that it took time to learn how to use the programs.

One difficulty of the *Athena* program was particularly telling. When constructing the chains of argument, the program demands that a decision if one argument should be a pro- or con-argument should be made with regard strictly to the argument immediately above it in the structure, not to the main thesis on top of the chain, as many students tend to think. This reflects the difficulty many people have in identifying chains of arguments. The tendency is to marshal a number of main arguments pro– and con- and then deciding which group seems stronger. The *Athena* program, which has been specifically developed to analyze chains of arguments, seemed somewhat easier to use, than the more general-purpose program *Mind Manager*.

Generally, the strength of the two visualization programs was *diagnostic* usefulness. In some *Word* groups, there were indications of unclear thinking, but it was difficult for the teachers to understand what the problem was. In the visualization groups the teachers could look at the argumentation tree presented by the students, and found it easier to ask questions of how the students had reasoned and to detect thinking errors.

The visualization aids then seem to support *cognitive apprenticeship* better than merely verbal representations. The teachers can help the students to develop useful *methods* for solving problems, not only evaluating the *outcome* of their work.

Literature seminars in planning theory

In the beginning, the students apparently conceptualized the learning problem as trying to convince the teacher that they had read the assigned literature and could be sufficiently active in a discussion. The teachers rather wanted the students to acquire competence to understand and use complex argumentation in critical analysis of scientific texts.

The first experiment with a debate on theoretical positions, did not sufficiently change the students' conceptualization. The debating groups hardly attacked the opponents' position, but only described and argued for their own, still regarding the teacher as the judge of their efforts.

In another setup, students were acting as chairpersons, secretaries and members of a jury who would award victory to one of the teams. The teacher was passive. The problem had become one of convincing fellow students of their knowledge and debating skills and the need to compete for a winning position. The students' energy in speaking and arguing was clearly strengthened in this setup. In evaluation the students also expressed appreciation of this form of literature seminars.

A remaining weakness in this latest version of the seminars was that the students rarely picked up the other team's arguments and addressed counterarguments to them. Mostly they just repeated their strongest arguments for their own position and against the opposing position. The ability to identify chains of arguments, evaluating each argument, its relation to others, and sorting out the important ones is apparently a rare skill (Rolf, 2007b). The one-day exercise two years earlier, using Athena to analyze argumentation, apparently was not sufficient to develop and maintain this skill.

Conclusion

Applying *conceptual apprenticeship* through *conceptual clarification* and *visualization* as a *diagnostic* tool has resulted in improvements in two educational contexts; both focused on training architect planners to structure and evaluate chains of arguments in planning cases. There is still need of improved training to stimulate and consolidate such professional skills. It is still unclear what factors, generally, are the important ones in conceptual apprenticeship: conceptual clarification, visualization, group discussion or teacher-student interaction

A research program for developing heuristics in planning

What are the implications of these educational experiments for the greater issues of improving professional skills in the complex tasks of planning and urban design?

The following planning dilemmas illustrate the need of inter-professional heuristic tools to reduce conceptual uncertainty and support cognitive apprenticeship. Lack of knowledge is not the main the problem. Nor always a conflict of interests. Rather, it is a matter of different worldviews, discourses and established professional working methods that are, if not incompatible, at least difficult to integrate with each other in an efficient collaboration process. Different actors have different interests and therefore different concepts to represent them. In order to negotiate and collaborate they must find a way to unite them (Rolf, 2008:5).

Planning and environmental protection paradigms

The concept of *sustainable development* and the Swedish National Environmental Objectives (NEO) are good illustrations of the problems of conceptual uncertainty. Under the umbrella of a spurious consensus, created by vague and unclear concepts different professions and interest groups involved in planning and environmental management will operationalize the concepts differently, interpret goals and handle goal conflicts in contradictory ways. Whereas the planning culture of the Planning and Building Act sees the problem as one of weighting social, economic and ecological factors the NEOs makes ecological sustainability a prerequisite and a restriction on social and economic development. Thus conceptual clarity is more important than indicators or data. (Emmelin & Kleven, 1999, Emmelin & Lerman, 2006, 2008)

One could say that there are two different paradigms in planning for environmental protection. The *environmental paradigm* relies on quantitative knowledge from the natural sciences,

knowledge which is considered objectively true and non-negotiable. Within the *planning* paradigm, scientific knowledge is respected, but in order to actually get things done with acceptable environmental impact, one must also realise that collaborative action usually demands negotiation and compromise.

Social processes and spatial planning

Öresjö (2004) and others have shown the non-deterministic and multi-causal relationship between spatial planning and the resulting built environment on one hand, and social processes and outcomes on the other. Functionally, technically and architecturally satisfactory housing estates may still become socially segregated, stigmatized and beset with social problems. Nevertheless, keeping up maintenance and frequently upgrading the physical environment are necessary in order to prevent social conditions to deteriorate further.

Planning cities and designing buildings

Should architects and planners use the same methods when planning an urban structure as when designing a building? Hillier (1996), Marcus (2000) and others have argued that these two tasks are essentially different and should be handled with different methods. Designing an urban structure should focus on *configurational* properties of the urban environment, affecting cadastral structure and infrastructure investment. Planning a city is not the same thing as designing public space, but rather providing a robust, legal and physical framework for future, largely unknown detailed designs.

Regional development and spatial planning processes

This is another example of non-deterministic, multi-causal relationships. Although planning for regional development and social cohesion is an important policy in the EU, the tools of spatial planning to influence regional development often seem blunt and ineffective. When something

happens, it is difficult to disentangle the causal relations (Nilsson,1998).

Simon (1997:112) recommends:
"Our concern is not to forecast the future but: (a) to understand the consequences of alternative possible futures and (b) to understand which of these possible futures is associated with particular strategies or policy measures."[5]

A future research program

In conclusion, there is a need to develop a research program – not to *complicate* knowledge in action but to *simplify* it, with heuristic tools as a possibility. The challenge is that these tools need double competences – both knowledge of the professional domains and metacognitive understanding of heuristics. A research program of this kind clearly needs participation from different scientific fields and planning professions and a strong commitment.

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[5] An example of this scenario approach to the development of Blekinge county is documented in Blücher et.al (2001).

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