Collaborative Research: Supporting Pedagogical Innovation for a Generation of Transformation via Inquiry-Based Learning in Mathematics (SPIGOT)

Evaluation Report: Workshop 1 at California Polytechnic State University, San Luis Obispo, June 24-27, 2013

Charles Hayward and Sandra Laursen
Ethnography & Evaluation Research, University of Colorado Boulder
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Executive Summary

Overall, workshop participants were quite satisfied with the quality of the workshop. Initially, they believed in the value of inquiry-based learning (IBL) and were highly motivated to use it in their own classrooms. About half indicated that they had tried IBL techniques, but they still largely relied on traditional teaching practices. After the workshop, participants reported stronger beliefs in the effectiveness of IBL, as well as increased knowledge and skills.

Participants said the facilitators were approachable and knowledgeable, and cited the variety of shared experiences from staff members as the aspect that most helped support learning. Participants enjoyed all sessions, but especially liked the collaborative work sessions in which they were able to develop materials for their own IBL classes along with peers and experienced staff members. Most of the suggested improvements were about logistics such as the quality of the food or size of the workshop room. However, some participants did want more examples of IBL in non-proof-based classes. Others felt that vocal individuals tended to dominate discussions and that the reporting back after breakout groups was tedious.

Prior to the workshop, participants expressed concerns about implementing IBL in their classrooms, although they were highly motivated to do so. After the workshop, participants were still highly motivated, and some of their concerns subsided. Some concerns remained, especially student resistance, which should be addressed in post-workshop mentoring. Participants reported that they both wanted and were likely to participate in post-workshop e-mail mentoring in order to help them successfully implement IBL in their own classrooms. Almost all participants indicated that they plan to implement IBL in the coming year.

Project Overview

Inquiry-Based Learning (IBL) is a student-centered approach to learning. In contrast to the traditional lecture methods, IBL puts the focus of learning on student creation, exploration, communication, and criticism of ideas, while still under the guidance and support of faculty. The techniques of instruction shared in this project are founded on methods used by the late R. L. Moore, but are generally consistent with the current scholarly understanding of how people learn.

The present project, funded by collaborative awards from the National Science Foundation, seeks to disseminate the use of IBL as an effective method of teaching college mathematics to a wide range of mathematics instructors, especially early-career faculty. To achieve this goal, the project provides hands-on, intensive, professional development workshops for faculty interested in learning about and trying out IBL methods. The Academy of Inquiry Based Learning at California Polytechnic State University, San Luis Obispo (Cal Poly), is the project lead, and practitioners from the IBL community have participated as presenters, panelists and facilitators at the workshops.

The workshops are designed to introduce participants to the IBL style of instruction and show them how to teach a course that has been fully developed in that style. The workshops are intended for participants new to IBL, but who may or may not have had some previous experience with IBL techniques. Preliminary readings and videos, the intensive week-long workshops, shared written and/or electronic materials, and post-workshop mentoring are all aimed at stimulating mathematics faculty to offer inquiry-based courses at their own institutions. After the workshop, organizers plan to connect participants to a mentoring support system to help them as they implement these ideas in their own classrooms.

In this report, we provide data on the first workshop of this project, held in June 2013 at California Polytechnic State University, San Luis Obispo. We report workshop outcomes and formative feedback to the project team for use in planning subsequent workshops. When all workshops have been completed, we will pool the data and conduct more detailed analyses.

Introduction and Data Set

Over the four day workshop, participants watched videos, read and discussed research articles, heard plenary talks, and participated in panel discussions with experienced IBL instructors. Additionally, large portions of each afternoon were designated as work time so that participants could develop materials in order to teach their own inquiry-based courses. During these sessions, participants were divided into workgroups whose members planned to teach the same course and were guided by experienced staff members who had already taught a similar course using IBL methods. Prior to the workshop, participants prepared by reading articles and viewing online videos.

Participants were asked to pre-register online and complete a brief survey; a similar survey was administered on the final day of the workshop. All forty-two participants completed the pre-workshop survey and the post-workshop survey. All forty-two participants' pre- and post-workshop responses were matched using unique, anonymous identifiers.

Both surveys included quantitative items and open-ended questions. Likert-scale items were developed to reflect participants' knowledge, skills, and beliefs about inquiry teaching, as well as their motivation to use inquiry methods and their perceptions of the overall quality of the workshop. For example, on both pre- and post-workshop surveys,

participants assessed their current knowledge of IBL in math education on a scale of 1 to 4 (1=None, 2=A little, 3=Some, and 4=A lot). Open-ended questions addressed the costs and benefits of using inquiry strategies, participants' impressions and learning from the workshop, and how they may use that learning in their own educational activities. Participants reported personal and professional demographic information such as career stage, institution type, gender, race and ethnicity so that we can analyze for differences between groups. They also provided some unique identifiers that could be used to match pre- and post-workshop responses on the anonymous surveys. Some items were adapted from prior evaluations of faculty development by our group (ReSciPE, Resources for Scientists in Partnership with Education) and other items were developed based on discussion with workshop leaders about their goals and expectations for workshop attendees; most had been previously applied in prior workshop evaluations (Hayward, Kogan, & Laursen, 2012). The study design and instruments were approved by the CU Boulder Human Research Committee. In addition, one evaluator (CH) attended the workshop as a participant-observer.

This brief report examines the results from analysis of the pre- and post-workshop surveys for the 2013 workshop. After all of the workshops have been completed, the data will be combined and a more detailed analysis will be conducted on the larger sample.

Methods

Responses to numerical items were entered into the statistical analysis program SPSS (IBM Corp., 2012), where descriptive statistics were computed. Means and standard deviations were computed for some of the ratings items, and frequencies were computed for all of the items. Several participants left some items blank; these responses were omitted in calculating means and standard deviations for survey items. Pre- and post-workshop responses were matched using unique identifiers, which allowed us to test for mean changes in each individual's responses (paired sample comparisons), not just changes in the overall group means. Open-ended responses were entered into MS Excel (Microsoft, 2011) and analyzed for trends based on the frequency of occurrence of common qualitative themes.

Key Findings: Pre-workshop Survey

On the pre-workshop survey, we sought to establish the prior experience and background of the participants. In this section, we report results from items assessed only on the pre-workshop survey, including demographics, initial teaching practices, goals for students, and goals for the workshop. The pre-workshop survey also had participants self-assess their familiarity and skill with IBL teaching so that these could be compared with their self-assessment after the workshop. We report these comparisons in the section *Key Findings: Pre/Post-Workshop Comparisons* on page 13.

Demographics

Overall, pre-workshop survey respondents (N = 42) came from diverse institutional backgrounds and represented a variety of career stages. The largest portion of respondents taught at four-year colleges (52%). Both masters-granting comprehensive universities and Ph.D.-granting research universities employed 19% of participants, and the smallest fraction taught at two-year colleges (10%). Most workshop participants held tenure-track

positions, with 22% tenured and 42% untenured. The rest of the participants were either graduate students (10%) or non-tenure track faculty (27%).[1]

We asked respondents if they worked at a minority-serving institution (MSI), a federal designation for historically Black colleges and universities, Hispanic-serving institutions, and tribal colleges. Just 19% (8 individuals) identified their workplace as an MSI; many respondents (38%) did not know if their institution is classified as minority-serving. It is likely that faculty would be aware of MSI designation as a distinctive institutional characteristic, so we assume that most faculty are not at MSIs.

Workshop participants had varied degrees of teaching experience. Some (12%) were new teachers with less than two years of teaching experience, while the majority (50%) had between two and five years experience. Together, 62% of participants had five or fewer years of experience, meeting the project's goal of enrolling at least 60% early-career faculty. Others were more experienced; 14% had 6-10 years of experience, 10% had 11 to 20 years of experience, and 14% had more than 20 years of teaching experience.

Some participants had prior experience with IBL techniques, having either incorporated them into their teaching methods (46%) or taken a class using them (17%). In total, 18 of the 42 participants (43%) reported no experience with IBL as a teacher or student.

The group was evenly split at 50% male and 50% female. The percentage of women was slightly higher than that among math faculty at four-year colleges as a whole (National Science Foundation, 2008a). Most participants were of European descent (81%), with some attendees of Asian descent (10%), Middle Eastern descent (5%) and African descent (2%). These proportions are about the same as in employed doctoral-level mathematicians and statisticians as a whole (National Science Foundation, 2008b).

Initial Teaching Practices

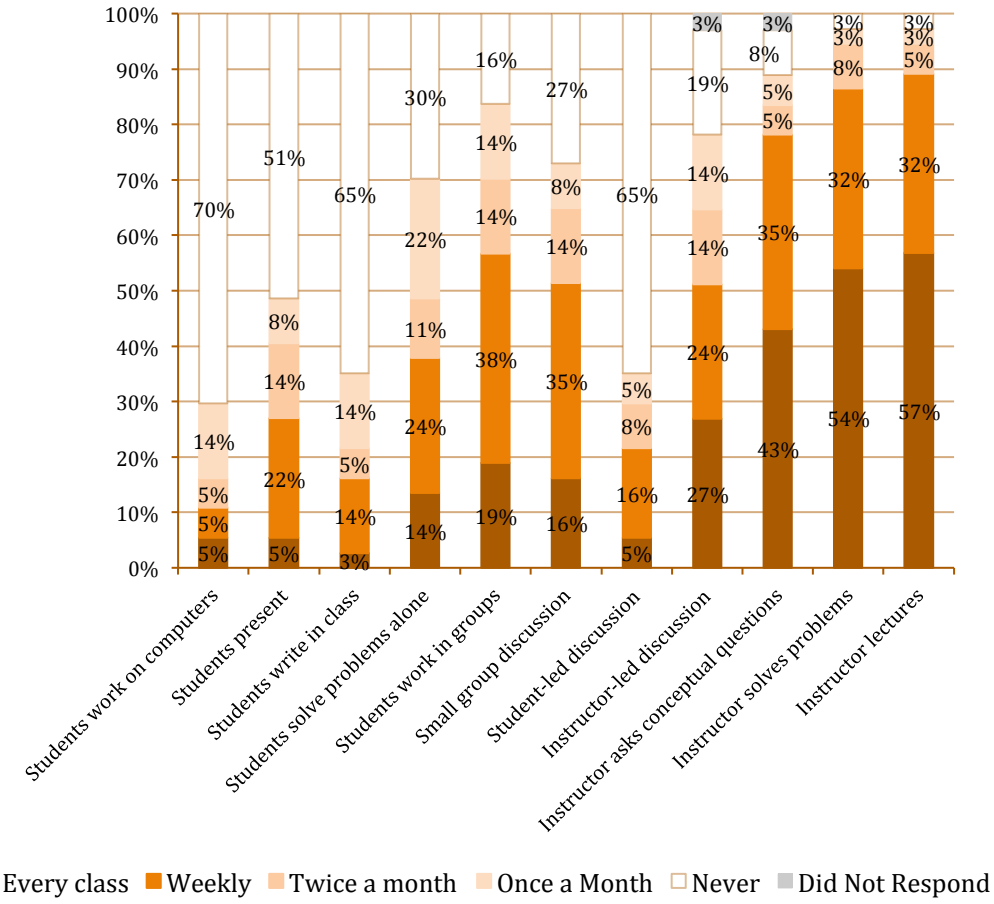
Attendees were asked to rate the frequency of their use of various teaching practices (never, about once a month, about twice a month, weekly, every class).[2] The most commonly reported strategies were traditional teaching methods: 57% of the respondents lectured in every class session, 54% solved problems on the board in each class, and 78% asked students conceptual questions leading to generalizations at least weekly. Student-centered teaching strategies were less common: 65% of respondents never used student-led discussions in their teaching, 51% never had students present problems or proofs, 65% never had students write in class, and 70% never used computers to aid learning.

However, many participants did say that they used some forms of active engagement in their courses at least once a week: 51% of respondents used small group discussion, 57% used collaborative work in small groups, and 38% had students solve problems individually. Thus, while workshop participants' initial teaching practices were generally quite in line with traditional mathematics courses, they also showed some signs of incorporating more active-learning methods. Full results from initial teaching practices are shown in Figure 1. Teaching practices will be measured again on the one-year follow-up survey and compared to these pre-workshop practices.

[1] One participant did not supply this information.

[2] Five participants (12%) did not complete this part of the survey and are not included in these results.

Figure 1. Participants' initial teaching practices.



Goals for Student Learning

Open-ended responses revealed that participants had fairly high hopes for IBL's effect on their students. The most common hope, which over half of the participants mentioned (55%), related to students becoming independent mathematicians rather than passive learners. This included confidence to attempt novel problems, independence in problem solving, communication skills, and ownership for 'doing' mathematics. As one participant said, "I expect them… to appreciate that knowledge, mathematical or otherwise, is not gained through a trickle-down effect from experts, but through hard work, persistence, and creativity." Other specific goals included better mastery of the material (10 comments), deeper conceptual understanding (9 comments), and improved problem-solving skills (6 comments). One participant hoped that using IBL would encourage pre-service teachers to use IBL techniques in their own classrooms.

Attendees also ranked the importance of various student goals on a quantitative scale. Table 1 displays the responses to these questions in decreasing order by frequency of 'the most important' ratings.

Table 1. Goals for student learning.

Goal for students	*Not very important*	*Somewhat important*	*Quite important*	*The most important*
thinking critically*	0%	7%	41%	50%
gaining confidence in doing mathematics	0%	7%	52%	41%
becoming more independent in problem-solving	2%	10%	50%	38%
developing skills in problem-solving	2%	17%	48%	33%
understanding mathematical concepts deeply	2%	19%	45%	33%
understanding the role of proof in mathematics*	17%	24%	33%	24%
communicating mathematics in writing	2%	21%	55%	21%
appreciating the beauty or significance of mathematical ideas*	7%	31%	38%	21%
learning specific mathematical ideas	7%	31%	43%	19%
understanding the nature of mathematics	5%	31%	48%	17%
communicating mathematics orally	2%	33%	52%	12%
applying mathematics to other fields	33%	24%	31%	12%
applying mathematics to everyday life	52%	24%	14%	10%

* One participant did not respond.

Like with open-ended responses, the top three goals here relate to students becoming independent mathematicians. In addition to these rankings, participants could fill in 'other' student learning goals. Three participants responded; two stated they wanted their students to gain math skills that would be applicable for their future careers, and one wanted students to gain a "more confident understanding of the most elementary ideas about numbers, fractions, and the decimal system."

In general, participants cited a broad set of learning goals that were not solely content-focused, but they did not always report using student-centered teaching strategies that are well suited to achieving those goals.

Goals for the workshop

In response to an open-ended prompt, participants shared what they hoped to gain from the workshop. The most common type of response was general IBL learning, such as "learn about IBL" or "learn how to implement IBL in my classes" (19 responses, 45%). While these responses are not necessarily informative, the lack of specificity speaks to the novice status of these participants and their general lack of knowledge about IBL. (Participants' impressions of their own level of knowledge are discussed later in the section *Knowledge About Inquiry-Based Learning* on page 13.)

The second most common type of response was specific skills or knowledge related to implementing IBL (16 responses, 38%). These included developing IBL-appropriate curricular materials (10 comments), how to implement IBL in lower-level or non-proof-based courses (8 comments), how to achieve student buy-in (7 comments), how to assess students in IBL classes (4 comments), and how to get students to participate (3 comments). These comments indicate some familiarity with IBL and the new teaching decisions that come with implementing it. In addition, four participants wanted to establish connections with other instructors using IBL, both beginning peers and experienced experts.

Key Findings: Post-Workshop Surveys

Post-workshop surveys were collected in person on paper forms on the final day of the workshop. All 42 participants completed the post-workshop surveys, which were matched with their pre-workshop responses using unique, anonymous identifiers. Hence, all 42 responses are included in this section on post-workshop findings, as well as in the next section on pre-/post-workshop comparisons.

The post-workshop survey asked participants to respond to items about the quality of the workshop, their expectations for using IBL in their own classes, and concerns about implementing IBL. Results from these items are reported in this section. As on the pre-workshop survey, participants self-assessed their familiarity and skill with using IBL. The results of these comparisons are presented in the next major section, *Key Findings: Pre/Post-Workshop Comparisons*.

Overall Quality of the Workshop

Participants rated the overall quality of the workshop highly. The majority (73%) rated the workshop as 'excellent' and the rest rated it as 'good' compared to other professional development workshops that they had attended. Five participants left the item blank. Participants rated the logistics of the workshop on the same scale. Most of the participants (50%) rated the logistics as 'good.' Full results for these two items are presented in Table 2.

Table 2. Quality ratings.

	Poor	*Below average*	*Fair or average*	*Good*	*Excellent*
Compared to other professional development workshops that you have attended, please rate the OVERALL quality of this workshop	0%	0%	0%	27%	73%
Please rate the LOGISTICS (food, facilities, timing, length, breaks, etc.)	0%	2%	17%	50%	31%

In an open-ended response, participants were asked to explain their ratings. Thirty-seven participants responded and were coded for general themes. While most comments were about the workshop itself, two mentioned pre-workshop e-mails. One said that providing materials and information well in advance allowed sufficient time to read and absorb. However, another participant found it difficult to find needed information because there were too many e-mails.

The most common theme, expressed by 13 participants, was that the schedule was well planned and effective. Participants highlighted the variety of activities as both a great learning experience and a good way to stay engaged during long, very active days. The frequency and length of breaks helped participants to avoid burnout and provided opportunities for informal networking with colleagues. One participant hoped for more networking opportunities and suggested scheduled group outings. One other suggestion was to provide slightly more time during lunch to account for the 15-minute walk to and from the dining hall.

The second most common theme was the meals provided at a campus dining hall. Eleven participants expressed concerns including poor quality, too much salt, a lack of variety, and not enough vegan or vegetarian options. However, some couched their statements by saying these were minor concerns, that they weren't there for the food, or that they still appreciated that it was included in the cost of the workshop.

Facilities concerns were also fairly common, with six negative comments and three positive comments. Some felt that the provided beds were too hard, however others liked the lodging and noted that the rooms were comfortable and private. Others noted that the workshop room was small, crowded, and hot.

While many of these concerns may be a matter of personal preferences, there did seem to be a more general consensus that power (8 comments) and Internet (9 comments) outages were frustrating. However, participants noted that these were largely out of the control of organizers and that the staff responded well despite the unforeseen circumstances.

In fact, eight participants commented on the high quality of the staff. One participant stated that throughout the planning and entire workshop "I felt very taken care of." Participants appreciated the broad experience of the staff and cited formal and informal discussions with staff as valuable learning experiences, which we discuss in more detail in the next section.

Workshop as a Learning Experience

In addition to rating the overall workshop and the logistics, participants responded to two open-ended questions about the workshop as a learning experience. They were asked to comment on the two best aspects of the workshop and the two aspects that most needed improvement. Participants also had a chance to provide any additional comments they wanted to add.

Best aspects

All 42 participants responded, and over half (24, 57%) cited the staff as a whole as one of the best aspects of the workshops. Participants appreciated the variety of experiences that the facilitators shared throughout the workshop. In fact, five participants specifically said that they liked seeing different varieties of IBL and different perspectives, rather than one 'right way.' Participants also noted that staff members were approachable and helpful, especially for instructors new to IBL. In addition to staff, participants also liked being able to collaborate with their peers (14 comments). As one participant explained,

> *The workshop was fabulous. It was a good-sized group of participants with plenty of facilitators with different experiences to share. There was clearly a lot of thought put into the activities, all of which were immensely helpful and helped me move easily and smoothly from someone who had no idea what IBL was really about to someone with the tools and confidence to start planning what I hope will be a successful course.*

Specific sessions were helpful to participants. The largest group of comments (14) was about the afternoon content planning sessions. Participants liked that this time allowed them to engage with peers and experienced IBL practitioners in order to walk away with concrete materials that they could use in their own classrooms. Eleven participants found the video sessions useful to see what IBL looked like in action and also to understand some of the mechanics of an IBL classroom, especially what to do when a student presentation does not go well. Others mentioned that panel discussions were informative, efficient, and well moderated (7 comments). Again, they liked the variety of viewpoints and found discussions about marketing and potential problems when implementing IBL especially helpful. Three participants found Dylan Retsek's plenary talk 'inspiring' and two participants said that the Nuts and Bolts sessions were the most helpful.

Areas for improvement

Thirty-five participants (83%) responded to the prompt about which aspects most needed improvement. Most of the suggestions (11 comments) involved logistics; five participants mentioned that the room was too crowded and too loud, and suggested having more options for smaller breakout groups. Other comments were about the quality of the provided food and the long walks to the dining hall or downtown. Also, some participants commented on the discussions (6 comments). Two felt that the process of reporting back to the whole group after small breakouts was tedious, and one person each mentioned that vocal individuals sometimes dominated discussions, participants were sometimes off-task, discussions focusing 'only on the positives' were not as effective as those about specific topics, and that it would be beneficial to hear more from 'staff experts' and less from attendees.

Participants also commented on content-related aspects of the workshop. Seven participants wanted more examples of IBL in non-proof-based courses, specifically calculus or college algebra. Three mentioned that they would have liked to know more about addressing potential problems when implementing IBL. For example, one suggested

addressing what to do if a student complains to a dean or department chair. Three other participants suggested providing more options for splitting up during discussion. One felt that discussions could split proof-based courses from calculus and lower-level courses because they are very different. Another suggested having breakout sessions during content planning time so that participants could instead have their questions answered or discuss topics such as IBL in large classrooms if they wanted to. During the workshop, organizers did discuss using IBL in non-proof-based courses, addressed potential problems when implementing IBL, and held a breakout group for using IBL in larger classes. Therefore, these comments likely indicate that participants wanted more time devoted to these topics and not that they were completely unmet needs.

Some participants also mentioned the videos (3 comments). One found them hard to see and hear, one wanted to see complete class sessions with multiple angles to also view students, and one found the pre-workshop videos too long and 'hard to engage with.' Organizers are currently working on a project to obtain more and higher-quality classroom videos, which should help alleviate these problems in future workshops.

Overall, the variety of improvements offered and lack of a clear consensus suggests that there were no significant deficiencies with the workshop and that many of these concerns are likely from differences in personal preferences. Despite difficulties with Internet and power outages and the lack of Wi-Fi in the dormitories, only two participants mentioned these logistical challenges as needing improvement. It is likely that the staff's ability to adapt to these circumstances outweighed the problems. In fact, in an open-ended 'additional comments' prompt, fifteen participants praised the staff, with one saying they "worked very hard to help everyone have a positive experience even when things out of their control made life challenging" and another was "impressed by the staff's ability to work around the logistical problems of the first day."

Concerns About Implementing IBL

Forty-one participants shared their lingering concerns about implementing IBL in their own classrooms. The greatest concern (23 comments) was student resistance. Participants were worried that students would not like IBL methods and would struggle to stay motivated and engaged if they are responsible for making meaning of the content themselves. Instructors expressed concern that they would not be able to get students to 'buy in' at the beginning of the course and would set themselves up for a rough semester of continually defending IBL. Five of these participants specifically worried about how student resistance would affect their teaching evaluations, and subsequently, renewal and tenure decisions.

The second most common concern was coverage (10 comments). Participants were worried that they would not have the time to teach all of the topics they needed to, especially if they had a departmentally mandated curriculum or taught a course that served as a prerequisite for other courses. However, two participants noted that they were "less concerned than before the workshop" and that "it's not as important an issue as I thought of it, compared to the benefits."

Concerns about time/workload and lack of skill to implement IBL were each noted by 8 participants. Concerns about time and workload related to the extra time required to prepare materials appropriate for an IBL classroom. Instructors were also worried that they might not be able to manage everything in a dynamic IBL classroom. As one participant put it, "I have great doubts about my abilities to manage, track, and respond to all the complexities in the classroom."

Three participants were worried that student may be less successful with IBL techniques. Specifically, they mentioned that IBL might be more difficult for English-language learners, shy or nervous students, and students with lower abilities. Additionally, two participants worried that colleagues might object to teaching "outside the norm," and one was unclear where to get IBL materials.

All of these issues were addressed during the workshop, but participants were still concerned about them. These topics offer suggestions for discussions that may be useful to participants during post-workshop mentoring, which is further discussed in the section *Support and Keeping in Touch*.

Likelihood of Implementation

Participants reported their likelihood of implementing IBL in the coming academic year, and if not this coming year, sometime in the future. Responses are reported in Table 3.

Table 3. Likelihood of implementing IBL.

Timeframe	*Did not respond*	*Not at all likely*	*Somewhat unlikely*	*Somewhat likely*	*Rather likely*	*Definitely*
In the coming academic year*	0%	0%	2%	2%	14%	81%
If not this year, in a future year*	43%	0%	0%	0%	10%	48%

* Percentages do not add to 100% because of rounding.

Most participants (95%) reported that they will likely implement IBL in the coming academic year, and more than half (57%) reported a high likelihood of implementing in the future, if not this coming year. Participants also provided some information about the class that they intended to implement IBL in. Most frequently, they planned to use IBL with mixed STEM majors (46% of responses), in small classes of 20-35 students (38%), and with mainly freshmen (30%) or sophomores (30%).

In addition to the likelihood of implementing IBL, participants commented on how the workshop may influence their future teaching in other ways. The most common response (16 comments) was that even if they continue to lecture, they would be more focused on what students are learning, rather than just what they are teaching. Participants also mentioned that they had formed good relationships with staff and peers (7 comments) that they planned on maintaining and using to help them to continue to develop as instructors.

Support and Keeping in Touch

On four items, participants reported their likelihood of participating in various post-workshop mentoring activities. Results are presented in Table 4.

Table 4. Likelihood of participating in post-workshop mentoring activities.

Mentoring activity	*Not likely to participate*	*Somewhat likely to participate*	*Very likely to participate*
Email listserv for exchanging ideas and getting advice from other workshop participants & facilitators*	10%	36%	55%
Email list for receiving articles, web links, and other resources from facilitators	5%	26%	69%
Web-based discussion board or chat room*	33%	50%	18%
Occasional personal phone call or e-mail from facilitators*	10%	38%	53%

* Percentages do not add to 100% because of rounding.

Participants reported high likelihoods of participating in e-mail lists and occasional personal phone calls or e-mails, but less likelihood of participating in a web-based discussion board or chat room. For e-mail lists, participants reported that they were more likely to participate in a list where they receive resources from facilitators, rather than one for exchanging ideas with other participants as well as facilitators. Since both of these activities can be accomplished on the same list, it seems important that facilitators take an active role on the post-workshop e-mail list.

In open-ended feedback, many participants felt that having others to bounce ideas off of and get advice from (26 comments) would be the most helpful support. Some wanted access to others using IBL in the same course or a similar institutional context, some wanted continued mentoring by the facilitators, and some just wanted somebody to commiserate with when things go badly. Others wanted example IBL materials (10 comments), or time (3 comments) or money (4 comments) to develop materials themselves.

Key Findings: Pre/Post-Workshop Comparisons

Four items were assessed on both pre- and post-workshop surveys. In these items, participants expressed strong beliefs in the value of inquiry strategies and high motivation to use inquiry-based methods in their own practice. Table 5 compares pre- and post-workshop responses that suggest changes in respondents' ideas due to the workshop. Below, we discuss highlights from these results.

Table 5. Immediate workshop outcomes.

Survey item domain	Survey	Frequency of response, by category				Mean (of 4)	Stat. Signif. of pre/post change
		None	*A little*	*Some*	*A lot*		
Knowledge about inquiry	Pre	2%	57%	38%	2%	2.40	$p<0.001$
	Post	0%	5%	57%	38%	3.33	
Skill in inquiry-based teaching	Pre	36%	45%	19%	0%	1.83	$p<0.001$
	Post	7%	38%	55%	0%	2.48	
		Don't know	*Not very effective*	*Somewhat effective*	*Highly effective*		
Belief in *effectiveness* of IBL	Pre	7%	0%	38%	55%	3.40	$p<0.010$
	Post	0%	0%	21%	79%	3.79	
		Not at all	*A little bit*	*Somewhat motivated*	*Highly motivated*		
Motivation to use IBL	Pre	0%	0%	24%	76%	3.76	$p=0.599$
	Post	0%	2%	14%	83%	3.81	

Knowledge About Inquiry-Based Learning

On the pre-workshop survey, most participants indicated knowing 'a little' (57%) or 'some' (38%) about IBL. Only 2% indicated knowing 'a lot.' However, on the post-workshop survey, most participants indicated knowing 'some' (57%) and 38% stated they knew 'a lot.' The pre-workshop mean rating of 2.40 (on a 4-point scale) rose significantly to a post-workshop mean of 3.33. Comparing pre-workshop to post-workshop responses, 31 participants increased their rating of their own knowledge about IBL and 11 did not change. No participants reported decreased ratings.

Skill in Inquiry-Based Learning

The largest group of participants indicated having 'a little' skill (45%) on the pre-workshop survey. But on the post-workshop survey, this rose as 55% of participants indicated having 'some' IBL skill. The pre-workshop mean rating of 1.83 rose significantly to 2.48 on the post-workshop survey. Comparing pre-workshop to post-workshop responses, 22 participants increased their rating of their skill in inquiry-based teaching, 18 did not change, and 2 decreased.

Participants' reported inquiry-based teaching skills were lower than their reported IBL knowledge, and reported gains in teaching skills were less than gains in knowledge. This is understandable, since at the time of the post-workshop survey, attendees had not yet had a chance to practice the newly learned techniques.

Belief in Effectiveness of Inquiry Strategies

Participants entered the workshop with already strong beliefs in the effectiveness of IBL: 55% reported believing IBL is 'highly effective' and 38% believed it is 'somewhat effective.' Attendees left the workshop even more persuaded: all respondents reported believing IBL is either 'somewhat' or 'highly effective,' with 79% in the latter category. Thirteen participants indicated strengthened beliefs from pre- to post-workshop surveys, while 26 did not change, and 3 participants reported weakened beliefs in IBL's effectiveness.

Motivation to Use IBL

Participants started the workshop already motivated to use inquiry-based teaching, with 83% indicating that they were 'highly motivated.' This is not surprising for faculty who chose to attend a four-day IBL workshop. Motivation did not significantly change from the pre-workshop survey to the post-workshop survey; it remained steadily high. Of the 42 participants, 28 reported the same level of motivation, 8 reported increased motivation, and 6 reported decreased motivation. One individual dropped from 'somewhat motivated' on the pre-workshop survey to 'a little bit' motivated on the post-workshop survey. All of the other changes in ratings were from 'somewhat motivated' to 'highly motivated' or vice versa, suggesting that almost all participants were motivated to use IBL prior to the workshop and remained motivated afterwards.

Concerns About Implementing IBL

On both pre- and post-workshop surveys, participants reported their concerns about implementing IBL. While we have already explored post-workshop concerns in order to inform continuing mentoring, here we compare pre- and post-workshop concerns as another way to evaluate how well the workshop met participants' needs. Full results are presented in Table 6. The first two columns for each concern show the *total* number of comments expressing each theme on pre- and post-workshop surveys. The next three columns compare each individual's pre- and post-workshop responses. *Raised* concerns were not mentioned on their pre-workshop survey, but were on the post-workshop survey. *Dispelled* concerns were present on their pre-workshop survey, but no longer present post-workshop. *Lingering* concerns were reported on both pre- and post-workshop surveys.

Table 6. Comparison of pre- and post-workshop concerns.

Area of Concern	*Pre-workshop comments*	*Post-workshop comments*	*Individuals' Concerns*		
			Raised	*Dispelled*	*Lingering*
Increased time/workload	3	8	6	1	2
Harder to cover material	12	10	7	9	3
Student resistance to IBL	24	23	8	9	15
Lower evaluations	3	5	3	1	2
Difficult to find or make IBL appropriate materials	4	1	1	4	--
Lack of skill to implement IBL	6	8	6	4	2
Relinquishing classroom control	3	0	--	3	--
Hard to find balance of IBL and traditional methods	5	0	--	5	--
Lower student success	7	3	2	6	1
Resistance from colleagues	3	2	1	2	1
Average coded themes per participant	1.71	1.46	*Totals* 34	44	26

Patterns in participants' concerns reveal some interesting trends. Student resistance was the biggest concern on both pre- and post-workshop surveys and was a lingering concern for 15 participants. Instructors new to IBL often have doubts about whether or not they should use IBL instead of traditional lecture methods. These concerns seem to have been largely addressed, as evidenced by dispelled concerns about relinquishing control and balancing IBL and traditional methods, as well as a reduction in participants' worries about student success.

Some concerns were dispelled for many participants since they did not mention them again on the post-survey. The two best examples of this were student resistance and coverage of material. Concerns about student success were also dispelled for a relatively large number of participants. These are some of the big hurdles that keep instructors from starting to implement IBL, whereas some of the other concerns can be managed once they are already implementing it. So, properly addressing these concerns may make it more likely that participants will implement IBL. This hypothesis should be analyzed on follow-up surveys. Another big hurdle is getting IBL-appropriate course materials, but the reduction in concerns about materials suggests that the workshop was successful in its strategy of providing collaborative time and space, as well as numerous samples of materials, so that participants could leave with materials in hand. It is also encouraging that overall, the average number of concerns mentioned dropped slightly from pre- to post-workshop.

Some new concerns were raised for many participants, including increased time commitment and workload, coverage issues, student resistance, and lack of skill to implement IBL. One possible explanation is that these concerns may have been present pre-

workshop, but were overshadowed by more pressing concerns like instructors' own doubts. Another possible reason for these new concerns is that as participants gained more familiarity with IBL, they may have also gained a better understanding of the challenges that come along with it and the expectations for themselves as instructors.

Conclusion

Overall, workshop participants were highly satisfied with the quality of the workshop. Though participants entered the workshop already holding strong beliefs in the effectiveness of inquiry based learning, they reported significantly stronger beliefs after the workshop. Participants also reported significant increases in their knowledge about IBL and skill in implementing IBL.

Participants said the facilitators were approachable and knowledgeable, and cited the variety of shared experiences from staff members as the aspect that most helped support their learning. Participants enjoyed all sessions, but especially liked the collaborative work sessions in which they were able to develop materials for their own IBL classes along with peers and experienced staff members. Most of the suggested improvements were about logistics like the quality of the food or size of the workshop room. However, some participants did want more examples of IBL in non-proof-based classes. Others felt that vocal individuals tended to dominate discussions and that the reporting back after breakout groups was tedious.

Prior to the workshop, participants expressed concerns about implementing IBL in their classrooms, although they were highly motivated to do so. After the workshop, participants were still highly motivated, and some of their concerns subsided. Some concerns still remained, especially student resistance, which should be addressed in post-workshop mentoring. Participants reported that they both wanted and were likely to participate in post-workshop e-mail mentoring in order to help them successfully implement IBL in their own classrooms. While almost all participants indicated that they plan to implement IBL in the coming year, we do not know the extent to which they have done so. Follow-up surveys will allow us to discover the long-term outcomes of the workshop.

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