A Pattern Approach to Person-Centered e-Learning Based on Theory-Guided Action Research

Michael Derntl and Renate Motschnig-Pitrik
University of Vienna
michael.derntl@univie.ac.at, renate.motschnig@univie.ac.at

ABSTRACT
Action research is gaining recognition as a methodology accompanying the introduction of technology into organizations and learning. Yet, the results of action research often remain restricted to an organization's context. In order to allow for a generalization and broader recognition of results, we abstract patterns of teaching/learning activities, organize them in a reusable, conceptual framework, and complement them with useful parameters as well as results from their application. Our proceeding is guided by the Person-Centered Approach that we adopt for blended learning and project work. This paper describes the pattern repository on PCeL (Person-Centered e-Learning) as the central structure within our action research framework and discusses means of generalizing and objectifying our findings.

Keywords
Person-Centered e-Learning (PCeL), Blended Learning, Patterns, Action Research

INTRODUCTION
The situation that we currently perceive in research on blended learning can be characterized as follows:

- Many experiments with blended learning have been conducted, but there is hardly any systematic research on the application of socio-technical frameworks or on individual parameters across courses or institutions;
- Innovative course design is very challenging and time-intensive, reuse is very limited;
- Research tends to be centered at technical or didactical or evaluation issues, but their interdependencies are clearly underrepresented;
- Integration of humanistic educational principles with web-based learning support is a novel asset;
- The limitations of classical empirical research in the area of organizational change become ever more evident, since situations in and across organization tend to be fuzzy, unique and include unpredictable events.

Based on these observations, we contribute to blended learning research and practice in the following ways:

- We aim to introduce an open, structured repository with highly reusable patterns for blended learning, along with web-service based support for instantiating scenarios across platforms and organizations. We derive patterns in the first place from our own teaching/learning experience, reuse them across courses, and evaluate individual parameters systematically. Since the patterns in the repository are based on actual practice, parts of the framework are in use since October 2003.
- The patterns and web-templates capture, abstract, structure, organize, and allow to instantiate learning scenarios such that reuse of facilitative practices is maximized and administrative overhead is considerably reduced.
- We develop the web-service based modules hand-in-hand with experimenting with or living humanistic educational principles in class, such as to achieve a high match between these two worlds. Thereby, the human side clearly informs the technical one, but the two are interdependent with respect to practical applicability and effectiveness. We believe that in this respect we are entering new ground, as is the case with the development of the measuring and evaluation procedures in order to asses, as completely as possible, the effects of our enterprise.
- Humanistic educational principles have been proved to add value to traditional learning, primarily with regard to creativity, capability to work in teams, interpersonal relationships, more positive self-concept,

more positive regard towards self and others, better understanding and increased problem-solving capabilities. To the best of the authors' knowledge, Person-Centered Learning has not yet been used as the didactic baseline for cooperative, blended learning. In this respect, the hypothesis underlying our integrative effort is that the provision of e-learning elements can, to a considerable degree, reduce the overhead for Person-Centered learning while preserving its benefits. As a consequence, this approach appears more feasible to facilitators, although the high demand on interpersonal skills that are essential to success must not be underestimated.

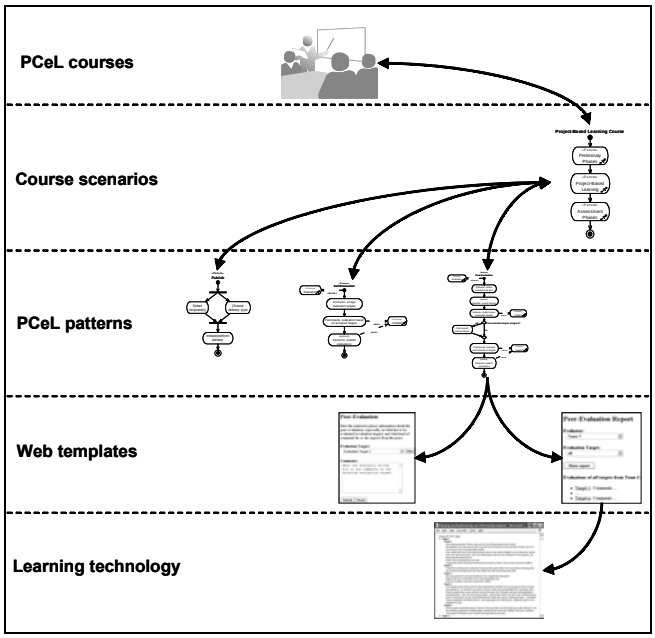
The paper is organized as follows. The second Section introduces the notion of patterns in general, and discusses our layered model of bridging the complexity gap between conceptual patterns and their actual, platform-supported application in courses and vice versa. It gives an overview of the pattern repository, describes our reuse-oriented strategy for pattern mining, modeling, organization, and description, and underlines the specifics of our approach in comparison to related work. Section three integrates our proceeding into a research framework that portrays the benefits of action research but simultaneously is designed to overcome several of its difficulties.

PATTERNS FOR PERSON-CENTERED E-LEARNING

According to the definition of architect Alexander (1977), a pattern describes a generic solution to a certain problem that occurs in a certain context. At the beginning of the 1990s this promising idea was picked up by software engineers to support reuse (e.g., Coad, 1992; Gamma, Helm, Johnson, & Vlissides, 1993) and documentation (e.g., Beck & Johnson, 1994) of software design by specifying *Design Patterns*, which are still the most predominant approaches associated with patterns today. Nevertheless, the pattern approach has found its way into many different disciplines, such as pedagogy and learning design (see the section on Related Approaches).

For our research and practice we have adopted the pattern approach to capture and enable reuse of blended Person-Centered e-Learning (PCeL) scenarios. From our point of view, acquiring knowledge, experience, and a sense of which activities are suited for what kind of online interaction, or which activities are preferably conducted face-to-face, is impossible to achieve within one or two application cycles. Therefore, we have developed the Blended Learning Systems Structure (BLESS) model (see Figure 1) as an essential conceptual tool for dealing with the complexity that is inherent in blended learning practice in a controlled way, and as a means to keep learning design platform-independent as long as possible.

Figure 1: The Blended Learning Systems Structure (BLESS) model



The top layer (**layer 1**) represents concrete courses that employ e-learning elements and that are conducted in a person-centered style. **Layer 2** aims at semi-formal, conceptual representations of concrete scenarios by

modeling their sequence as activity diagrams in the Unified Modeling Language (UML) notation (OMG, 2003). This is also the first step of pattern mining, aimed at modeling concrete activities. Subsequently, these concrete activities are abstracted and combined into patterns of learning activities. Such a modularization and abstraction process (link to layer 3: modularization, decomposition) entails substantial advantages for the analyst and course designer, as it enables reuse of these patterns for both course scenario description (link from layer 1: visualization, conceptual modeling) and application (link to layer 1). The learning activity patterns at **layer 3** are described uniformly to support quick location as well as comparability of relevant patterns in the repository. To support optimal reusability of the learning scenarios, the patterns are arranged at different levels of detail and abstraction. For example, super-ordinate scenarios like project-based learning are decomposed into smaller, more reusable and tangible units, such as team building, project milestone, and blended evaluation. This kind of modularization enables targeted implementation of learning scenarios (link to layer 4). By compiling and combining single patterns a new course or learning scenario can be formed (link to layer 2: composition). The web templates at **layer 4** show interactive web pages that describe how learning platform utilities can be arranged and combined to optimally support a pattern's flow of activities. Generally, each learning platform offers a set of features to users and administrators, whereby there are some features that most of the current platforms include, such as content and information pages, discussion forums, chat facilities, and document storage (files, folders). The patterns' web templates use these learning technology *atoms* such as to build *molecules* in a way that optimally maps the underlying process pattern onto the platform (link to layer 5: initialization, application) (Derntl & Motschnig-Pitrik, 2004). To support a learning scenario on a learning platform (**layer 5**), the respective pattern has to be implemented by instantiating its own web templates, as well as those of its included patterns. For example, in the *Online Discussion* pattern, the web template instantiation process is relatively simple: The instructor only has to specify the location of the discussion forum by selecting a learning activity or web page to which the forum shall be anchored, as well as some optional parameters regarding its usage (Are users allowed to initiate their own discussion threads? Shall it be possible to post replies to other users' postings?)

Pattern Description

In accordance with many software pattern catalogs, we use a template style with a number of sections that each pattern comprises for quick location and comparison of relevant sections and patterns. The following sections are defined:

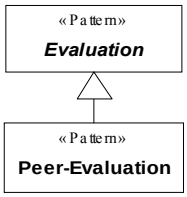
- *Name*: Succinct descriptor of the pattern, capable of conveying its essence.
- *Intent*: Short statement about the intended use of the pattern.
- *Motivation*: Aims to justify the existence of the pattern by outlining general motivational aspects.
- *Sequence*: Presents the sequence of the pattern as a UML activity diagram (see BLESS layers 2 and 3). *Structure*: Shows structural relations among entities involved in the pattern as a UML class diagram.
- *Taxonomy/Dependencies*: Embeds the pattern into a network of related patterns using UML class diagrams.
- *Parameters*: Used to categorize, identify, relate, and distinct different patterns. The parameter values provide a concise list of common properties of each pattern, e.g., pattern author, pattern categories, presence type, flexibility, application effort, suggested assistance, target skills, inputs/outputs, and others.
- *Web Template*: See the description of layer 4 of the BLESS model as depicted in Figure 1 above.
- *Examples*: Shows examples where the pattern was employed or scenarios for intended usage.
- *Evaluation*: Questions that have already been used in questionnaires in one or more courses along with respective results, or issues and questions of interest which have not yet been evaluated.
- *Remarks*: Provides comments or other useful remarks.
- *References*: Lists references cited in the current pattern.

Pattern Organization

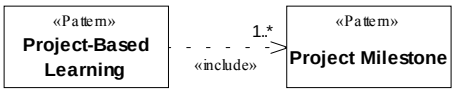
It is essential for pattern writers to provide collections of patterns in a way that supports the pattern user in selecting and applying the patterns. There are different ways to organize pattern collections, yet all serving a common goal that is helping the pattern reader/user in finding the pattern or family of patterns appropriate to the "problem" at hand. The pattern collection as a whole is useless if pattern readers have to read, analyze, and understand every pattern in detail to find the one they need (Buschmann, Meunier, Rohnert, Sommerlad, & Stal, 1996). For example, some sub-languages of the Pedagogical Patterns Project offer pattern maps (e.g., Fricke & Völter, 2000) showing how the patterns relate to each other, and most of them offer a *Quick Access Table*, which shows the problem in the left column and the patterns suitable for the respective problem in the right

column. However, most of the existing pattern collections describe pattern relations only textually. To overcome the shortcomings of such an approach (cumbersome usability and readability), our pattern organization concept employs two different types of relationship, allowing for simple yet concise communication of relationships among patterns using standard modeling and extension mechanisms of the UML:

Generalization / specialization. This relationship interconnects a more concrete lower-level pattern with a more abstract higher-level pattern. For example, the *Evaluation* pattern is (among others) specialized by the *Peer-Evaluation* pattern, as the latter specifies that the evaluation is done by participants' peers. A derived pattern inherits all the sections (including section content) from its parent pattern. But it may override any of the inherited sections by specifying an own description of the section. Generally, to keep the pattern repository clear and understandable, no more than three levels of generalization are used.



Dependency. The dependency relation is used to model the usage, inclusion, or refinement of another pattern. Usage of this relationship is derived from the activity diagrams of the patterns: If a pattern uses another pattern in its sequence, it is *dependent* on the other pattern. To keep the overall model clear, this relationship is only used in the *Taxonomy/Dependency* section of each pattern.



The PCeL Pattern Repository

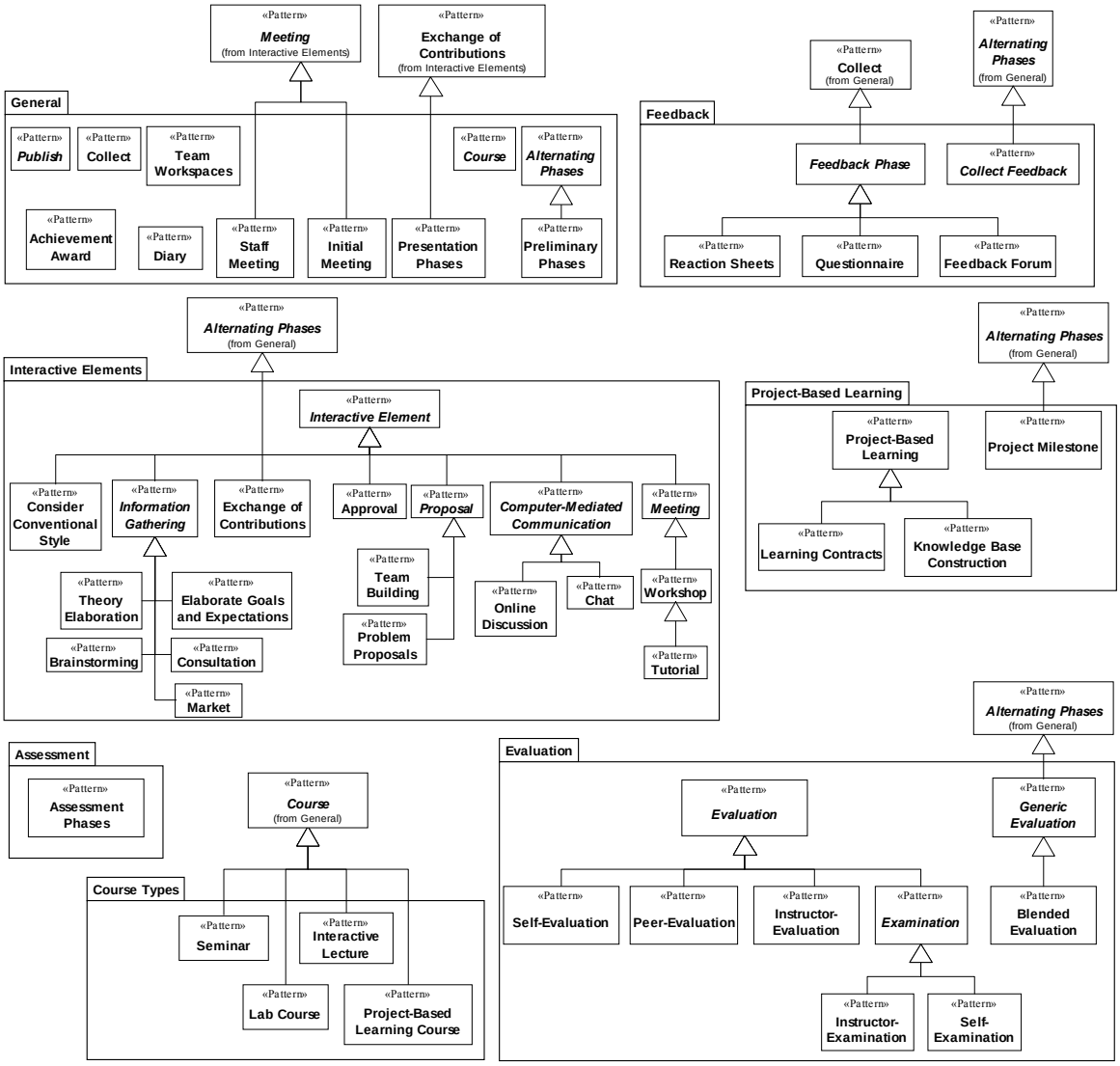


Figure 2: Overview of the initial PCeL pattern repository.

As depicted in Figure 2, our approach provides a formal conceptual model of the generalization hierarchy in the pattern repository using UML static structure diagrams. Generally, families of related patterns are organized in packages, which contain the pattern definitions, e.g., the *Alternating Phases* pattern is located in the *General* package. Inside the packages, the patterns themselves are modeled using classes which are stereotyped with the custom keyword «Pattern».

As given in Figure 2, seven different packages are defined:

- The *Assessment* package defines patterns that show different ways of assessing participants, whereas the ultimate goal is to specify a grade for each participant. The patterns in this package describe composed scenarios, using other patterns that define concrete ways of evaluation.
- The *Course Types* package re-defines familiar course types (e.g., lab courses) in terms of the Person-Centered e-Learning pattern repository.
- The *Evaluation* package describes different methods for evaluation. Thereby, evaluation means valuing judgment on the performance of participants. There is a significant difference to the *Assessment* package: The primary aim of evaluation patterns is not to fix a grade but rather to lay the foundation (e.g., producing evaluation reports) for fixing a grade.
- The *Feedback* package contains patterns that describe different ways of collecting feedback.
- The *General* package hosts patterns that are generally reusable or do not perfectly match one of the specific purposes defined for other packages.

- The *Interactive Elements* package is by far the largest package, defining a number of patterns that aim to foster interaction and interactivity among participants, instructor, tutors, and/or external guests.
- The *Project-Based Learning* package defines patterns that describe some sort of iterative and/or incremental, complex learning process, which can be expressed in terms of (project) milestones.

Related Approaches

Surprisingly, even though the pattern approach has found its way into many different disciplines, the field of e-learning clearly seemed to lag behind until very recently more and more projects and efforts have emerged:

- The Pedagogical Patterns Project (2002) provides a compilation of prose-style patterns for many educational scenarios. However, these patterns are neither tied to any pedagogical baseline, nor do they include or address explicitly the use of learning technology. The PPP consists of several pattern sub-collections of patterns written by different authors, e.g.:
  - *Patterns for Active Learning* (Eckstein, Bergin, & Sharp, 2002) is a pattern collection which focuses on engaging students and keeping them active in learning settings.
  - *Seminars* (Fricke & Völter, 2000) is a patter n language about teaching seminars effectively.
  - *Patterns for Experiential Learning* (Eckstein, Marquardt, Manns, & Wallingford, 2001) focus on many aspects of experiential learning, mostly on what is needed to learn by experimentation and by drawing on the students' own experiences.
- The E-LEN project (E-LEN Project, 2003) aims to create a network of e-learning centers and organizations in the learning technologies, as well as to develop and disseminate pedagogically informed technology for effective e-learning experiences. The project started in mid-2003 at a workshop of the CSCL conference in Norway. Its results are not yet completely available to the public.
- CSCL scripts formally describe collaborative learning scenarios that students and tutors have to play like actors play a movie script (Dillenbourg, 2002). The approach is highly formalized regarding both syntax and semantics (inside as well as among scripts). Through "programmed collaboration", there seems to be not much space for flexibility on the side of the learners and facilitators.
- The Educational Modeling Language (Koper, 2001) was one of the cornerstones in the specification of the IMS Learning Design (LD), an XML-based language for specifying learning content and process in a widely pedagogy-independent way.

Our approach differs from the above approaches in several respects:

- A didactic concept or base to build upon (Person-Centered Approach).
- Usage of standardized conceptual modeling and visualization techniques inside as well as among patterns, in particular the combination with the object-oriented paradigm (generalization hierarchies) that additionally fosters reuse as well as analysis and design processes.
- The methodological underpinning: Action Research as the primary driver of cyclic mining, description, and evaluation processes.
- Integration with the BLESS model to deal with complexity inherent in spanning the socio-technical space.

ACTION RESEARCH IN THE CONTEXT OF PCEL

According to Baskerville (1999), the ideal domain of action research is characterized by a social setting where:

- The researcher is *actively involved*, with expected benefit for *research* and *organization*,
- The *knowledge obtained* can be *immediately applied,* based on a clear conceptual framework,
- The research is a (typically cyclical) process *linking theory and practice* (Baskerville & Wood-Harper, 1996).

According to the prevalent action research description by Susman and Evered (1978), five phases are iterated: diagnosing, action planning, action taking, evaluating and specifying learning. The action research (AR) we conduct can be classified as inherently participatory (Ottosson, 2003): The social setting is such that the project manager (co-author of this paper) is at the same time the facilitator of courses as well as the thesis supervisor of three research and teaching assistants. One of them, the co-author of this paper, conceptually models the patterns emerging from teaching/learning scenarios, another develops the platform modules, and the third cooperates on the design of evaluation instruments for blended learning courses. These same assistants also

either currently participate or participated in some of the facilitator's courses in the recent past and thus contribute complementary perspectives. The research team on PCeL at the department of computer science and business informatics participates actively in individual aspects of the whole AR cycle which typically is repeated every semester. We cooperate with a Person-Centered counselor, Ladislav Nykl, who co-facilitates one course, with a communication psychologist and counselor at Tomcom, Dietmar Treichel, the developers of the e-learning platform we adopt in our courses, with the department of education, and the department of psychology.

Our goals of action research on introducing PCeL are astonishingly numerous. Immediate, short term goals are:

- Personal development of all concerned with PCeL;
- Participatory design of a user-centered, open source learning platform, based on users' needs;
- Scientific knowledge about
  - the integration of New Media into teaching/learning,
  - the introduction of organizational change by introducing learning technology,
  - the application of the Person-Centered Approach in higher education and management,
  - the use of Internet technology for the support of teaching/learning processes,
  - the acquisition, modeling, application, and evaluation of patterns for PCeL,
  - the evaluation of innovative teaching/learning practices.
- Individual learning and training in innovative facilitation of courses.
- Reuse of acquired knowledge and experience.

In the longer run, we also aim at organizational development regarding the improvement of teaching/learning practices for both learners and instructors, both nationally and internationally, as well as transfer of knowledge and expertise to organizations outside the university context.

Changes in learning scenarios and platform features are immediately transferred into practice and are subject to the course-evaluation that includes feedback on the evaluation process. Summarizing, we view our project and setting as meeting all the criteria of AR, in other words, an optimal test-bed for AR. In order to advance this fascinating, authentic methodology per se, we use one of its strengths, namely its flexibility, to overcome its major difficulties that we clearly envisage and work around, as described below.

In general, action research (AR) is appreciated for integrating and concurrently advancing both practical and theoretical aspects. AR accompanies real change effected by real actions in real organizations and thus has immediate validity for the hosting organization. Action research, however, is also criticized (Kock, 2003) for:

- lacking methodological precision,
- lacking controllability, due to the complexity and fuzzy-ness of a real environment,
- being subjective or biased, due to the researchers' deep personal involvement,
- delivering results that are difficult to generalize.

While we consider the criticism as justified, we exploit the freedom of AR methodology by complementing it thoughtfully with situated investigation methods that contribute more traditional procedures to those aspects that are better amenable for classical investigation. Thus, whereas our overall framework or strategy is AR, individual components are empirical, qualitative, or based on prototype construction.

We view our AR as *theory-guided* is so far, as our plans and actions in teaching/learning processes are guided by the Person-Centered Approach (Rogers, 1961, 1983) The novel feature is to adopt this approach in the context of using New Media in education. Thus, the research is specifically on actions regarding the integration of New Media within Person-Centered education. There still remain many aspects to be considered, nevertheless, we perceive the theory-guided nature of our AR as something that significantly reduces complexity and makes actions more amenable to systematic investigation.

In our AR design, we address the general lack of controllability and objectivity by empirically evaluating individual features of our courses, such as students' motivation, learning effects, learning outcome along various dimensions, platform usage, etc. This is done by *online questionnaires*. Although we do not have control groups, we do have courses that are partitioned into groups that different instructors conduct in the same environment. Also, in the case that the same course is taught by the same instructor in consecutive years, loose comparisons regarding the variation of distinct parameters can be obtained. Thus, iterations, a core feature of AR, allow us to approach comparability between groups, although not as rigidly as in a classical experimental design employing control groups.

Besides questionnaires we collect *online reaction sheets* of students for each PCeL course and often also after individual course units. These free-style reactions can be evaluated qualitatively, as well as in terms of how often course-features are mentioned as positive, negative, or neutral. By this we complement the subjective view of the researcher (facilitator) by the broad perspective resulting from the participants' reaction.

Depending on the goals of the course and on the features we want to assess in each cycle, the online *questionnaires are adopted* to the particular questions. Also, experience with the questionnaires flows into the design of the questionnaires for the following term. This allows us to exploit the iterative nature of academic courses for an incremental design and adaptation of test instruments. Thus, our AR involves a meta-dimension, namely research on the evaluation (viewed as action) of actions.

We address the lack of generalization of the results obtained by AR by conceptually modeling reusable scenarios and systematically capturing relevant parameters and corresponding evaluation results. Thereby we hope to share our experience with others who decide to follow the specified scenarios and produce evaluation results such that cases are assembled and results gradually become objectified and can be generalized.

Summarizing, the results of AR are the following components that evolve in each cycle:

- Pattern repository containing the specification of course scenarios and multiple parameters;
- Course descriptions containing the instructors' point of view;
- Repository of course evaluations;
- Questionnaires and their statistical evaluation;
- Student's reaction sheets and their evaluation;
- Web-Service based platform modules;
- Experience and feedback on dayta, an open source, object-oriented e-learning and knowledge management platform;
- A handbook of person-centered teaching/learning practices.

Currently we are in the process of transferring the expertise made in our department to a university wide context by initiating a project to be coordinated by the research center on innovation at the University of Vienna.

CONCLUSIONS

Based on our experience with the Person-Centered style of blended learning we have been searching for means that allow us to share our experience, evaluate effects, generalize our findings and reuse successful learning designs and platform modules. To meet these goals we have proposed a theory-guided action research framework that is based on visual, conceptual models and reusable patterns of learning scenarios. With our research and practice we aim to combine theories from the social and the technical sciences to contribute to making learning more meaningful, effective, and growth-promoting.

REFERENCES

Alexander, C., Ishikawa , S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Angel, S. (1977). A Pattern Language - Towns, Buildings, Construction. New York: Oxford University Press.

Baskerville, R. L. (1999). Investigating Information Systems with Action Research. Communications of the Association for Information Systems, 2, http://cais.isworld.org/articles/2-19/.

Baskerville, R. L., & Wood-Harper, A. T. (1996). A Critical Perspective on Action Research as a Method for Information System Research. Journal of Information Technology, 11(235-246).

Beck, K., & Johnson, R. E. (1994). Patterns Generate Architectures. Paper presented at the European Conference on Object-Oriented Programming (ECOOP) '94, Bologna, Italy.

Buschmann, F., Meunier, R., Rohnert, H., Sommerlad, P., & Stal, M. (1996). Pattern-Oriented Software Architecture: A System of Patterns. Chichester, U.K.: John Wiley & Sons.

Coad, P. (1992). Object-oriented patterns. Communications of the ACM, 35(9), 152-159.

Derntl, M., & Motschnig-Pitrik, R. (2004). Patterns for Blended, Person-Centered Learning: Strategy, Concepts, Experiences, and Evaluation. Paper presented at the 19th ACM Symposium on Applied Computing (SAC 2004), Nicosia, Cyprus.

Dillenbourg, P. (2002). Over-Scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), Three worlds of CSCL. Can we support CSCL (pp. 61-91). Heerlen: Open Universiteit Nederland.

Eckstein, J., Bergin, J., & Sharp, H. (2002). Patterns for Active Learning. Retrieved Jan 4, 2003, from http://www.pedagogicalpatterns.org/current/activelearning.pdf

Eckstein, J., Marquardt, K., Manns, M. L., & Wallingford, E. (2001). Patterns for Experiential Learning. Retrieved Nov 25, 2002, from http://www.pedagogicalpatterns.org/current/experientiallearning.pdf

E-LEN Project. (2003). E-LEN project homepage. Retrieved Jan 14, 2004, from http://www.tisip.no/E-LEN/

Fricke, A., & Völter, M. (2000). Seminars - A Pedagogical Pattern Language about teaching seminars effectively. Retrieved Dec 12, 2002, from http://www.voelter.de/data/pub/tp/tp.pdf

Gamma, E., Helm, R., Johnson, R. E., & Vlissides, J. (1993). Design Patterns: Abstraction and Reuse of Object-Oriented Design. Paper presented at the European Conference on Object-Oriented Programming (ECOOP) '93, Kaiserslautern, Germany.

IMS Global Learning Consortium. (2003). IMS Learning Design Specification. Retrieved Oct 4, 2003, from http://www.imsglobal.org/learningdesign/index.cfm

Kock, N. (2003). The three threats of action research: a discussion of methodological antidotes in the context of an information systems study. Decision Support Systems, 1062, 1-22.

Koper, R. (2001). Modeling units of study from a pedagogical perspective: the pedagogical meta-model behind EML, from http://eml.ou.nl/introduction/docs/ped-metamodel.pdf

OMG. (2003). OMG Unified Modeling Language Specification, Version 1.5, March 2003. Retrieved May 12, 2003, from http://www.omg.org/cgi-bin/doc?formal/03-03-01

Ottosson, S. (2003). Participation action research - A key to improved knowledge of management. Technovation, 23, 87-94.

Pedagogical Patterns Project. (2002). http://www.pedagogicalpatterns.org. Retrieved Nov 5, 2002, from http://www.pedagogicalpatterns.org

Rogers, C. R. (1961). On Becoming a Person - A Psychotherapists View of Psychotherapy. London: Constable.

Rogers, C. R. (1983). Freedom to Learn for the 80's. Columbus, OH: Charles E. Merrill Publishing Company.

Susman, G. I., & Evered, R. D. (1978). An assessment of the scientific merits of action research. Administrative Science Quarterly, 23(4), 582-603.