

How Can The Design Of Educational Technologies Affect Graduate Students' Epistemologies About Learning?

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Abstract: This paper describes a course in which graduate students learn practical and theoretical aspects of educational-design. The course was enacted with 14 students in education. Outcomes illustrate tensions between students' professed beliefs about learning and their actual design practices in four dimensions that characterize the technologies they designed: *Learner-activity*, *Collaboration*, *Autonomy*, and *Content-accessibility*. By peer-negotiating of these tensions, students developed their skills to design educational-technologies and increased the coherence of their epistemological understanding.

Introduction

Although modern learning theories emphasize constructivist or socio-cultural models of learning, most instruction is still didactic. Numerous researchers have documented the resistance of educators to employ constructivist pedagogies in the classroom, even when they explicitly espouse constructivist learning theory (e.g., Maor & Taylor, 1995; Tobin et al., 1994). In this paper, we describe how a similar disconnect exists in educational-design students, and how a practice-based approach helped these students develop practices more well aligned with their espoused beliefs. Educational design is an important area of study both because of its inherent importance in producing educational materials, and also as a model for studying learning in complex domains. Yet, design is an elusive subject to teach. In traditional design fields such as architecture or graphic arts, design is taught through a studio approach in which learners examine examples, conduct lengthy design projects in the company of others doing similar projects, and proffer and receive frequent peer and expert feedback. Schön (1983; 1985), and Glaser (1996) have described this as an important way to teach design and professionalism in other disciplines, while Hoadley & Kim (2003) describe how such methods can be used in teaching educational design.

In this paper, we describe a particular course in which students learn educational design through studio methods. We show how the course format highlights tensions between students' professed beliefs about learning and their actual design practices. We also look at how the design studio format allowed students to negotiate these tensions, ultimately leading to more coherence between ideas about learning and their designs.

Context

The design of the course was based on a previous study (Ronen-Fuhrmann & Kali, 2005), which characterized graduate students' use of a Design Principles Database (Kali et al., 2004) in designing new educational technologies. One of the main findings were that students had difficulties in designing their own educational technologies due to the open-ended nature of the task; based on this finding we decided to use a more structured design process, and build the course around a model we call the design studio model. Our model for the design process builds on the well known ADDIE stages (analyzes, design, develop, implement, evaluate) (Dick & Carrey, 2001), in which we expand the *Design* stage, to include three other non-linear iterating stages: *Brainstorm*, *Build-flow* and *Design-features*. The Design Principles Database is used in four stages in this model as illustrated in figure 1.

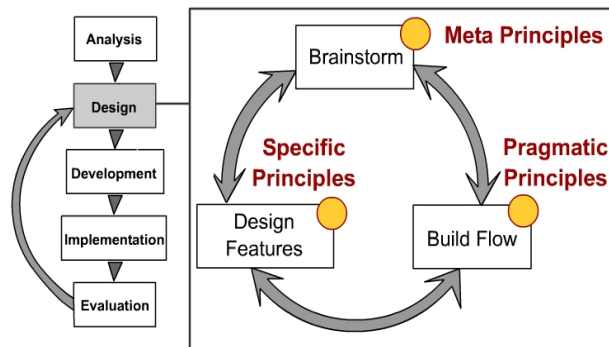


Figure 1: The Design studio model – the yellow dots indicate stages in which the design principles database is used

Methodology

The design course described above was enacted in spring semester 2005 with fourteen graduate students at the Technion. In order to characterize student learning, rich qualitative data was gathered throughout the semester. Data sources included whole class online discussions about the literature, group online discussions (for the design studio and analyzing technologies projects), student artifacts (documents produced at various stages of the in the design studio in which students designed their own educational), entries in the Design Principles Database, and a reflective diary in which we documented important events in each of the class meetings.

To analyze the data and characterize student epistemologies at various stages of the design process we developed a rubric based on two existing frameworks. The first is Reeves' framework, which includes 14 pedagogical dimensions for assessing computer-based education (Reeves, 1994). The second is the SKI framework, mentioned above, for designing web-based inquiry curricula (Linn et al. 2004). Since these frameworks do not include a rubric for quantitatively assessing the design of educational technologies, we combined and modified these frameworks to develop a rubric consisting of four dimensions: a) Learner activity, b) Collaboration, c) Content accessibility, and d) autonomy.

Outcomes

The analysis of the data indicates that most of the students expressed ideas that were categorized as "high" according to the first three dimensions of the rubric (Learner activity, collaboration and content accessibility). These expressions were found when students were engaged in face-to-face or online discussions. An example showing a high degree of the "content accessibility" dimension, in one of the first online discussions, is: "as a school teacher, I see that learning is meaningful when the context is tangible and relates to the learners' world; when I teach about the concept of pendulum in physics, I connect it to the swing at the school yard".

However, when they began designing their own technologies, many of them designed modules, in which learners have a passive role, as consumers of information, and the interaction with the technology was restricted to reading, or watching things on the computer screen. Students tended, at initial stages of their design studio project, to design environments in which users work with the technology individually, in their own pace. In addition students tended to build the flow of activities in their technologies based solely on the structure of knowledge in the domain they intended to teach. They were mainly concerned with what learners should know at each stage of the flow, and less concerned with how to make this flow engaging for the learners.

As the semester proceeded, their designs incorporated more and more components in which learners have an active role, and are engaged in construction of knowledge in interactive environments, using tools that allow them to express their ideas, manipulate elements, or build artifacts. Students tended to embed more and more social supports in their designs, and enabled their potential users to negotiate their understanding with their peers. Students became more concerned that the domain content within the technology environments, build on learners' prior knowledge, connect with their everyday lives, and engage the learners.

We view the high level of pedagogical ideas expressed by students throughout the semesters as their "theoretical epistemologies". We consider the ideas expressed by students' actual design practice as their "applied epistemologies". As apposed to the other dimensions, the autonomy dimension did not reveal a clear gap between students' epistemologies as expressed in their sayings and their doings. However, we did observe a change in students' epistemologies in this aspect throughout the course. From the beginning of the semester, many concerns were expressed by our students about the lack of control that teachers have in open-ended environments. The notion that technology (or the teacher) should monitor and control student learning was most prominent. This notion was consistent with their designs at initial stages of the design process. Many of the projects were tutorial type environments that funnel learners in different learning paths according to their performances and provide teachers with precise information of learners' progress. As the design process proceeded, students' designs increasingly included open-ended activities and tools in which learners have more flexibility in directing their own learning paths.

Discussion and Implications

This study revealed a gap in students' "theoretical" and "applied" epistemologies. At the beginning of the semester, when engaged in theoretical discourse, students tended to advocate socio-constructivists paradigms, whereas when engaged in designing technologies they tended to neglect these ideas and apply more traditional approaches. The analysis also indicated that in three of the four dimensions (learner activity, collaboration, and content accessibility) this gap was reduced during the course. Thus, as students developed their skills to design educational technologies, they also increased the coherence of their epistemological understanding.

The outcomes indicate that these advances may have resulted from various aspects of the design of the course. The three-theme structure of the course, including the, *Technology Analysis*, *Design Studio* and the *Theory* themes, provided a rich variety of resources that made it possible for students to learn important aspects of design. The cognitive apprenticeship model of instruction, and the supports for peer learning in the course, enabled students to take advantage of these resources, and eventually brought to widening their intuition for designing educational technologies, and to development of their epistemological understanding.

This study reveals that epistemologies that are based on theoretical understanding about various approaches in the field of education may lack coherency if they are not applied to real situations. Engaging students in design using a studio course format, proved to be a productive way for students to examine their own epistemological beliefs, negotiate them with peers and experts, and explore them in relation to theory. Such engagement can bring to expanding of students' design intuition as well as meaningfully enhance their epistemological understanding. We therefore suggest that designing curricula in a studio fashion, whether it involves technology or not, should become an integral part of the academic professional development program for graduate students in education.

To explore the generality of the outcomes, we continue to study the course in a design-based research approach, in several enactments with more students in other institutions in the United States. Data from these enactments will help examine the extent to which our current findings reflect a local situation, or are more widely spread.

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