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Opening the Door of the Computer Science Classroom: The *Disciplinary Commons*

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ABSTRACT

The *Disciplinary Commons* project had two primary objectives: to *document* and *share* knowledge about teaching and student learning in Computer Science (CS) classrooms, and to establish practices for the scholarship of teaching by making it *public*, *peer-reviewed*, and amenable for *future use and development* by other educators. The mechanism for achieving these goals was through a series of monthly meetings involving Computer Science faculty, one cohort of ten CS faculty in the US and one cohort of twenty in the UK. Meetings were focused on the teaching and learning within participants' classrooms, with each person documenting their teaching in a *course portfolio*. Surveyed on completing the project, participants discussed the value of the *Disciplinary Commons* in providing the time and structure to systematically reflect upon their practice, to exchange concrete ideas for teaching their courses with other CS educators in the discipline, to learn skills that apply directly to course and program evaluation, and to meet colleagues teaching CS at other institutions.

Categories and Subject Descriptors

K.3.2 [Computer and Information Science Education]: computer science education

General Terms

Human Factors.

Keywords

Scholarship of teaching and learning; professional development; course portfolio, folk pedagogy.

1. INTRODUCTION

Teaching in higher education is governed by a central irony. College teaching is perhaps unique among the major professions, in that the majority of its practitioners rarely receive formal education either in the theory and methods of the profession, or practical training and experience in the actual work of teaching. Prior to

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starting their lives within the profession, practitioners have essentially no experience of what will be their daily tasks. Then, having started, they almost always practice behind closed doors, isolated from the very community of professional colleagues with whom they might (but usually do not) share collective cultural knowledge about how to teach and how to become better teachers. As Mary Huber, senior scholar at the Carnegie Foundation for the Advancement of Teaching lamented about the winner of a prestigious national teaching award: "what he himself had learned from teaching remained his own craft knowledge: under examined, under documented, and subject to loss (Shulman 1999) ... Aside from his syllabi and fading memories, he had no real record of what happened in those award winning courses" [1]. And for those of us who do not win national teaching awards, the situation is rarely better.

This paper describes the *Disciplinary Commons*, a project undertaken with two explicit goals: to *document* and *share* knowledge about teaching and student learning in CS classrooms, and to establish practices for the scholarship of teaching by making it *public*, *peer-reviewed*, and amenable for *future use and development* by other educators. During the 2005/6 academic year, two cohorts of computer science teachers—one group of 17 in the UK and another group of 10 in Washington state (USA)—met face-to-face each month to document and discuss their practice of teaching of computer science, with each cohort led by one of the authors. Participants in the *Commons* constructed a *course portfolio* for a CS course that they taught during the academic year, thus creating a powerful community resource. Participants also evaluated the portfolios of other participants, establishing shared, scholarly practices.

The novelty of this project lies in the combination of two fundamental beliefs. First, it is centered *on the discipline*, rather than treating teaching as a set of generic skills that, once learned, can be applied in any discipline. Lee Shulman, president of the Carnegie Foundation for the Advancement of Teaching states "we need to reconnect teaching to the disciplines ... the communities that matter most are strongly identified with the disciplines of our scholarship. ... We need to make the review, examination, and support of teaching part of the responsibility of the disciplinary community" [2]. Second, and as importantly, it treats teaching as a *reflective* practice. In doing so, it places particular emphasis on making explicit the rationale for teaching choices that are usually tacit.

2. MAKING THE TACIT EXPLICIT

Schön [3] provides a conceptualization of skilled professional practice, what he calls, *professional artistry*, that is developed

through *reflection-in-action*. This artistry relies upon the ability to embody domain-specific knowledge that is enacted in practice: "I shall use knowing-in-action to refer to the sorts of know-how we reveal in our intelligent action ... We reveal it by our spontaneous, skillful execution of the performance; and we are characteristically unable to make it verbally explicit." Many teachers develop this mastery through years of classroom experience. But how are we to pass on this knowledge to others if we are unable to verbalize it? How are we to acquire the skills and practices of the masterful teachers around us? And how can we accumulate skilled practice within the designs and instantiation of the courses that we teach?

One supposition in our design of the *Disciplinary Commons* is that this skilled practice can be facilitated by exposing our tacit knowledge about our teaching so that it becomes available for critical scrutiny and improvement. Karl Popper expresses this sentiment about human knowledge in general, when he states: "There is a world of difference between holding a belief, or expecting something, and using human language to say so. The difference is that only if spoken out, and thus objectivized, does a belief become criticizable. Before it is formulated in language, I may be one with my belief: the belief is part of my acting, part of my behavior. If formulated, it may be criticized and found to be erroneous; in which case I may be able to discard it" [4]. Within the context of teaching, this tacit knowledge is what Jerome Bruner calls *folk pedagogies* [5], those tacit beliefs that we each hold about how our students think and learn, that largely determines the ways in which we teach our courses.

Paradoxically, this tacit knowledge, by its nature, may not be directly accessible through deliberate acts of reflection. So we sought the impressions that these beliefs leave in our practice through the examination of artefacts, of the "texts" that teaching generates, such as syllabi, exams, assignments, and comments to students. Bob Broad reflects this sentiment when he states "people (including instructors) do not have satisfactory access to their educational values by sitting and reflecting on them. Instead, people need to enter into discussion and debate of actual, specific performances in an effort to reach decisions about them (i.e., to judge them)." [6].

In the *Disciplinary Commons* we documented teaching and learning in *course portfolios*, individually written, collaboratively critiqued. The course portfolio, well known as a method for advancing teaching practice and improving student learning, is a set of documents that "focuses on the unfolding of a single course, from conception to results" [7]. The purpose of the course portfolio "is in revealing how teaching practice and student performance are connected with each other" [8]. Course portfolios typically include a course's learning objectives, its contents and structure, a rationale for how the course design meets its objectives, and the course's role in a larger degree program. Importantly, the portfolio also includes evaluations of student work throughout the term, indicating the extent to which students are meeting course objectives and the type and quantity of feedback they are receiving. Not only should the course portfolios describe the *what* and the *how* of a course, it should say something about the *why*. Further, its empirical focus on student work can lead to insights into how this course might be taught differently in the future so as to improve student learning.

The course portfolio served a number of our purposes simultaneously. First, it provided a structure for one academic year's worth of monthly meetings. Second, because the course portfolio was centered on the situated activity of an ongoing course, it kept individual reflection and group discussion grounded in the empirical realities of our lived experiences, rather than the generalized (and often meaningless) abstractions of the more common *teaching* portfolio [9]. Third, the process of writing the portfolio inherently required engagement in a number of reflective and collective teaching practices, from introspection on basic assumptions about learning within the discipline, to systematic analyses of student work, to peer observation of one another's classrooms. Finally, it provided an archival set of documents that represented a collective effort at bringing scholarship to the act of teaching. In this regard, it embodies the ideals of scholarly teaching as defined by Lee Shulman: "a scholarship of teaching will entail a public account of some or all of the full act of teaching -- vision, design, enactment, outcomes, and analysis -- in a manner susceptible to critical review by the teacher's professional peers, and amenable to productive employment in future work by members, of that same community" [10].

3. INSTANTIATION OF THE PROJECTS

In the US (hereafter the Tacoma *Commons*) each participant, from a combination of both universities and two-year community colleges, committed to construct a course portfolio for a course that they taught during the 2005-2006 academic year that was on the path for a baccalaureate degree in a Computer Science-related program. In the UK (hereafter the London *Commons*) each participant, from a variety of universities in England, Scotland, Ireland and Wales, constructed a course portfolio for the introductory teaching of programming (itp) course that they teach. In this way, both instantiations—designed together and delivered in parallel—had a central core of interest to the participants: in the US this was the student body, in the UK, the closely linked course objectives.

Each monthly meeting was focused on exploring a single aspect of the Course Portfolio (see Table 1). Outside of the exercises undertaken in meetings, participation in the *Commons* involved participants in selected readings, peer-observation of each others' teaching and peer-review of each others' emerging portfolios. In this last aspect, some participants widened the pool, and reviewed work from the mirror *Commons*, cross the Atlantic. Prior to each meeting, all participants prepared a portfolio *increment* related to the portfolio aspect to be discussed at that meeting. During the meetings, participants presented and critiqued one another's new work—in plenary, in small groups, and in review pairs. Most importantly, participants discussed course designs and tacit pedagogies that the portfolio increments represented in plenary, establishing baseline scholarly reflections.

Table 1: The Commons sessions

	Tacoma Commons	London Commons
September	Course Objectives	
October	Institutional & Curricular Context	Institutional Context & personal trajectory into teaching
November	Course Content & Structure	Curricular Context of itp course
December	Teaching Methods	Course Content
January	Rationale/Teaching Philosophy	Instructional Design
February	Evidence of Student Learning	Student Assessment
March	Grading	Evaluation (for improvement)
April	Self and peer observation	Delivery (including debrief of peer observation)
May	Conference Presentation & External Review	Complete “first draft” overview
June	Portfolio Presentations	Portfolio Presentations

4. OUTCOMES

Outcomes were evaluated in two primary ways. One was through a set of constrained-answer (5 point Likert scale) post-project survey questions that each participant anonymously completed during the last meeting session. Participants also provided explicit statements of lessons learned and project outcomes within their portfolios, during the final meeting session, and on open-ended questions on the post-project survey. All 10 Tacoma *Commoners* completed the post-workshop survey, and 13 of 17 London *Commoners* completed this survey. For the purposes of this discussion, responses have been aggregated across cohorts.

Every participant indicated that the *Disciplinary Commons* was a good use of their time, that they would recommend a similar experience to a colleague, and that they connected to a network of people in the region. All but one indicated that they would participate in another *Disciplinary Commons*, 16 of the 23 respondents shared parts of their portfolio with someone not participating in the *Commons* project, and all but one were able to get insight into teaching issues that they faced. Every *Commoner* thought that they would contact other participants in the *Commons* project about teaching-related questions in the future.

Participants made specific comment on the benefits of participation. One was concerned with the opportunity “to reflect on what you are doing,” to “focus on the big picture” concerning how the course fit the larger curricular and program goals. Another stated “The value of reflection is immeasurable.” A third

commented that the *Commons* “forced/obliged/encouraged me to reflect on my teaching process and delivery.”

There were comments on participants being validated for what they already did well: “It was good to see that many of my instincts about teaching were sound and that all my hard work in preparing the materials and assessment tools for this course was well placed. Participation in this portfolio project made me feel valued for my hard work and expertise.” Another stated “It’s terrific to have something to be able to say ‘this is what I do.’”

Other comments related to participants’ developed skills in course assessment, i.e. “How to perform a basic test on the effectiveness of an element of my teaching”. The *Commons* thus allowed participants to “realize that some of your practices do not directly relate to course objectives – a reality check!” And for some, it demonstrated “How to look more critically at what is actually happening in my classes.”

Many participants spoke about specific changes that they would make to their examined course the next time that it was offered. One stated: “partition the lesson plans so that it’s not all didactic lecture. Intermix some lab work, a break or two, engage students ... In effect, more stringent partitioning of the material into ‘units’ that can be sequenced along with labs to ensure better delivery, and better use of time.” Another commented “I want to have more peer assessment built into the team projects I assign. I want to continue to find ways to make the classroom experience interactive.” A third stated “An analysis of the final lab assignment suggests ... that students often have difficulty with *flow of control*. ... Possible solutions include either doing more imperative-type programming in the course or perhaps giving more practice exercises focusing on flow of control.” And another stated that he would “Rework the homework grading sheet criteria to provide more detail.”

Several spoke of the value of working closely with peers, that the project helped them to “find new ways to enhance the course’s effectiveness from peer insights.” Another commented how the work with peers was “other directed”, and characterized by mutual concern: “Why isn’t the *Commons* more common? It’s similar to meeting the same people at conferences, but at conferences people are interested in themselves, their presentations. Here we’re interested in each other.” Another stated “I was surprised to realize how private the process of teaching can become ... by making it more public and more available to scrutiny I am more accountable for the quality.” One stated “one significant result has been the increased rapport with the other members of the *Disciplinary Commons*. As we each worked our own Course Portfolio, we were editing and revising based on input from others who taught the same courses. Collectively our insight to the process of teaching the material, and to the students we teach grew. ... as Lee Shulman says, we have begun to put an end to our pedagogical solitude.” And finally “I think we have achieved what many teams envy: that magical balance of collaboration and critique, competition and cooperation, individuality and respect, work and fun.”

We are currently undertaking additional project evaluation—including a more extensive survey directed at the relationship of *Commons* participation to the professional identity of the participants, and selected in-depth interviews. Given this on-going

evaluation, the outcomes described above should be regarded as preliminary and may not persist over time.

5. ANALYSIS

By the current measures employed, we believe the *Commons* projects to have been a success. There are two aspects to the *Commons* projects which involve quite different skills and invoke quite different outcome measures: *participation* and *reification*. We borrow this terminology from Wenger [11], who was concerned with the ways in which individuals construct identity and become members in nested levels of social group that share common practices in specific settings. (e.g. *teacher, computer scientist, software developer, scholar*). “I will use the term participation to describe the social experience of living in the world in terms of membership in social communities in active involvement in social enterprises ... I will use the concept of reification very generally to refer to the process of giving form to our experience by producing objects that congeal this experience into ‘thingness’.” Part of the strength of these *Commons* projects, we believe, is in the manner in which these twin aspects are combined.

5.1 Participation

One of the most obvious features of these projects is that they bring practitioners together, not simply sharing physical space, but actively engaging in issues of mutual concern. Clearly, engagement in this kind of interchange has considerable individual value; why else would teachers from around the UK travel up to 8 hours each month to and from the meetings in London? And why else would participants in the US—some teaching four courses during the academic term—meet monthly on *Saturday*?

It may seem (indeed, it has been said) that the people who came together to talk in the *Commons* should have had other avenues for this sort of communication – that the *Commons* unnecessarily replicated existing opportunities, either

- individual (involving private reflective practices, such as teaching journals or action research projects),
- institutional (via central Faculty Development Units, or similar endeavours), or
- disciplinary (practitioner conferences)

Superficially, this would appear to be true. All these opportunities existed prior to the *Commons* and are places where practitioners meet. However the *Commons* proved to be a different sort of project, and provoked participation at a different level from these other, more ordinary and recognizable activities. It is striking that when asked to nominate the three most valuable things about the *Commons* from a list of nine items, the two statements that received the highest number of votes in aggregate across both cohorts were *getting to know other teachers who care about teaching issues* and *coming to the meetings*, respectively. These preferences hold as well in each cohort separately, despite the significant differences in context of the participants. This suggests that these other outlets are not fulfilling the scholarly needs of CS educators.

5.2 Reification

The use of portfolios to reify practice among groups of educators from different disciplines has been previously reported [7,12]. Our use of course portfolios differs from these efforts by being carried out by faculty within a single discipline, and, with the London *Commons*, in a single course. We believe that this is especially powerful. One of the recognized problems with teaching portfolios is that they are produced by individuals, normally for benchmark or personal development purposes: rarely do they contain reference to a wider context (institutional or disciplinary), and they are individualistic in form. Not only that, but they are scattered across all subject areas – drawing, psychology, maths – and so are both hard to navigate and difficult to use with respect to a given subject or situation.

However, the power of the portfolio approach is multiplied when there are several examples available for a single disciplinary aspect, and they have some commonality of approach and form, as in our projects. We trust that our collection of these portfolios into a repository and archive may help to chart and calibrate excellence over time, highlighting differences in teaching and learning in response to differences in context.

In this way the *Commons* contributes unique texts to the teaching and learning body of knowledge, helping to ameliorate the dearth of public, peer-reviewed examples of teaching excellence that characterizes the legacy of even award winning faculty:

5.3 Participation & Reification

Participation without reification free-rides off the collective efforts of others, and underestimates the importance of externalizing tacit pedagogies. Reification without participation is isolating, leaving the individual standing apart from the scholarly community, their “product” an un-contextualized (although not necessarily un-reflective) account of practice. Participation *with* reification couples a set of practices for the examination of teaching and learning, with the medium of a common externalization that can be discussed, critiqued and adapted by others.

The strength of the *Commons* is in its combination of both of these aspects: participation builds a knowledgeable community of scholars who can engage with and support each others’ practice, reification provides a foundation for this dialogue to extend to other CS teachers, over time.

6. ACCESSING THE REPOSITORIES

All the portfolios generated in these *Commons* are publicly available. They document detailed CS teaching and learning practices from a wide range of institutions. Between them they archive twenty three portfolios concerning CS1 courses, two information systems, one capstone course and one undergraduate seminar. In addition, all materials concerning the construction and delivery of the *Commons* themselves are available. See:

Tacoma *Commons*: <http://depts.washington.edu/comgrnd/>

London *Commons*: <http://www.cs.kent.ac.uk/~saf/dc>

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