

A Pattern Language as an Instrument in Designing for Productive Learning Conversations.

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Abstract: There is a rapidly growing interest in using design patterns and pattern languages for instructional design. The patterns-based approach was pioneered by Christopher Alexander in the domain of architecture, and was described by him in such a way that it has become a point of reference in other domains where design questions are studied. This paper describes, in the context of Alexander's intentions for the development of his methodology, how it may be used in the dissemination of results of design research on tools for computer supported collaborative learning. In particular, we focus on how it may help with the difficult problem of facilitating mutually-intelligible discussions about learning, within multi-disciplinary design and development teams. This focus is especially appropriate in our case, because the kinds of learning we aim to support are themselves dependent on students' engagement in productive learning conversations.

*The proper answer to the question
"How is a farmer able to make a new barn?"
lies in the fact that every barn is
made of patterns. (Alexander, 1977, p. 178)*

Introduction

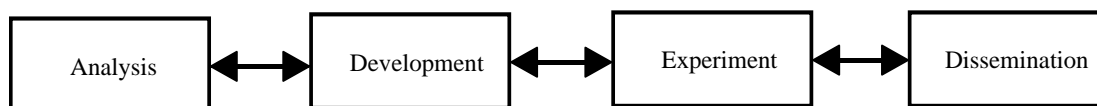
Asynchronous computer supported collaborative learning (CSCL) has been attracting a great deal of interest in recent years, especially because of its potential to help students acquire a deep understanding of the phenomena they are studying. In principle, active participation in joint discussion and joint problem-solving engages cognitive mechanisms which engender a richer conception than might be obtained through private study (Dillenbourg, 1999; Lehtinen, 2003, Romiszowski & Mason, 2004). But such potential benefits are not always obtained in practice, for at least four reasons:

- CSCL research and practice are based on a wide variety of theoretical approaches (Koschmann, 1996), (Dillenbourg, 1999) (Stahl, 2000) (Lehtinen, et al., 2004), (Bereiter & Scardamalia, 2003). This hybrid theoretical basis makes it *difficult for teachers to interpret* and combine research findings and translate them into powerful applications.
- Even if the theoretical base was coherent and complete, translation of research findings into action-oriented guidance is notoriously difficult. Burkhardt and Schoenfeld (2003) have described a number of models through which research and practice (R<->P) can be brought into a productive relationship, recognising that teachers rarely turn to research when they run into practical difficulties. Burkhardt and Schoenfeld argue strongly in favour of an R<->P model which uses *design experiments* and an *engineering approach* in research “to refine ideas and material so that they are robust across a wide range of contexts of implementation” and so that designed materials can act as carriers of good educational practice.
- There are tensions between the educational principles of CSCL and the implicit educational beliefs embedded in much current practice: whether that practice be traditional forms of instructional design or transmission-oriented approaches to teaching (Goodyear et al, 2004). In CSCL-design, learners are not seen as passive objects that can be manipulated after a technical-rational design process. Rather, design approaches need to acknowledge the active contribution of learners in shaping their learning activity and learning environment.
- The design, development and management of complex learning environments – such as the Virtual Learning Environments being installed in many universities – necessarily involves collaboration between people from different professional backgrounds (subject experts, educational specialists, researchers, technical staff, etc). It is rare for these multidisciplinary teams to have a shared set of concepts about learning or a shared language with which they can discuss and plan support for learning (Goodyear & Jones, 2002).

What is an effective way of connecting research findings with design and development practice? How can we best facilitate meaningful discussions about learning within multidisciplinary teams (e.g. across the educational-technological divide)? These questions will be explored in this paper. Alexanders’ methodology of creating design patterns and integrating them in pattern languages (Alexander et al, 1977, Alexander, 1979) is the source of inspiration for this exploration. The illustrative context for the exploration is taken from recent work at the Learning Lab of the University of Maastricht: a series of design experiments involved in the development of a new tool for the support of learning interactions (‘productive learning conversations’).

Design: Research

“Researchers with development goals are focused on the *dual objective* of developing creative approaches to solving human teaching, learning and performance problems while *at the same time* constructing a body of design principles that can guide future development efforts” (Reeves, 2000). The Learning Lab team worked according to the process model depicted below.



Although, in the long term, progress was made from the left to the right side in this plan - by cyclic movements - the most difficult part proves to be the dissemination phase. It is in the process of dissemination – of ‘rolling out’ designed artefacts and research findings – that one runs the greatest risks of an innovation losing its pace and direction. There are dangers of the innovation being misunderstood or research findings misinterpreted. Hence, dissemination needs strategic help through the construction of shared understandings. In turn, these depend on the availability of shared language and shared constructs.

Analysis 1: In several curricula of the University of Maastricht, all students and teachers were involved in a comprehensive review about improving the use of technology to support problem-based learning (PBL) where students work in small groups. The outcomes prioritised the use of communication tools because planned face-to-face (f2f) meetings appeared to be insufficiently supportive of the learning process.

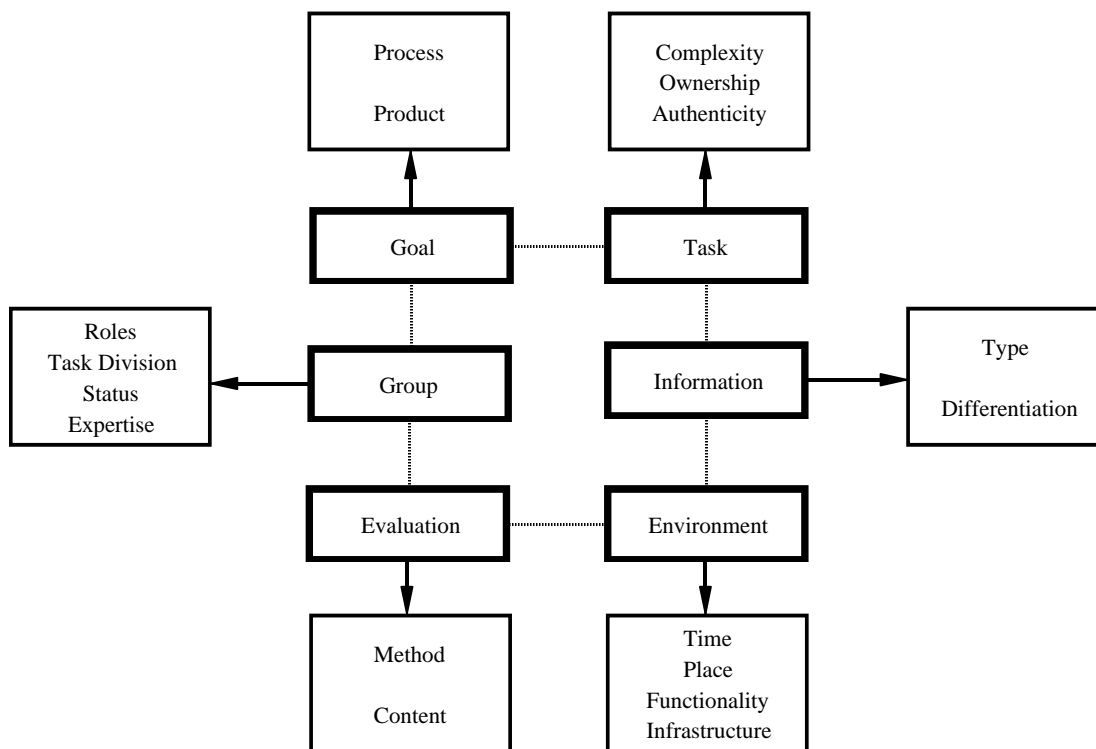
Development 1: A tool for forum discussions was constructed using the groupware application, Lotus Notes.

Experiment 1: Four experiments were carried out with POLARIS in PBL settings. All four experiments, using the same scenario in different curricula and with different classes, gave students access to a group environment in which they worked together in a self-managed manner. In-depth analyses of group interaction patterns and the content of material submitted by the participants showed us two things. First, it emphasised that asynchronous collaborative learning is complex. Second, it gave us the insight that different, sometimes related, entities in the learning situation can contribute to an effective use of the tool. The learning environment itself was one of those elements that could be manipulated. That was the basis for a reiteration of the development process.

Analysis 2: Important for the second cycle was the focus on the development of a general tool that can be used in different pedagogical scenarios. Based on Dillenbourg's model (Dillenbourg, 1999), collaborative learning activities were analyzed in terms of three main questions: 1. How can students learn together? (analysis of learning mechanisms), 2. What are students doing? (analysis of learning behaviour) and 3. What initiates the collaborative learning? (analysis of the learning environment). This analysis was concluded with the definition of the technical requirements for the next development phase and pedagogical requirements for the design of a second series of experiments.

Development 2: A new application was developed with a range of new features and functionality for stimulation of productive learning interactions. It was integrated into the frequently used type of applications that were developed for computer mediated communication (threaded discussion).

Experiments 2: Evaluation of the new application involved describing and analysing constituent elements of the different scenarios that might affect, in quantitative as well as in qualitative terms, the productivity of the group work (see the framework illustrated below). Survey and interview data about the learning environment, drawn from all participants, were interpreted in the context of this framework. Again, technical evaluations of the tool, and changes in the technical infrastructure of the University, led to the decision to undertake a third round.



Analysis 3: This phase was focused on tuning of the framework. Detailed studies were made of relations between several elements of the framework (Ronteltap & Eurelings, 2002). Literature and websearches helped identify problems and solutions in the realization of CSCL, for use in subsequent dissemination and implementation activity.

Development 3: A third version of Polaris was developed, mainly involving a simplification of the functionality of the second version and reconstruction as a “building block” in the Blackboard Learning System.

Design: Dissemination, Implementation, Integration

The final phase of the project framework is dissemination, in which the methodology of design patterns and the development of a pattern language is a valuable point of reference. Alexander is the originator of this approach. He worked it out in the domain of architecture and it later became widely known among software developers (see e.g. Gamma et al., 1995). Some of the key concepts in his method are: *quality*, *patterns of events*, *structure* and *being alive*.

A basic motivation behind Alexander’s methodology was his concern about the *quality* of buildings that he saw. His perspective is that quality is something that cannot be made but only generated. His first question in a keynote presentation for software engineers who adopted his method, was: “Under what circumstances is the environment good?” (Alexander, 1996) and the answer in his approach is given in terms of patterns of events: “In order to define this quality in buildings and in towns we must begin by understanding that every place is given its character by certain *patterns of events* that keep on happening there” (Alexander, 1977, p. 55). For the purpose of sharing this information he used a three-part *structure* that relates (1) context, (2) a description of a problem within that context in terms of a system of forces, and (3) a solution formulated as a configuration that resolves a conflict among forces. A more detailed description of the structure and content of patterns is given in Baggetun et al. (2004)

The second question in his work was “To what extent does that language generate entities (buildings) that are whole and coherent?” (Alexander, 1996). It was not his way of thinking that design patterns are part of a repository that is available for copy and paste work. The generative intention, where flexibility and adaptability are critical features aimed at the creation of quality, is formulated in this way: “A pattern language is a finite system of rules which a person can use to generate an infinite variety of different buildings.” (Alexander, 1977, p.191)

Goodyear et al. (2004) portrayed the value of Alexander’s methodology in this way: “His work provides a principled, structured but flexible resource for vernacular design. In our view, he strikes the right balance between rigour and prescriptiveness - offering useful guidance without constraining creativity and providing helpful foci for design.” This conclusion illustrates our feeling that writing guidelines, templates, standards, rules, good or best practices and any other format that is used in traditional dissemination activities might not have the effect that is needed in the dissemination of design research. Patterns and languages can be a good alternative.

The development of the framework - that was on one hand the result of analysis and on the other hand a guide for the planning of evaluation - became, step by step, an instrument for the implementation of the project results. The use of design patterns and pattern languages will be the core of the activities in the coming period. The entities of our framework for productive CSCL- design and evaluation, partially based on our own findings in experiments and partially on analysis of literature, will be completed and expressed as design patterns. The completion will focus on possible connections between patterns and the compilation of smaller patterns that are part of larger patterns. About the subject “tasks for students in collaborative learning” for instance, smaller patterns can be written about different aspects of productive tasks, such as: relevance, ownership, complexity, perspective, reflection, domain specificity, assessment or structure, etc. (Reeves, 2002). Completeness is less important than flexibility and adaptability for designers, from the perspective of making the design process come alive.

On several occasions Alexander compares pattern languages with natural languages. Both are combinatory systems that are used in creative processes. Patterns are the single “words” in the pattern language. A pattern language is seen as a system of connections among patterns (“sentences”), copied from accessible repositories (“dictionaries”) or developed in the design process (“living language”). A logical conclusion of this comparison is that specific “linguistic” skills are needed. To speak a language fluently we need a working knowledge of vocabulary, rules of syntax and a feeling for using the language in a specific context. The strategy for using pattern languages as design instruments in the dissemination phase of the project at a local level, includes the following strategic steps:

1. Development of a set of patterns, as a tool for transfer of the design process.
2. Holding workshops to support the development of analytic skills. (Such analytic skills are typically underdeveloped in educational environments, yet observation and analysis are the ‘entrance’ to design patterns.)
3. Organization and support of design communities in which pattern languages are shared.

Conclusion

Within this work, we have several reasons to believe that the patterns-based approach will support our goal of facilitating meaningful conversations between staff with very different professional backgrounds. First, the approach is now recognisable to people with experience in software/systems development. It offers possibilities for creating tighter definitions of key educational processes and phenomena than technology-oriented staff have been used to. It thereby offers them some help in reducing the ambiguity and complexity of their interactions with educational specialists. Second, it has the richness and flexibility that educators need in order to describe what is important to them, without trivialising or over-formalising the descriptions of key processes and phenomena. In a sense, the degree of structure or formality can be *negotiated* between technical and educational specialists, rather than being imposed by the approach and thereby disenfranchising one of the parties. Third, the culture of ‘pattern hatching’ and of revising and sharing patterns is one which encourages collaboration, experimentation and on-going improvement. The tools and ideas are open and customisable. They do not *impose* a fixed modus operandi (or lingua franca, for that matter).

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