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ACM SIGPLAN Curricular Patterns

OOPSLA '96 Workshop Report

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Pedagogical Patterns — Successes in Teaching Object Technology
A Workshop from OOPSLA '96

Helen Sharp, Mary Lynn Manns, Phil McLaughlin, Maximo Prieto, and Mahesh Dodani

Background

The process of educating people in OT is an ongoing challenge which has many unanswered questions, and while many good pedagogical ideas are presented at conferences and published in proceedings and journals each year, very little has been done to collate the effective practices of many OT educators into one publication. Our aim is to do just this: to produce a 'handbook' of proven experiences of teaching OT, presented in a homogeneous format. In January 1996, an article in *Object Magazine* (Lilly, 1996) gave us the initial idea of formulating the experiences into 'pedagogical patterns'. This would provide the homogeneity we had been looking for, and although the format has evolved since we initially adopted it, the main sections remain intact (a description of the template, and one example pattern are included at the end of this report).

This workshop was the third conducted as part of the project. The first session was held at ECOOP '96, as part of the ECOOP Educator's Symposium in July; the second was held during STOT (Symposium on Teaching Object Technology), held following TOOLS USA in August. In both of these sessions, we received an encouraging response to the project, and a number of patterns were generated during and immediately after the sessions. The workshop at OOPSLA was the first whole-day workshop where we had asked participants to submit patterns in advance.

We had submissions from 18 potential participants, with some individuals submitting more than one pattern. The total number of patterns sent out in the pre-workshop mailing was 20; two further patterns were submitted too late to be circulated, but were presented on the day. Each participant was asked to:

1. Read all the submissions;
2. Identify stronger and weaker elements of each pattern, and areas requiring clarification;
3. Consider how (whether) each pattern could be used within the participant's environment;
4. Look for relationships which may exist between the submitted patterns;
5. Read Susan Lilly's article.

One of the most striking points about the patterns generated so far is the wide variety of interpretation: some 'patterns' are only suitable for teaching OT concepts, while others have a wider applicability and could be used for teaching other concepts. We decided early on that we should accept this variety and gather a wide range of ideas.

The Workshop

The workshop aims were to:

1. Disseminate experiences, and hopefully to provide participants with new techniques for teaching OT which they could immediately take into their own setting;
2. Refine the submitted patterns, as a step towards producing a final publication;
3. Review the project, and come to a conscensus as to whether or not the project should be pursued.

The day began with a general introduction to the project as a whole and the workshop in particular. After this, the participants divided into groups of four or five. Within the groups, each participant was asked to

'present' their pattern for a few minutes, and then the group was asked to address each of the issues above: stronger and weaker elements of the pattern; clarification required; how (whether) the pattern could be used in different environments; and relationships with other workshop patterns. This was done to provide participants with feedback on their pattern which would allow them to refine their pattern after the workshop and re-submit it (thus addressing the second workshop aim). After approximately one hour, the groups were swapped around, and the process repeated. Two group changes were made, so everyone took part in three groups, received two or three sets of comments on their own pattern, and was able to discuss in detail nearly all of the patterns submitted.

This worked quite well, with everybody's pattern getting reasonable exposure and discussion.

The post-lunch slot, which is always a bit sluggish, began with some general discussions of OT educator 'war stories', i.e., experiences of teaching OT which were not successful. The main issue to arise from this discussion was the need to adequately prepare the educators themselves before presenting courses to others.

We then moved to considering the patterns again, and heard a report from each participant on the feedback they received in the groups. Generally, the feedback offered seemed to be positive and helpful, with everyone agreeing that the group sessions worked well. A common theme which emerged was the need to improve the names of patterns to make them more memorable and to capture the essence of the pattern. Most of those submitted were named after their structure, so for example a pattern which consisted of a lecture followed by a laboratory session followed by a discussion was called Lecture-Lab-Discussion. Other patterns had more memorable names, such as 'What did you eat for breakfast', and 'The Three Bears.' While it was agreed that more suitable names should be chosen, there was concern expressed to ensure that the name accurately reflects the essence of the pattern. Adequately naming patterns was also seen as a move towards maturity in which we can start using pattern names as a vocabulary.

The appropriateness of the format currently being used was also discussed, and broadly we agreed that it was suitable, particularly to provide the commonality required, but that we should not be constrained by it. For example if further information needs to be expressed about a pattern, then extra entries could be used to expand on the idea. Some time was spent conjecturing on what it means for a pattern to be 'related-to' another pattern: 'similar to'?, 'an alternative to'?, 'can be used with'?, 'is composed of'?. No certain conclusions came from this, and it remains an open question.

At the end of the day, the workshop aims had been met. Everyone agreed that they had picked up some new ideas which they could use when they went back to their own environment (thus addressing the first aim). It was also agreed that each of us would take the feedback from the discussions and refine the pattern they submitted, and to find a better (more memorable) name (addressing the second aim). The suggestion came from Mahesh Dodani that a pattern should be usable by 3 people, so a longer-term goal is for each of us to use the patterns and to report back on how well they worked, and any modifications or clarifications which were required to make it work: to record the usage and to increase our understanding.

In response to the third workshop aim, it was agreed that the project is worth pursuing, and we should aim to maintain and build the community and to produce a handbook of patterns. A further workshop session is being held at OT97 in Oxford, UK, in April next year.

If you wish to be kept informed of the project, or would like to know more, please look at the web page:

`http://www.cs.unca.edu/~manns/oopsla.html`

or contact one of the organisers listed below.

Reference

Lilly, S. (1996) 'Patterns for Pedagogy', *Object Magazine*, January 1996.

Pattern Template

The following template follows closely the format used by Susan Lilly; we have added the heading 'Example Instances' to help clarify the pattern's use, and 'Special Resources' to provide more background for a potential user.

NAME: For most patterns submitted to the workshop, this consisted of a string of descriptors which reflected the pattern's structure, e.g., Lecture-Tutorial-Practical. We have decided to identify more memorable names.

INTENT: What is the main aim of the pattern?

MOTIVATION: What situation has led to the generation of this pattern, e.g. students find it hard to learn programming concepts if they have not experienced the run-time environment.

APPLICABILITY: Under what circumstances has this pattern been used, e.g. for industrial students experienced in C doing a two-week full-time course, or for first-year undergraduate students who have no experience of programming.

STRUCTURE: This identifies and describes the components of the pattern.

CONSEQUENCES: What happens when this pattern is used, i.e., why does it work?

IMPLEMENTATION: Key issues which need to be considered when using this pattern, e.g., it requires a substantial amount of preparation, be careful to avoid the following situation, and so on.

RELATED PATTERN: Any known patterns which are somehow related to the current pattern, and in what way(s) are they related.

EXAMPLE INSTANCES: Specific description of one use of the pattern, including the subject which this pattern has been used to teach.

SPECIAL RESOURCES: This describes any resources required to fulfill the pattern which you would not normally expect to be available to the instructor.

Example Pattern: Explore-Present-Interact-Critique (EPIC)

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INTENT: To give the student the ability to learn in the future, and to share knowledge with the other members in a project group.

MOTIVATION: Two of the most important abilities of successful software developers are (1) to be able to learn new material efficiently, and (2) to be able to share knowledge and insights with the other members of the work group.

This pattern allows the students to acquire these abilities by forcing them into being the teachers for themselves.

APPLICABILITY: This pattern has only been used in courses at the Master's level. Whether it is applicable at other levels is not known. This pattern is used as the primary (only) educational pattern for entire semester courses. This pattern have been used for at least 10 years in many different courses.

The pattern is usually instantiated for groups of 2-3 students. It has also successfully been used for individual students. Student groups with more than three students are usually not successful.

STRUCTURE: The pattern is instantiated by the students being handed (or they have voluntarily chosen) a subject matter (e.g., garbage collection, multiple inheritance, attribute grammars, the Eiffel language). They are also handed some materials (papers, book chapters, etc.) on the subject matter (or a list of references to such materials).

The pattern then consists in four major parts, which are more or less sequential:

1. **Explore:** Here it is the obligation of the students to gain an insight into the subject matter. In most cases, sufficient insights cannot be gained from the materials, and it is the students' responsibility to seek further materials (by tracking references from the materials, seeking further materials at the library, or elsewhere).

   In this phase, the Lecturer offers assistance in understanding the difficult parts of the materials, and by giving pointers to other, possibly interesting materials on the subject matter.

   This exploration phase is usually 2-3 weeks.

2. **Present:** Here the students are expected to prepare a lecture for the other students in the course on the subject matter. The quality of the lecture is expected to be comparable to one the Lecturer would otherwise have been giving. Emphasis is put on clarity of presentation and especially the ability to present the essentials of the subject matter.

   The lecture is usually 2 $\times$ 45 min.

3. **Interact:** Immediately following the lecture, the entire course discuss the subject matter, guided by the students responsible for the subject matters (i.e., they must have prepared this discussion phase). In this phase, it is important to make comparisons with the other subject matters, that might have been presented previously in the course (or in some cases, those that will follow later on in the course).

   This interaction phase is usually approx. 30 min.

4. **Critique:** Immediately following the interaction phase, the entire process is discussed. The students responsible for the subject matter give their evaluation of their work, and the rest of the students in the

course offer critique (positive as well as negative) on (1) the preparation, (2) the presentation, and (3) the discussions.

This critique phase is usually 5-10 min.

The pattern is used repeatedly within the same course. The entire course is organised as a sequence of instances of this pattern. These instances are active, overlapping in time (more later).

Each week, one pattern instance is active in the lecture time of the course. This implies that the presentation, interaction and critique phases are conducted in the lecture time of the course.

Each pattern instance is active for approx. one month (depending on the students).

CONSEQUENCES: The EPIC pattern:

1. Provides practice for students to learn by themselves
2. Provides practice for students to present material to peers (sharing knowledge)
3. Provides practice for students to give and receive critique to and from peers.
4. Compels students to focus on essentials rather that details when approaching new subject matters.

IMPLEMENTATION: Issues to consider:

1. The subject matters needs to be chosen to match the capabilities of the students in the course.
2. The sequence of subject matters presented in the course should be planned ahead to enable interesting comparisons during the course. Especially important is to plan for possible contradicting conclusions in the different subject matters (to spin off discussions in the group).

RELATED PATTERN: (none so far)

EXAMPLE INSTANCES Please note that this pattern is targetted towards being used as the overall pattern for an entire course. The following is a list of subjects that were covered in the last course, where this pattern was used repeatedly.

Subjects:
Week 0: Introduction to the course
Week 1: Introduction to Smalltalk
Week 2: Introduction to C++
Week 3: Introduction to Eiffel
Week 4: Introduction to CLOS
Week 5: Introduction to Self
Week 6: Multi-methods in OO languages
Week 7: Constraint OO programming
Week 8: Concurrent OO programming
Week 9: Distributed OO programming
Week 10: Introduction to CORBA, SOM, etc (*hand-in of group reports*)
Week 11: Persistence and OO databases
Week 12: OO Analysis and Design
Week 13: Evaluation of course, and discussion and evaluation of group reports

In this instance the students were required to supplement their presentations with a small written report on the subject matter (5-10 pages). This report was presented, discussed and evaluated (no grading) in the last week of the course (jointly by the teacher and the students).

The hand-outs for each subject was 2-4 papers (or book chapters).

SPECIAL RESOURCES NEEDED: None

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