

Using Pedagogic Design Patterns for Teaching and Learning Information Visualization

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ABSTRACT

We explore using pedagogic design patterns to aid in the design and implementation of an introductory course on information visualization. We describe one pattern that we have employed, reflect on its benefits, and suggest key topics in information visualization in which earning design patterns might be used for future curriculum development in information visualization.

Keywords: pedagogy, learning design, design patterns

Index Terms: Information Visualization, Pedagogy, Learning Design, Design Patterns for Learning

1 INTRODUCTION

One of the challenges that teachers of Information Visualization face is creating new learning activities for students. Although experienced teachers may have developed some of their own curriculum, they may be less certain about how to translate their own expertise into effective teaching practice. Senior faculty are also tasked to develop new curricula for Information Visualization courses that has not yet been offered. They may have inherited a curriculum or be asked to quickly come up with learning activities that will engage students in learning principles of Information Visualization, but have little guidance how to do so. Less experienced practitioners, such as junior faculty and doctoral students may have been asked to teach Information Visualization course of which some parts of which may be unfamiliar. Another difficulty is ramping up capacity to accommodate the increasing demand as new courses and sections are added to degree programs. This makes it all the more likely that less experienced teachers and doctoral students will need to become confident quickly.

Teaching from Information Visualization textbooks offers some support, but with the drawback that exercises are not easy to personalize based upon a practitioner's deep knowledge. Moreover, academic textbooks are typically content-focused and teaching and learning activities they provide may not be grounded in pedagogic theory. Although they may provide a good content structure and sometimes a syllabus for teaching Information Visualization content textbooks are primarily communication documents, not design tools. They are less helpful for developing new learning activities.

These problems are not unique to Information Visualization and are common within any domain in which knowledge is rapidly changing, particularly technology-focused subjects. Researchers within the discipline of educational technology have proposed Pedagogic Design Patterns (hereafter, simply "pedagogic patterns") as a way of overcoming some of these problems (for an

overview see [5] and [4]). Patterns address these challenges by supporting adoption and adaptation. They aid adoption by supporting effective communication of "known good" practice among teachers, and are more robust than textbooks, which may offer boilerplate solutions that are not necessarily applicable in specific learning contexts. They provide a structured approach to communicating effective strategies among practitioners, which aids in disseminating practice, thus facilitating ramping up capacity. Pedagogic patterns can also act as a design framework within which new activities can be created and captured, supporting the difficult work of operationalizing learning and translating theory into practice within a learning setting.

We have been exploring the use of pedagogic patterns for developing teaching and learning activities for Information Visualization and are in the early phases of employing this approach with students. We believe that the benefits of patterns will aid us in designing new learning activities and will help us to share our work within our own community and within the wider world of teaching and learning Information Visualization. As an initial stab in the effort, we present below an example of a pedagogic pattern, describe a teaching and learning activity we developed with this approach.

2 ABOUT PEDAGOGIC PATTERNS

Like *design patterns* from the domain of Architecture [1], Computer Science [5], and Human-Computer Interaction [2], a *pedagogic design pattern* is a short document that describes a design pattern for learning, organizing design knowledge captured from learning design practice. In short, pedagogic patterns translate learning design stories into design templates which can be used to create new learning strategies.

Mor, et al. [4] provide explanation and rationale for the use of pedagogic patterns and have assembled an edited collection of examples of their use within four different technology-centered learning domains. The patterns are named with succinct and understandable titles, for example: BLENDED EVALUATION, FEEDBACK ON FEEDBACK, TRY ONCE - REFINE ONCE, HINT ON DEMAND, INTERACTIVE LECTURE MODE, to name a few. Each pattern has the same structure and provides:

1. A Summary
2. A *Problem* which the pattern aims to solve
3. A *Context* within which the pattern can be applied
4. A Solution
5. *Supporting* information and resources for implementing the pattern

We examined a number of these to determine a suitable collection of patterns upon which to base new learning designs for Information Visualization and employed one pattern, INTERACTIVE LECTURE MODE with a recent cohort of students.

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3 USING A PEDAGOGIC PATTERN FOR INFORMATION VISUALIZATION LEARNING

In one of our graduate level courses, "Introduction to Information Visualization", we adapted the INTERACTIVE LECTURE MODE pattern described by Kabicher and Motschnig-Pitrik (see [4], pp. 55-58) as a means of structuring the course and activities. The benefit of this pattern is that it "...tries to achieve increased student freedom and responsibility, to increase students' awareness of their learning as compared to a conventional lecture (frontal teaching), and to decrease students' dependence on formal exams."

Rather than presenting a series of lectures followed by an exam, as in a typical engineering course, we structured the course based upon the framework provided by the pattern. As described by the summary of this pattern: "This pattern supports instructors who aspire to teach their students in a learner-centred way and to support deep and meaningful learning. The pattern helps to design and implement an interactive mode of lecture in academic courses by including (1) an electronic diary (or e-portfolio) service, (2) interactive spaces for team projects, and (3) personal as well as interpersonal reflection."

The full pattern is employs conventional lectures as well as online diary or portfolio, elaboration of a team project and self and peer evaluation. We operationalized these through conventional lectures on topics in information visualization, group discussions based on in-class work and course readings, student managed websites to share their work building a major visualization project (comprising 60% of the overall grade for the course), and peer self-assessment.

As we were teaching a course and not undertaking a formal study, our results are primarily in the form of feedback from students. Students provided informal feedback on this course structure verbally and in the written quality assurance surveys used by the university. Student responses were generally positive and specifically identified the in-class activities, and online presentation of projects. In particular, we received feedback that the course structure was appropriate for the material that we were trying to teach. We received the most criticism from students regarding activities that were not seen as engaging the students effectively in a dialog with us as teacher and with each other, once which, in short, departed from the aims of the design pattern.

As designers of learning, we found the pattern-based approach to be extremely useful for helping us to structure the course, identifying ways that students would be enlisted into the process of their own learning. It also helped us to structure a course that could be effectively delivered without resorting to final exams, which we have found are not very suitable for our master's students.

It also was a suitable structure for a course within a human centered design program, which is focused on addressing design challenges based upon a deep understanding of user needs. This type of learning lends itself to a course structure that supports both lectures and studio-based design work. The INTERACTIVE LECTURE MODE pattern was very appropriate for the kind of teaching that we wanted to undertake.

A criticism of this approach is that it can be difficult to communicate the nuances of learning activities for particular sessions. That is, such a high level pattern as this one does not aid teachers in understanding what to do to teach specific topics unique to information visualization. For example, what activities might be suitable for teaching data cleaning, and lead to effective learning outcomes? More micro-level patterns might describe learning activities at a more granular level.

4 FUTURE WORK

We are in the early stages of developing a repository of learning activities drawing upon pedagogic patterns and aim to address a wide range of teaching and learning activities in Information Visualization, such as:

- Understanding data types
- Graphical representations and mappings
- Data cleaning and manipulation
- Understanding users' needs
- Prototyping novel Information Visualization systems

We are particularly interested in creating learning designs by adopting patterns based upon constructivist learning principles and which are aimed at supporting learning in a studio-design setting, using participatory and collaborative learning modalities.

Our objectives are to share these teaching and learning activities within our own community of teachers, to share our strategies with others who are engaged in teaching and learning Information Visualization, and to collect new narratives of teaching practice that can be translated into pedagogic patterns that are uniquely suited for Information Visualization. We would like to assemble a public repository of teaching and learning activities from which practitioners can adopt and adapt their own learning designs.

We also aim undertake more formal studies to evaluate the pedagogic and design efficacy of using pedagogic design patterns to create learning activities and curriculum designs in information visualization.

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