Case Study: Faculty Professional Development Workshops for Innovation Diffusion

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ABSTRACT

Part of computer science education research focuses on the design of new technologies and techniques for improving educational experiences. However, for these systems and techniques to be truly impactful, their use must be disseminated to the larger instructor population. Single-instance workshops, where instructors are brought together to learn about a new technique or system so that they can possibly adopt it, are a common dissemination method. Unfortunately, rarely do we see reports regarding their effectiveness. In this case study, we report on two NSF-funded single-instance workshops designed to support adoption of the Ubiquitous Presenter (UP) active learning classroom presentation system. Though only 44% of workshop attendees used the system in their classrooms, 65% of those used the system repeatedly. Overall this impacted 1570 students. Additionally, 60% of our attendees used the active learning features of UP – a much higher usage rate than in the general UP user population. We reflect on the aspects of the workshops which seemed to promote, and hinder, instructor adoption and, finally, suggest some metrics for evaluating innovation dissemination workshops in general.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer use in Education.

General Terms: Human Factors

Keywords
Tablet PC, Ubiquitous Presenter, Instructor adoption, Faculty development workshop.

1. INTRODUCTION

It was Chairman Mao who created the Hundred Flowers movement (百花運動), which advocated "[l]etting a hundred flowers blossom and a hundred schools of thought contend is the policy for promoting progress in the arts and the sciences...." [12] Indeed, this approach of allowing many ideas from many sources to flourish has been replicated elsewhere, such as through the US National Science Foundation’s (NSF) Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics program [13]. While Mao may have used this movement to trap his intellectual opponents, the intent of NSF and other such groups is to encourage many innovative approaches towards improving undergraduate STEM education, with the hopes that the best approaches should rise to the top, and be adopted by others.

And yet, it is not clear how to foster such adoption in the educational arena. Two of the most well-known books in innovation adoption are Diffusion of Innovation [10] and Crossing the Chasm [7], which are staples of many business programs. But, the challenge of diffusing innovation and crossing chasms with respect to educational interventions remains. Popular approaches to such adoption include making materials available on websites (and in digital libraries), publishing information about the intervention and its impact on student learning in journals and at conferences, publishing textbooks, and running professional development workshops, among many others. However, the relative effectiveness of these various dissemination strategies in computing education is unknown. Some research, such as [8] have suggested reasons for the non-adoption of computing inventions in specific areas, but the relative effectiveness of various dissemination approaches was not examined. [6] argued for specific technical aspects of tools to make them more instructor-friendly, as well as for the use of professional development workshops, without exploring why or what aspects of professional development workshops are likely to be most effective. This paper provides a case study of the effectiveness of one such workshop and, based on that study, discusses useful metrics for future work in studying dissemination effectiveness.

In this paper we look at two workshops designed to introduce instructors to the Ubiquitous Presenter (UP) program. UP is a web based presentation system designed to facilitate student engagement in the classroom through a combination of digital, web-based student submissions and inkable instructor slides via a Tablet PC [11]. In our analysis we consider the following questions:

- What impact did these workshops really have? What was the rate of adoption among workshop attendees? What barriers did they face?
- What did the workshop organizers do to address perceived problems in the second deployment of the workshop?
• How do adopters via professional development workshops (costly adoption) differ from lower cost, over-the-web adopters?
• How did metrics regarding the success of this workshop compare to others recently reported and what metrics do we recommend be considered in the future?

2. RELATED WORK
Most comparable to this work is that by Ni [9] looking at what issues influence computing instructor change. She studies one year of workshops promoting use of a media computation context in CS0/CS1, and we compare with her results.

There is also literature on the broader issue of technology adoption among instructors at higher education institutions. In [5] they report on university-instructor technology adoption by studying the impact of job relevance and perceived relevance on user acceptance of new technologies. They show the importance of motivating relevance when introducing a new technology to a potential adopter.

Harris studied technology adoption by focusing on internal barriers to instructor technology adoption [3]. While not focusing on the workshop scenario itself, it does classify adoption barriers which should be taken into account when designing technology dissemination workshops. These barriers range from low level of perceived usefulness to user self-confidence when interacting with technological systems, and are important to keep in mind when recruiting workshop attendees and designing workshop curriculum.

Henderson and Dancy’s study of active learning in physics also informs our research, as it highlights the differences between the instructor’s perceptions of how they teach and how an unbiased observer would classify the same teaching methods [4]. This study shows the importance of using quantitative data of instructor usage to back up self-reported data, since instructors may perceive their adoption rate as higher than it truly is.

3. BACKGROUND
3.1 Ubiquitous Presenter (UP)
UP is an extension of the University of Washington’s Classroom Presenter (UWCP) Tablet PC presentation system [1]. The UP system seeks to bring the spontaneity of dynamic instructor “ink” to static, digitally prepared materials. It also supports anonymous, electronically-enabled active learning in the classroom, by allowing students to “submit” work via a web-based application and easing the sharing (e.g., digital projection) of that work in the classroom.

UP differs from UWCP in that it is both web-enabled and supports both pen-based and typing-based student submissions [11]. Web support provides student access and control: Should the instructor so choose, nearly any computing device can view the instructor's reusable inked slides, in any order, at any time, in the classroom or out. Student submissions permit students to author solutions to in-class active learning exercises and submit them anonymously to the instructor. Both pen and keyboard inputs are available – supporting students with normal laptops or Tablets. Students can make submissions in a variety of formats including multiple choice, typed text, drawn, or screen shot. The instructor can display student submissions and multiple-choice bar graphs for discussion, and students can peruse them on their own.

3.2 The UP Workshops
The 2-day UP workshops studied were held for two consecutive years at UC San Diego – though numerous other UP workshops had been held in the Tablet PC education community. The UP workshops were funded by an NSF CCLI Phase 2 grant which sought to train STEM faculty to engage UP's technology-based active learning system to enhance or enable active learning experiences in their classrooms. The 2007 workshop had 25 attendees (64 applicants), and the 2008 workshop had 20 attendees (44 applicants). Most attendees received a grant of $1600 to cover most of the cost of a Tablet PC. This decision was among a number made specifically to try to increase the likelihood of an attendee’s personal and institutional buy-in.

3.2.1 Practices to encourage adoption
Each year the workshop organizers designed activities specifically to engender user adoption – while also fulfilling our goal to disseminate broadly and diversely.

Applications. Applications were encouraged from institutional teams of two faculty (from different departments), with the goal of providing “partners” for instructors. Applicants were selected from diverse STEM disciplines and university characteristics (students served, class size, department size, under-represented group representation, etc.). We also asked about the import of research for tenure-track faculty -- to get an impression as to whether participants would be supported not only in adopting UP technology, but in assessing and reporting on its use. Applicants also answered two short answer questions on their definition of active learning and why they valued it in their classrooms. In the first year applicants were asked to describe how they would benefit from the workshop and what skills or strengths they brought to it.

Finally, we attempted to communicate both the expectations and value of the workshop through a series of statements applicants were asked to agree (or disagree) with, such as, “I intend to teach at least 2 courses next year using active learning as the primary classroom pedagogy.” Others asked whether students would have access to required technology, whether the applicant's department would support them in their use of the technology, whether they would agree to obtain IRB approval to study student use of UP, and commitment to pre-workshop meetings.

The primary goal of our detailed application was to indicate the “high bar” we were placing on participation – we felt the appeal of a free Tablet PC would be high and wanted to make clear our expectations for system adoption in at least 2 classrooms.

Pre-Workshop Communication. Pre-workshop contact was minimal in the first year with no required communication. We advised regarding Tablet PC purchases and asked participants to install UP client software before the workshop, though few did so.

Workshop Activities. Workshop activities were designed both to engage instructors with each other in discussion of active learning and how UP might support them in their classes (especially across their disciplines), the workshop format itself employed an active learning format with numerous planned individual and group activities, and time was dedicated to getting instructors set up technically.

Post-Workshop Communication. Post workshop communication involved emails from the leaders to the
participants offering assistance and requests for attendees to complete on-line surveys regarding their UP use.

**Second Year.** Table 2 summarizes changes made in the second year to increase adoption. Overall these changes sought to better prepare people technically and give them greater ownership over (and hopefully commitment to) workshop activities. By putting workshop activities more in the lens of group research activities we hoped to increase engagement during the academic year through research’s natural position within academia.

**Table 1. Workshop Changes To Support Adoption.**

| Application: | Asked more about applicant support/reward by dept/university for making and studying innovation
|             | Asked about specific pedagogical or instructional assessment activities/experience
|             | Exactly which 2 classes will you use UP in, and what is the motivation for using it in those classes?
|             | How many hours per week could you spend on implementing and assessing, what is teaching load?
| Pre-meeting: | Strongly encouraged conference calls (75% attended), required pre-installation of UP (75% complied)
| Workshop:   | Added time for technical help (both providing setup and use training)
|             | Had participants brainstorm their own research questions/studies and then form interest groups (on day 1), which they continued to work in.
|             | Provided much more time (with structured development activities) for the groups to outline what they would do, including filling in and presenting to the group their plan for continuing work after the meeting – including a specific “next meeting” post-workshop conference call date.

4. **RESULTS**

Here we consider both server log information and surveys to give a more explanatory picture of the adoption patterns of these NSF-funded workshop participants. We also compare workshop attendee data to general UP user data.

In general, we can postulate a number of ways in which the NSF workshop participants may differ from other UP users. First, the workshop participants were selected to cover a broad and balanced range of STEM disciplines, in contrast we find that 39% of UP classrooms target computing-related material. Concerns might arise that workshop participants possess less technological expertise than the general UP user. However, our workshop users self-reported a high level of technological self-confidence with 100% of participants reporting they felt “mostly” or “very” confident in using technology, and 92% reporting that they felt mostly/very confident in their ability to use technology in the classroom. It is important to note that only 62% of our workshop participants responded to our survey, which biases the results.

The next difference we might expect between workshop participants and general users is in the level of motivation. Usage data taken from the entire set of UP users reports on those instructors who came to use UP “on their own”. Some may have found the system on the internet, read about it in a conference or lay publication, or possibly attended a short (1-2 hour) introductory workshop. People who sought out UP of their own volition might be more persistent in dealing with technology-related barriers or concerns that arise in using UP. The motivation of our workshop attendees may have varied. It seems likely that they had some motivation, as they were willing to give up three days of their summer to travel to and attend a workshop.

In the recruiting process we expressed preference for interdisciplinary teams of two from each institution, so it is possible that up to half of our attendees were somewhat less interested in UP than their partner colleague from their institution. Additionally, workshop attendees were awarded a grant covering the majority (or all) of the cost of purchasing a Tablet PC so that they could use the UP system. Perhaps some participants were more interested in having a Tablet PC than using UP, specifically. Another possibility is that general users (finding UP on their own) may have likely already had access to a Tablet PC (and were looking for a lecturing system to take advantage of it) and that this meant that their technical skills and comfort in using a Tablet PC were higher than those of the workshop attendees (who were, on the whole, not already Tablet PC users).

Next we present data from the general UP server logs of all users to provide a better context for workshop data.

4.1 **General UP usage**

We have previously characterized adoption rates and differences of UP system users since 2006, based on server usage logs [2]. Here we replicate that, but separate out workshop participants to assess the impact of the workshops compared against overall UP use. We look at usage through the lens of classrooms created, instructors and their use, and student impact (students who “enroll” to view course materials online and who engage by “submitting” via the active learning supports).

Those results showed that UP has been used by 520 instructors affecting 8,348 students in 969 classrooms around the world. Of the 969 classrooms, about 20% regularly use UP in a classroom setting (at least 5 lectures with at least 5 students enrolled on UP for that class). Additionally, 44% of those classrooms make use of the active learning supports of UP (with an average of 5 submissions or more per student).

19% of instructors who registered a login on UP have gone on to actively use UP in at least one classroom (using it for at least 5 lectures, and having at least 5 students register on UP for the course). Of instructors who used UP in a real classroom environment 50% used active learning features such as student submissions (with at least an average of 5 submissions per student). Of the 8,348 students enrolled 3,246 engaged in active learning creating a total of 82,162 submissions. This UP general usage data will serve as a backdrop as we take a closer look at the 2007 and 2008 workshop participants.

4.2 **Workshop Server Results**

There were notable differences between 2007 and 2008 workshop attendees which are highlighted in Table 2. While the 2007 workshop had 5 more participants than the 2008 group, we see much higher engagement numbers across a range of metrics for the 2008 instructors.
The first thing an instructor needs to do is create a classroom. Many classrooms are created by users who are testing the system and are never used live in a classroom. There were a total of 130 classrooms created by workshop attendees 58 by the 2007 group and 72 by the 2008 group. Through human inspection we found that 16 (28%), of the 2007 classrooms and 48 (67%) of the 2008 classrooms were used “live”, with real students in the classroom. Additionally, 12 of the 16 classrooms created by the 2007 instructors, and 39 of the 48 classrooms created by the 2008 instructors made significant use of student submissions.

It is also important to look at individual instructor success when determining the success rate of the workshops. We found that of the 25 instructors from 2007 only 6 succeeded in using UP live in the classroom, while in 2008, 14 of 20 instructors succeeded. Also, of those combined 20 instructors using UP in the classroom, 13 chose to use UP in a second class. This is interesting to note since while only 44% of instructors adopted the technology for classroom use, 65% of those who succeeded at using UP in one classroom decided to use UP in future classes.

Another notable difference between the two workshop groups is the number of students impacted, with 521 student enrolled in classrooms created by 2007 instructors and twice that number of students impacted, with 1,049 student enrolled in classrooms created by 2008 instructors.

Table 2. 2007 and 2008 workshop usage statistics compared with general UP usage.

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>All Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classrooms created</td>
<td>58</td>
<td>72</td>
<td>969</td>
</tr>
<tr>
<td>Non-test classrooms (%)</td>
<td>(28%)</td>
<td>(67%)</td>
<td>(20%)</td>
</tr>
<tr>
<td>Active learning classrooms (%)</td>
<td>12</td>
<td>39</td>
<td>84 (43%)</td>
</tr>
<tr>
<td>Instructors (%)</td>
<td>25</td>
<td>520</td>
<td></td>
</tr>
<tr>
<td>Instructors using UP in the classroom</td>
<td>6</td>
<td>14</td>
<td>100 (19%)</td>
</tr>
<tr>
<td>Instructors using active learning in classroom</td>
<td>3</td>
<td>9</td>
<td>50 (50%)</td>
</tr>
<tr>
<td>Students enrolled</td>
<td>521</td>
<td>1,049</td>
<td>8,348</td>
</tr>
<tr>
<td>Students engaged in active learning (submitting)</td>
<td>445</td>
<td>619</td>
<td>3,246 (39%)</td>
</tr>
<tr>
<td>Number active learning exercise answers (submissions by students)</td>
<td>1,317</td>
<td>10,647</td>
<td>82,162</td>
</tr>
<tr>
<td>Average Submissions per student</td>
<td>3</td>
<td>17</td>
<td>28</td>
</tr>
</tbody>
</table>

4.2.1 If at first you don’t succeed

It is also important to look more closely at those instructors who never succeeded in using UP in their classrooms. They invested varying levels of effort regarding how long they tried before they gave up. We call each of the unused classrooms created by a user a “try” (often test classrooms made to explore system use). Figures 1 shows the differences in use across the years (note that “successful” instructors are included).

In 2007, 7 attendees never made a classroom while in 2008 that number was only 2. The 2007 group invested much less effort before discontinuing use with 10 giving up after one try (classroom creation), 2 giving up after 2 tries and one giving up after 3 tries. It should be noted that all participants should have (but didn’t necessarily) make a classroom before or at the workshop. The 2008 group was more resilient, with only one participant giving up after a single try, and 6 after two or more tries.

Figure 1. Workshop Adoption Rates

4.3 Workshop Survey Results

In addition to the data collected via server logs we also requested that attendees from both years participate in online surveys to help our understanding of why they chose to use or not use the system. Of the 45 total instructors that attended the workshops 28 (62%) participated in the online surveys. From these we identified 4 common barriers to adoption and 2 common circumstances that encouraged adoption.

4.3.1 Barriers

Barriers to adoption are critical to identify because when left unaddressed their presence can result in an otherwise well-designed workshop having minimal impact.

Technological Support. Lack of technological support was by far the most cited reason for not using UP in the classroom. This is despite the fact that all survey participants self-identified as “mostly” or “very” confident in their own technological ability. Many cited technological barriers that were outside their range of control such as “[Our] classroom environment [has] limited access or no access to Internet” and “none of my students have tablets, and many (most) don’t bring laptops to class”. These comments are interesting since those specific factors were asked about in the application process (where they were indicated not to be a problem). Surprisingly, 54% of survey participants indicated that it was difficult to get classes scheduled in technologically appropriate rooms. These barriers exist at the institution level and are hard for instructors to change.

Lack of Institutional Support. Some institutional support was intended to be built into the workshops in that institutional pairs

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1 For workshop attendees we manually determined non-test classrooms. To get the usage numbers for all users we selected classrooms with at least 5 students and 5 lectures.
of attendees were recommended. Still, many felt alone in trying to use UP in the classroom. Respondents stated they would have used UP more “if other faculty around me were more supportive of technology use in the classroom.” They also said “lack of supportive environment within faculty at my home institution” discouraged use. 57% said they had not met with another UP-supportive environment within faculty at my home institution” of technology use in the classroom.” They also said “lack of workshops should additionally focus on IT personnel who will be technological support can be critical and may indicate that [IT person], were very familiar with it”. This level of technological problems “in large part because my colleagues and credited their success to their IT person, saying they didn’t have Perceived Time Commitment. 29% of survey respondents said would have used UP more if someone else in the department was using it too.

Perceived Time Commitment. 29% of survey respondents said the perceived time commitment of UP moderately or significantly deterred them from using the system. Specifics mentioned include “time to update slides was prohibitive to using UP in the classroom” and “time to prepare for uploading [and] editing.”

Other Technology. Four study participants used other active learning teaching technologies adopted by their university (which resulted in them not using the UP system). This is not a barrier in terms of supporting student engagement with active learning, but it is a barrier to specific tool dissemination and reinforces the importance of institutional support.

4.3.2 Positive Influences
There were also influences positively affecting instructor adoption reported in the surveys.

Good Technology Support. Instructors who reported that they had good technology support at their home institution felt more confident about using UP in the classroom. One instructor credited their success to their IT person, saying they didn’t have technological problems “in large part because my colleagues and [IT person], were very familiar with it”. This level of technological support can be critical and may indicate that workshops should additionally focus on IT personnel who will be supporting instructors.

Community. “I worked in the team of other faculty who attended the workshop. Together we were helping each other.” This respondent reflected our original goal of having pairs of participants support each other, but only one response of this type was noted.

4.3.3 Suggestions
In addition to asking participants to reflect on their own UP usage, we also asked them what suggestions they had for future workshops. A common suggestion was to devote more time to the introduction of the UP system. Of the participants who responded to the survey 90% had never used UP before and over 50% had never used a Tablet PC before. Both workshops included a session on learning to use UP, but respondents requested more time devoted to basic training at the expense of sessions on more general topics such as integrating active learning in the classroom. Several respondents suggested including practice presentations where they could practice using UP in front of each other (though at least one such opportunity was offered each workshop, not everyone managed to accomplish this). There were also requests for more follow up after the workshop with instructors to see how well they were doing at using the technology in the classroom and to offer advice when instructors had trouble.

5. DISCUSSION
Were these workshops successful? Is a 44% adoption rate a reasonable expectation for a project of this scope? What about a 22% adoption rate (which reflects those instructors who actively used UP for active learning – the stated workshop goal)? Is it still reasonable considering the investment per instructor, which included typical workshop costs plus $1600 towards a Tablet PC purchase? Ni reports one workshop-based effort to get teachers to adopt new curriculum [9]. They surveyed 36 summer workshop participants, 24 (67%) responded. Of respondents, 63% reported adopting or adapting workshop curricular materials. Making the most pessimistic assumption of non-respondents, the adoption rate would be similar to ours -- 42%. We hope to see more reports of adoption rates so that as a community we can develop a better understanding of what methods are successful in diffusing innovations.

Workshop Specific Recommendations. There are several observations we make concerning increasing the potential positive impact of faculty professional development workshops:

1) “Pre-meetings” can be an effective means to help get participants ready for a workshop – serving both to ensure they have done necessary technical and educational set-up, as well as helping them to get excited about the workshop to follow.

2) In order to increase response rates of participants concerning post-workshop work, it is important to repeatedly e-mail reminders to participants to complete surveys as well as following up with phone calls. Understanding regarding these commitments should be outlined at the time of application.

3) It is important for potential workshop organizers to realize the difference between a “one and done” workshop versus continual support. Clearly the latter is more effective (and helps more to build community among participants), but can be significantly more expensive (in terms of money and personnel) to implement. Future grant proposers should be aware of the differences.

4) Having institutional “partners” for closer institutional support still seems valuable, but perhaps within department pairs would be better or groups (2-5?) of faculty with a support IT person.

5) When considering participants from research-intensive institutions (who, in this case were quite likely to have greater benefit from the use of UP), it is important to know if such an activity will count towards promotion/tenure for the faculty member in terms of teaching and/or research (reporting on the effectiveness of the intervention).

6) Offering desirable “free stuff” can lead to faculty applying to attend a workshop for other reasons than improving student learning. In our case, it was necessary to offer faculty Tablet PCs, but this can be a problem.

7) It is essential to make clear what technology is needed, and to ensure that workshop attendees do have sufficient technology in the classrooms in which they’ll be teaching and are comfortable using it.

8) It is hard to differentiate potential workshop attendees who are “innovators” (using Moore’s [7] terminology) and who will overcome all technological hurdles at their home institution from those who are “early adopters”, who won’t. Workshop developers should be clear which group they are seeking to target.

Metrics for Measuring Diffusion. In a sense, measuring adoption of an innovation like the UP system is relatively easy. Because all use was logged on our server, we could effectively get data from all attendees, whether they elected to respond to us (via survey) or not. But the variation in use we saw emphasizes that innovation adoption is not a binary event. Variations on use, use
in restricted forms, use of features (be they key or not) – are all important to recognize and assess. As we consider more global innovation diffusion metrics and data which would help describe the impact of various types of innovation diffusion techniques, we urge the community to consider:

- Define adoption (in various forms). How many courses did it impact? Was adoption maintained? Were there any 2nd-order adoption effects (e.g. others the adopters inspired)? Do you have a reliable source for measuring adoption?

- What kinds of adopters is your diffusion method targeting? Innovators (who are always trying the next thing), early adopters (who are looking to make lasting change using something new)? Is there support for 2nd order effect adopters – which could be a result of a train the trainers model or simply local diffusion enabled by an adopter.

- What were the goals of your recruitment methods? How well were they met? Did your recruitment attract the appropriate adopters? How did your recruitment affect diversity?

- How many students were impacted, and what was the “depth” of the impact? How many “learning hours” did this affect? Did variation in use among adopters affect the impact on students and how can that be used to guide adoption practices in the future?

- What are the barriers to adoption? Can you give both quantitative and qualitative descriptions of these barriers and their importance? What recommendations can you make for overcoming them?

- What was the cost of your method? What was the monetary cost per adopter? What was the cost in terms of required time commitment of adopter, both in “training” and in “deployment”? What was the cost to the trainer/disseminator?

6. CONCLUSIONS

This case study of two single-instance workshops found that the rate of instructor adoption can vary greatly depending on recruiting methods and workshop design (including pre-workshop events). We found that encouraging participants to make commitments in the application process increased the chances that the participant would later use the technology in the classroom.

We found that the workshops increased instructor usage by 20% and had a stronger increase in use of active learning features (in terms of instructors using active learning) when compared with the adoption rates of general users. However, we also found that non-workshop users who used active learning, used it more pervasively, with non-workshop active learning courses averaging 28 submissions per student over the course. This is in contrast to an average of 3 submissions per student in the 2007 courses, and 17 submissions per student in the 2008 courses.

Though pervasive active learning use was lower, overall general adoption rate by participants in the workshop was 44%, comparable to the rate reported by Ni [9]. We would encourage others disseminating through workshops or other forms to report on their successes and contribute to a more robust body of knowledge in this area.

7. ACKNOWLEDGMENTS

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8. REFERENCES


