What Learners Teach Us –
E-Learning Patterns for Adult ICT Education

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ABSTRACT
Based on our own experiences in the domain of University level ICT teaching for adult distance learning and blended learning, we develop a vision on design patterns for learning support. We analyze relevant pattern collections for structure as well as reusable content. We categorize learning goals at different levels, and we indicate how patterns may be developed and provided in a framework that enables design to match learning needs in context.

Author Keywords
E-learning; design patterns; learning goals; adult learning.

ACM Classification Keywords
H.5.1 [Multimedia information system]; H.5.2 [User interfaces]; H.5.3 [Group and organization interface]

General Terms
Education; Design; Learning Goals; Human Factors.

INTRODUCTION
The Merriam-Webster defines learning as the acquisition of knowledge or skills or modification of behavior tendency [10]. The online Oxford states that this occurs through study, experience, or being taught [12]. Gray [7] defines learning as “any process through which experience at one time can alter an individual’s behavior at a future time”. When we discuss learning we start from the definition of Cobb [4]: “Learning is the lifelong process of transforming information and experience into knowledge, skills, behaviors, and attitudes”. Lifelong learning never stops
We teach regular university students as well as adult students who mostly have a job and often a family. Mainly this latter category is focused on specific qualities of their learning: time is scares and available at irregular and often unpredictable timeslots; the learning goals are specified by the individual learner’s current needs and the current context, which frequently results in a change of learning goals because of family issues or job situation; and the background of each learner, in terms of competences, prior knowledge and skills, and educational history is unique, as well as changing overtime as a result of ongoing learning experiences. Finally, lifelong learners as we teach them are adult. They decide for themselves, they set their own goals and change them, and they find learning resources even if we do not provide these.

Different learning goals
Learning goals exist at different levels, first of all we have the learning goals of our students itself, which we call first level learning goals. The teacher will add his own learning goals to a course, because he believes certain parts are interesting or necessary as a base to continue understanding the rest of the course. These learning goals are second level learning goals. Apart from the student and the teacher, educational institutes have their own learning goals, which we call third level learning goals. Academic institutes in Europe typically want their courses to comply to the Dublin descriptors, very general statements of typical expectations of competences students should demonstrate at the end of first, second or third cycle, often described as Bachelor, Master and Doctorate.

A teacher should learn, and then teach
Information technology hardware still develops according to Moore’s law [11]. ICT applications seem to develop at a speed at the same order of magnitude. Obviously, our domain of interaction design keeps that pace. Consequently, teaching continuously changes. Teachers need to collect (new) knowledge, and immediately provide this knowledge to the learners. In our courses, learners are challenged to teach each other, about new concepts, techniques, and tools. They happily collaborate. If they cannot participate in synchronous sessions, they invent ways to still be active: some spontaneously provide a home-made video of themselves teaching the item they signed up for. Occasionally our students asked permission to upload their presentation prior to a synchronous meeting, soliciting comments from their peers as well as tutor or teacher in order to improve their growing understanding of a new concept.

While “teaching” in this context, we continuously experience new understanding of issues in the domain of interaction design. We also continuously develop new understanding of how adult learners in our domain (prefer to) learn, how concepts, tools and techniques in the domain of adult learning may be beneficial to learners in their multiple and diverse contexts. This paper is our way of sharing our growing understanding of how to support adult learning in the domain of interaction design. Our knowledge is not complete, and will never be, and we are happy to believe that
WHY USING DESIGN PATTERNS IN ICT LEARNING
At the end of the seventies, design patterns were used for the first time by Christopher Alexander [1] for urban planning and used in the field of architecture. In 1987 Kent Beck and Ward Cunningham published the article “Using Patterns Languages for Object Oriented Programs” [2] for designing window-based user interfaces. Design patterns gained real popularity in computer science after the publication of the book Design Patterns: Elements of Reusable Object-Oriented Software [6]. Despite the fact that the first design patterns in computer science were written for user interface design [2], the development of patterns and pattern languages in this domain developed much slower. A pattern collection makes it possible to gather useful patterns of different authors, therefore facilitating the sharing of knowledge. Furthermore, a pattern collection is not a finished end product; new patterns can still be added to the structure. These new patterns might deal with knowledge that is already out there, but not yet described in a pattern or new forms of communication or technology allow new patterns.

DIFFERENCES BETWEEN PATTERN AUTHORS
Pattern authors often have their own specific focus and structure. J. Tidwell [14] emphasises solving design problems in her patterns. Design patterns are existing, repeatable and generic solutions to problems, but they are not specific nor necessarily the best. It will give you however a decent solution. The rationale within the patterns will allow you to understand the background of the problem and allows you to decide why and when a certain solution is appropriate. The design patterns of the Amsterdam Pattern Collection describe interaction patterns related to user interfaces. These patterns focus on solving problems that end-users can encounter while interacting with the system [8]. Jan Borchers wrote patterns for interaction design and wants to show interface designers how to use patterns to capture and structure user interface design knowledge and how to use them to understand each other’s design principles and solutions [3].

THE STRUCTURE OF A PATTERN
Not only do design patterns authors write for their specific domain, the format in which they structure their patterns can be slightly different.

Reviewing the structure of patterns
When comparing the patterns from Alexander [1], Tidwell [14], Welie [8] and Borchers [3], several elements are similar while some seem slightly different. First we discuss the elements we see in each structure and then we look at the differences. Every single pattern has a name and a visual element to demonstrate the pattern. This can be a picture or illustration but Alexander and Borchers use diagrams as well. Each pattern author presents a problem and describes the context. Alexander and Borchers call this section “context”, while Tidwell and Welie describe the context in the section “use when”. A pattern always presents a solution. Alexander and Borchers describe the solution in a section called “solution” while Tidwell and Welie have a section “How” that describes how you can implement a solution and a section “Why” that explains the rationale behind the solution. Finally, a pattern contains examples of the pattern and sometimes references to similar patterns. Alexander and Borchers use a ranking mechanism that informs the reader how sure the author is about the pattern. Tidwell and Welie have no such mechanism.

A pattern for learning pattern collections
Each pattern solves someone’s problem. Three different levels of learning goals exist. Patterns for large units refer to detail patterns that can have a different type of goal. This is a consequence of the learning situation in education. For example to solve the problem of an educational institute can mean we have to solve problems at the level of the teacher or student. Be explicit about whose problem you solve and realise that you are solving problems at that level. A third level learning goal for educational institutes is reducing the number of students that stop their education before graduating. This problem on itself is not interesting for individual students, but by providing solution for students the number of fall-outs might still reduce.

A pattern to solve complex problems
Patterns can solve complex problems, involving multiple stakeholders or including a collection of smaller problems. For example we can solve the problem of the website owner by solving the problem of the users of the website. In the same way patterns can solve the problems at different levels of learning goals. An example of a complex pattern is the museum pattern from Welie [8] (Figure 1) describing the problem as “Users need information about a museum for the purpose of visiting it, getting information about the collection of the museum, or getting information about other activities of the museum. “This pattern is not just about the visitor, but also about the museum itself. “You are designing a website for a museum. A site for a museum mainly acts as ‘brochure’ for the museum by giving all sorts of information which primarily is supposed to attract people to visiting the ‘physical’ museum. The target audience for a museum website is first of all formed by potential visitors.” The museum wants to attract potential visitors to the museum by providing an attractive website of the museum. Within the museum pattern, detailed patterns emerge, for example the shopping pattern. And within these patterns another layer of patterns can emerge like the shopping card pattern allowing users to shop easily.
Our structure
Because there are a lot of different formats for patterns, we will show and explain how we structure our patterns.

Name
The name of the pattern

Author
We often re-use existing patterns from different pattern collections and we want to give credit to the authors.

Problem
What is the problem we want to solve with our pattern?

Solution
A short solution to the problem is shown here.

When
This section explains when the solution good is a good solutions, the context and forces are important here.

How
How exactly do we solve the problem, this is a more elaborate explanation.

Motivation
The rationale behind our solution, why do we solve the problem in this way?

Examples
To explain how to use a pattern in an actual showcase and to prove the validity of a pattern, i.e. the solution is a proven solution. Finally examples can show the generic aspects of a pattern, i.e. the pattern is valid in different domains.

Picture
A picture is added to give visual feedback about the pattern.

THE START: EMPIRICS IN THE APPLICATION DOMAIN
Our understanding is based on our teaching of interactive systems design, for many years, in many different curriculums (Ergonomics, Computer Science, Information Sciences, Cognitive Psychology, Artificial Intelligence) in many (mostly European) counties, in the context of blended learning or distance education, for Adults and Academics.

Learning goals exist at different levels
We learned that our students actually try to reach many different learning goals. We found four different levels of learning support that were considered useful depending on the type of goal:
- atomic activities (order of magnitude 1 minute);
- mini-courses (order of magnitude 10 minutes);
- chapter (order of magnitude 100 minutes);
- course (order of magnitude 50 hours).

Atomic learning activities are the smallest possible tasks. For example “Give me a definition of X”, “Check my answer on question Y”, “Give me an example of phenomenon Z”. It does not make sense to the learner to split these into subtasks.

Mini-courses are activities that are a collection of different atomic learning activities. Generally a mini-course takes about 10 minutes to complete and it deals with one topic. The length is kept short to allow adult learners to keep a good attention during the span of the mini-course. A mini-course may begin by explaining a concept, then giving an example, showing how you can apply the newly learned concept. A mini-course typically is about a concept, a technique, or a tool. The structure of a mini-course can be different depending on the aim of the mini-course. For example, some mini-courses want to introduce a concept, while others want to share how-to knowledge. We found that students lose attention when a mini-course is longer.

A learning chapter is an activity that typically takes 1 to 2 hours. It is a collection of mini-courses that together deals with a cluster of related subjects. A complete course is a collection of different learning chapters that belong together in order to give a broad view on a domain, approach, method, or theory. Our method of using several time-based levels is not unique. Knuth [9] already used the concept of different levels of learning goals through a scaling for exercises ranging from 00 to 50 to give readers an estimate of the difficulty and length of an exercise. The book “Pedagogical patterns” [13], provides a scaling structure as well with a scale of weeks, days, hours, and minutes.

Matching learning patterns to learning goals
In order to identify relevant patterns, we aim at combining these (time-scaled) learning activities to the actual learning goals, e.g. getting feedback, becoming active, getting different perspectives.

TEACHING HOW TO SUPPORT LEARNING
Teaching is providing opportunities to learn. We describe different ways to providing patterns: a structured list of the patterns, or, alternatively, a guided knowledge discovery. Finally we show how to map the knowledge space to the application context. Depending on the specific situation of the designer the best lookup method can be selected.
Without structure, no knowledge

An example of a listing of patterns can be seen Figure 2. In the grey box on the left side patterns are listed in a meaningful categories. The user can directly click on the pattern names and the pattern becomes visible. The listing provides full flexibility and allows the user to browse through the whole collection of patterns at will. This method of presenting patterns is quite commonly used by van Welie [8], Tidwell [14], the Visual design wizard [15], and pedagogical patterns [13].

Guiding knowledge discovery

Another possibility to find the right patterns is by answering a series of questions. Depending on the answers the user provides, different patterns become visible. This suggests which patterns can be useful in your specific case[15]. Figure 3 shows an example. Learning context, specific sort of learning goal, background of the student (education…) are indicative to decide what patterns will be relevant.

Learning and applying the knowledge

Patterns are proven solutions for given problems. The examples can be from completely different domains where the same principles are applied. In each pattern we decided to provide the name of the original author, because this is the one who “discovered” the generic knowledge. Patterns are meant to be generic solutions and are often domain-independent. Depending on their level, patterns can be used by educational institutes to form a new curriculum or course, by the teacher to guide the students through the course, or by the students to choose for a PDF, a video or a MOOC.

PATTERN MINING

Teachers should continue learning, from colleagues, but also from their own students to improve their teaching. We present two examples, one is a pattern we discovered from our own experience, the other is from colleagues in the field of pedagogy. It makes sense to use the information other people in our field already collected. But there are many other field where learning is involved, and therefore it makes sense that experiences from these domains are taken into account as well. Both patterns we present were used by us and our students. The first example is “Video lecture”, a mini-course level. The second patterns is “Explore for your own”, it is a pattern that fits in the learning chapter level. This pattern is our own interpretation of an existing pattern, originally written by Jutta Eickstein [13] for teaching in a normal classroom setting.

Video lecture

Name
Video lecture

Author
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Problem
Students want to follow a lecture with a teacher but have no (more) physical access to the teacher.

Solution
Give students access to video lectures where both the teacher and the slides of the course are visible, similar to the situation in a normal classroom setting.
When
Students might not be able to attend course physically because of timing issues, illness, logistic difficulties, distances, availability of the specific teacher, lack of lectures organised, etc. Still the student likes to have a (specific) teacher explaining and sharing his knowledge with them in a way similar to attending a lecture hall.

How
Make a video capture of the teacher explaining his course, while the slides are presented next to the teacher. The head, shoulders and hands of the teacher should be visible on the screen so that students can see the body language and hand gestures of the teacher. The teacher should know in advance where the slides will be visible on the screen so that gestures are made in the correct direction. Video lectures preferably are not longer than 10 minutes to allow students to keep maximal concentration. When video lectures are longer than 10 minutes, try to split them up in several shorter videos. Video quality is especially important for learners from whom the video lecture is the primary source of learning.

Motivation
With a video capture it is possible to hear and see the teacher similar to attending a lecture in person. Video capture allows students even from other continents to have access to very specific courses they are interested in. World renowned teachers are able to give a course to large amounts of students. Video lectures can be used by students that miss classes because of illness, or work, but can also be used as revision material for students that did attend a physical lecture.

Examples
We used several video lectures with lecturer and slides visible in our courses. For our students at the Open University of the Netherlands, this was the primary learning material. We discovered that the quality of video was very important for them. The Stanford Human computer interaction course that is freely available through Coursera makes use of video lectures with slides and teacher visible at the same time. [5] Thousands of students from all over the globe can participate in these courses.

Explore for your own
Name
Explore for your own.

Author
Jutta Eckstein, based on Class Concept Map by Jeanine Meyer [JMI], Explore-Present-Interact-Critique by Jorgen Lindskov Knudsen and Ole Lehrmann Madsen [KL], and Challenge by Jutta Eckstein [JE1]. It was revised by Joe Bergin. The pattern presented here is our own interpretation based on the version from Joe Bergin. [13]

Problem
A person's success is based mainly on her ability to learn new concepts efficiently and to act as a team player by sharing knowledge and insights. But students are often afraid of taking responsibility for their own learning.

Solution
Assign topics to the students that they have to learn on their own and ask them to present the topic afterwards. It is helpful to provide hints for resources related to the topic.

When
Presenting and explaining a concept to somebody else is an important part of the learning process. If students are irritated or uncertain about how to progress, providing them with more specific hints to overcome their own uncertainty and handling the situation for themselves. Find a balance between providing too much structure (so that students do not explore for themselves anymore) and laissez-faire.

How
It is important to suggest students an approach to follow, otherwise there is the risk that they feel completely swerving. But, while explaining the task, it is fundamental to underline that the offered approach is not an unchangeable solution but only a proposal which could, and would, be improved and personalized, basing on student’s attitude, skills and preferred way of interacting (e.g. slides, video, presentation of a mock up...) with companions. In that way the student has a potential starting point to build the project but is already aware that his/her personal approach and strategy will add a relevant value to the assigned task.

Motivation
Adapting and creating own strategies to accomplish a task could be useful to develop collateral skills (e.g. public speaking), show quite peculiar and personal abilities (e.g. be able to draw), find heuristics, accept a challenge.

Examples
Jeanine Meyer used this patterns for teaching technical vocabulary. At Aarhus University in Denmark this pattern was used to introduce various object oriented concepts, among them garbage collection, CORBA, and OODB. We used this pattern with the students of Service Design lecture in Italy. The final aim of the course was to demonstrate to have understood the concept of Services thanks to the development of a project with the real customer involved. The assigned task was to prepare a short presentation concerning the chosen tool or technique in order to explain it to the audience (companions, the tutor and the professor). Students have been left to organize themselves in order to be conscious that they were directly responsible and aware of developing the assigned task in a proper way, time and method.

CONCLUSION
We want to make a contribution towards adult ICT learning. Therefore we want to write down the knowledge we experienced from teaching and what we learn from others.

Keep learning
We want to encourage collaboration with students, teachers, researchers from both each teacher’s own and others’ domains: Students may help in discovering what is important for them. Teachers can share valuable knowledge from their own teaching experiences. Experts from other domains can share valuable knowledge that is applicable to our own domain. Through
collaborating teachers will enlarge their own knowledge as well as contribute to common knowledge.

**Keep teaching**

We believe patterns are a good way of sharing teaching knowledge. Patterns are easy to read and understand by peer teachers, even if these are without much pattern knowledge. Patterns can be shared easily. A body of knowledge may grow as well as improve: a pattern collection is not a static environment.

**Use known techniques to spread the knowledge**

To make patterns accessible as well as usable, we should not just write patterns, but present them in an attractive way. Listings of patterns that allow browsing or searching by name are fine for advanced users who need to look up specific patterns. But chances are small that people with little knowledge about patterns will find the ones that fit in their design needs. Therefore techniques like wizards [15] can help.

**REFERENCES**

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