ETHOS: A Pedagogical Pattern

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This paper is organised as follows: First, I introduce the current format for pedagogical patterns and some modifications considered necessary during "shepherding" by Paul Dyson (thanks for your helpful suggestions, Paul!). Second, the ETHOS pattern is described in full detail. Third, I give some background information regarding the pedagogical patterns movement.

1 Pattern Format

Taken from the home page of the pedagogical patterns project [10], the format contains the following sections:

Section	Contents or Purpose
Name	pattern name
Intent	what the instructor wants to teach, or avoid, or …
Idea	how this pattern can achieve the Intent
Motivation	describes why the instructor wants to achieve the Intent with this pattern
	Note: Think of the above three sections in the following way: "I want to (the Intent), using (the Idea), because (the Motivation)."
Indications	circumstances in which this pattern is most useful, in the opinion of the pattern author and others who have used the pattern
Contra-Indications	when not to use the pattern
Structure	description of the pattern's structure in time (and space), e.g. the sequence of instructions or students' activities
Consequences	what has been seen to occur when this pattern has been used
Issues to Consider	the pragmatics of using the pattern
Cultural Dependencies	issues which may make this pattern less useful for a particular culture
Resources Needed	the resources which are needed to implement the pattern
Known Uses	specific instances in which the pattern has been successfully used
Related Patterns	other patterns which are related to this pattern

In general, I have tried to adhere to this format. However, some modifications have been regarded necessary. First, the pattern format seems to spread problem, context, and forces over the first six sections. What is needed here is a clear *problem statement* somewhere near the beginning of the pattern description. Subverting the original format somewhat, I have inserted

the problem statement in the Intent section. Second, some pattern sections have been split into how it affects and/or aids the instructor and the learner. These sections are subdivided into ☞ "instructor's perspective" and ✍ "learner's perspective". The latter one was evaluated and partly formulated by a group of postgraduate students who finished a course structured in the ETHOS fashion; many thanks to André Berten, Hans Peter Kunz, and Sascha Meyer.

2 ETHOS

The following pedagogical pattern addresses a whole course philosophy for teaching facets of a wide-ranging engineering subject. The pattern's setting is general course design at universities.

Name

ETHOS

Intent

We teach many students that will take managerial-type positions. These positions will demand that the student has some knowledge of a wide range of subjects. Hence we need a course that covers a wide range in some detail. This is hard to do such that all topics are covered. Some areas may be overlooked, and some areas may be outside the lecturer's immediate sphere of experience.

☞ From the instructor's perspective: there is a need to structure a course of lectures, or the chapters of the manuscript that go with it, in order to maintain thematic coherency.

✍ From the learner's perspective: there is a need to comprehend a varied subject matter in its entirety.

Idea

To coherently master a variety of facets of a broad subject, you need a *mnemonic* and an *organisational* aid. This is because, on the one hand, you need to remember all the areas you should cover and, on the other hand, you need to organise your material such that these areas are covered.

Motivation

University-bred engineers will mostly take managerial-type positions where *specialisation* is of secondary value. Any technology transfer, for example, is a decision-making process that requires – besides a sound technical knowledge – a broad understanding of the economic, so-

cial, and organisational implications of the new technology. For this target group, you want to draft an introductory course about, say, object-oriented software engineering. The subject matter is to be taught in its whole spectrum *(grand tour)* avoiding pedantic and boring lectures. You choose aspects you want to elaborate upon for a longer time. In a way, you are looking for some pedagogical "spotlights" to focus the learner's attention to the principal aspects of the teaching matter. Your motive can be outlined as follows:

You want:

! to add variety to your lectures;
! to take account of all important aspects;
! to arrange lectures along a common thread in order to support cohesive learning;
! to widen the learner's perspective to include interdisciplinary aspects.

Indications

The subject matter should be one of engineering, e.g. a method for analysing, designing, and implementing large-scale systems. It is important that economic and technical aspects are present.

Check if the following points apply to your problem:

? the subject matter involves a *paradigm* [4], that is:
(1) a "higher principle" or way of thinking, typical of a certain discipline, but one which cannot be clearly formulated and which manifests itself by examples, and
(2) a "disciplinary matrix" of opinions and values holding together a scientific community;
? you want to hold an introductory course, i.e. you don't intend to go into details.

The pattern also applies to structuring a textbook or manuscript about a wide-ranging subject.

Contra-Indications

☞ From the instructor's perspective: by favouring "breadth over depth", ETHOS could lead into a mode whereby abstracting and generalising the subject into key concepts has the side-effect of over-simplifying a rich and deep technology full of subtleties.

✍ From the learner's perspective: this could lead to underestimating the intellectual effort needed to master the concepts.

To avoid this risk, you may confront the learner with a MISSION IMPOSSIBLE [10] that will intentionally "shock" him or her into thinking more deeply about the subject and provoke further questioning, exploration, and self-study.

Most engineering subjects are inherently technically biased. So keep in mind that ETHOS is very particular to broad courses featuring *non*-technical issues on an equal footing with technical ones.

Structure

ETHOS reminds you that a solution to an engineer's problem commonly comprises Economic, Technical, Human, Organisational, and Social aspects. As an acronym, ETHOS is strictly sequential, thus it provides a test to determine whether all relevant aspects are taken into account. The pattern's basic structure follows its initials:

E : economic,
T : technical,
H : human,
O : organisational, and
S : social aspects.

If several topics apply to the same aspect, subdivide the structure's individual elements by indexing, e.g. T_1, T_2 ,..., T_n (see Known Uses).

Consequences

☞ From the instructor's perspective:

- 👍 ETHOS allows kaleidoscopic lectures, i.e. being arranged in a colourful succession, each one a self-contained unit within a wide spectrum;
- 👍 it favours breadth over depth, general knowledge over specialised knowledge;
- 👍 it provides a general framework into which new topics (current developments) can easily be integrated without changing the course's basic structure;
- 👎 the lecturer has to familiarise him-/herself with all facets of the subject, this could mean a major change of view: from a specialist's to a generalist's view.

✍ From the learner's perspective:

- 👍 ETHOS supports cohesive learning: it helps to see what's what, and guards against becoming a narrow-gauged specialist;
- 👍 changing perspective on the same subject refreshes one's memory;
- 👍 it permits continuous learning: even if some lectures have been missed, the student can follow the others. Thus, ETHOS helps to encapsulate a lecture as a learning unit; with the manuscript being similarly structured, the congruence between lecture and manuscript will be held, i.e. arbitrary cuts and context switches can be avoided;
- 👎 as a breadth-over-depth approach, ETHOS might lull the learner into a false sense of competence. Hands-on experiences and pragmatic subtleties of the subject could be easily underestimated (see Contra-Indications).

Issues to Consider

☞ From the instructor's perspective: ETHOS presupposes a deep analysis of both the subject matter and its didactic; the importance of and relationship between individual ETHOS aspects have to be made explicit. Try to visualise the ETHOS pattern with the help of typography and layout. Integrate the ETHOS aspects into the general structure of your course; do not let them stand on their own. For a concrete example, topics and the content of a course on object-oriented systems design are given in Known Uses.

Note: it is important to use *striking* teaching vehicles in the lectures such as ACQUAINTANCE EXAMPLES [1], COLOURFUL ANALOGY [1], and PHYSICAL ANALOGY [10], otherwise the individual ETHOS aspects might remain abstract and hard to remember.

✍ From the learner's perspective: the nature of ETHOS is to structure the wide spectrum of a subject in order not to lose an important aspect. Any full-scale education or training in a broad subject like object technology, for example, will require follow-up courses, accompanying lab-based exercises, group projects, etc.

Cultural Dependencies

None.

Resources Needed

None.

Known Uses

Albert Thiele first recommended the ETHOS pattern in his textbook on presentation techniques [9]. Inspired by its usefulness, I followed this pattern to condense the range of benefits of design patterns in an introductory article for a scientific journal [6].

Since 1994 I have successfully applied the ETHOS pattern to a half-year introductory course on "Object-Oriented Systems Design" annually given at the University of Siegen, Germany. The lecture is accompanied by lab-based exercises and a student project team. Topics and manuscript of the course comply with ETHOS, as shown in the following tables:

Topics of Lectures [11]

1. Overview: ECBS "Engineering of Computer-Based Systems"
2. Paradigms of Design in Computer Science
3. Complexity of Designing
4. Mastering Design Complexity

5. E Industrialised Software
6. T_1 OOX: Abstracting – Partitioning – Communicating
7. T_2 OOAD: Foundations of Analysis and Design Methods
8. T_3 OOP: Defining and Categorising Object-Oriented Programming Languages
9. H_1 Cognitive Aspects: Designing as Human Problem Solving
10. H_2 On the Object's Trinity: Structure – Behaviour – Constraints
11. O Management Aspects: Technology Transfer and Project Organisation
12. S A Science of Design
13. Looking Back: FAQ and Course Evaluation

Contents of Manuscript [7]

1 Paradigm Shifts in Computer Science

- Paradigm Shifts in the Large: Kuhn's Thesis.
- Paradigm Shifts in the Small: A Time without a Method ◦ The Art of Programming vs. Software Engineering ◦ The Human Factor ◦ SA/SD vs. OOX.
- Object-Oriented World Models: Executable Models ◦ Scenario of Object-Oriented Designing.

2 The Problem: Mastering Design Complexity

- "No Silver Bullet": The Descriptive Nature of Complexity ◦ Complexity and its Dimensions ◦ Design Complexity.
- "Hopes for the Silver": The Magical Number Seven ◦ The Architecture of Complexity ◦ Divide and Conquer.

ETHOS Aspects of the Object Paradigm

3 E for Economic

- On the Way to Industrialised Software: The Principle of Locality ◦ Software Reuse ◦ Standard Class Libraries.
- Competitive Pressure: Productive Software Development ◦ Software Quality.

4 T for Technical

- Object-Oriented Concepts: Abstracting ◦ Partitioning ◦ Communicating.
- Object-Oriented Applications: Analysis and Design ◦ Programming Languages.

5 H for Human

- On the Psychology of Object-Oriented Concepts: Designing as Human Problem Solving ◦ Cognitive Structures ◦ Scheme and Correction ◦ The Contribution of the Object Paradigm.
- On the Philosophy of Object-Oriented Concepts: The World of Ontology ◦ An Ontological Object Model.

6 O for Organisational

- Technology Transfer: Questions about the Technology ◦ Questions about the Interface between Client and Designer ◦ Questions about the Design Process ◦ Questions about Project Control ◦ Questions about Staff Management.
- Aspects of Management: Homomorphism between Process and Product ◦ Lean Management ◦ Object Management.

7 S for Social

- "The Science of Design": Creating the Artificial ◦ Curriculum of a Science of Design ◦ The Contribution of the Object Paradigm.
- Architectural Designing: Ideals of a Generalised Discipline of Design ◦ Good Designing from an Architectural Perspective ◦ The Contribution of The Object Paradigm.
- An Ontology of Design: Deep Structure: States – Events – Laws ◦ Good Designing from an Ontological Perspective ◦ The Contribution of the Object Paradigm.

A Excursions: Imagery ◦ Classification ◦ Inheritance vs. Encapsulation ◦ “The Treaty of Orlando” ◦ The Terminology of the Object Management Group.

B The Object-Oriented Method by Example: Analysis ◦ Design ◦ Programming.

C Tables: Literature ◦ Persons ◦ Glossary ◦ Abbreviations ◦ Index.

Related Patterns

The acronym SWOT could stand for a similar pattern for structuring a wide-ranging topic: Strengths – Weaknesses – Opportunities – Threats. I have seen it work several times as a structuring vehicle for a presentation. However, if SWOT addresses a pattern, it is still waiting to be written.

3 Background

Design patterns and pattern languages are celebrated as a new kind of literature in the software engineering community: they help to capture, communicate, and reuse design experience in a clear and concise way. It is this *economy of expression* that has inspired instructors to use the pattern form to condense the body of knowledge in educating and training people in object technology [1-3, 5]. Like software engineering, pedagogy, too, is regarded as a *design* discipline: courses, lectures, exercises, and labs have all to be designed. As most instructors of object technology have not had a specific pedagogical education or training, they look for an efficient vehicle to transfer teaching experience. Pedagogical design patterns will help here. A first Internet-based project has started and about 50 patterns have already been collected [10]. However, none of them has yet been reviewed in a PLoP-styled Writers’ Workshop.

Since 1996, a number of pedagogical patterns workshops have been run: at ECOOP ’96 in Linz, Austria, at TOOLS USA ’96 in Santa Barbara, California, at OOPSLA ’96 in San Jose, California. In addition, potential patterns were collected during a fourth workshop, held at the OT ’97 conference in Oxford, England. There was also a large amount of interest generated after a short Educators’ Symposium presentation and Birds-of-a-Feather session held at the OOPSLA ’97 conference. What is still missing is the creative feedback of a *Writers’ Workshop* as practised at PLoP conferences. The author of this paper is willing to incite a similar kind of workshop series for instructors of object technology in academia and industry called (Euro)-PLoT: Pattern Languages of Teaching [8]. Most people attending PLoP conferences are instructors or trainers of object technology. So, EuroPLoP ’98 ~~can be~~ was a good start to submitting pedagogical patterns to the new writing culture.

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