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Follow-up results for Workshop 3 were not reported under this project.

To cite these reports, please cite the individual report using the format:

Authors (date). *Report title*. [Report to the SPIGOT project] Boulder, CO: Ethnography & Evaluation Research, University of Colorado Boulder.

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

Overall Project Goal Update | February 2016

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

Each of the SPIGOT goals is presented below. The bar graph indicates the current status. The line graph gives a quick indicator of the status over time (in black) in relation to the goal (in green). The dot at the end of each goal indicates if the goal is currently on track (green) or not on track to be met (yellow).

Project Goals



d) Instructors will actively participate in at least one follow-up activity such as mentoring, Visiting Speakers Bureau, attendance at the Legacy of R.L. Moore Conference, and submitting proposals to the AIBL Small Grants Program.

Self-reported participation from follow-up survey

(Follow-up data from three workshops. Data from final workshop will be collected in Fall 2016.)



Listserv activity

(Current data from all four workshops.)



Participation from follow-up surveys is the most conservative estimate, as it considers the participants who did not respond to the survey as non-active. Active participants do not necessarily overlap between these two measures. Since the surveys are conducted anonymously and listserv activity is not, they cannot be cross-referenced. If they could be, participation in at least one follow-up activity may be higher than either individual measurement indicates.

e) An evaluation-with-research study will be used to make adjustments during the project, and to enable the project to contribute to STEM education knowledge base on faculty development.

To date, the evaluation team has completed reports for each of the four workshops based on pre- and post-workshop surveys, as well as follow-up reports for the first three workshops. Each report has helped to identify concerns for the organizers to address, and subsequent reports have identified adjustments the organizers have made in response. The evaluation team has also completed a cumulative report for all four workshops, which provides overall results and shares insights learned throughout the project.

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

Cumulative Report: Workshops 1-4 March 2016

Charles Hayward and Sandra Laursen
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This report covers the pre- and post-workshop survey results for all four of the SPIGOT workshops, and follow-up results for the first three. The only missing results are follow-up survey results for the 2015 workshop. Those data cannot be collected until the Fall of 2016, after the SPIGOT grant will have ended. This is the final report for the SPIGOT project. Quantitative results are presented as averages for all 138 attendees of the four workshops, and can be used as baseline comparative data for the upcoming ProDUCT workshops. Qualitative data, specifically counts of comments, are totals for attendees for all four workshops. Additional results for individual workshops are available in the previous reports, including three pre/post workshop reports and two follow-up reports. (In both cases, the two 2014 workshops were reported on in a single report.) Detailed descriptions of the project, the data set, and the research methods are available in a previous report (Hayward & Laursen, 2013). The survey instruments and methods remained unchanged for all of the workshops.

SPIGOT CUMULATIVE

Overall Project

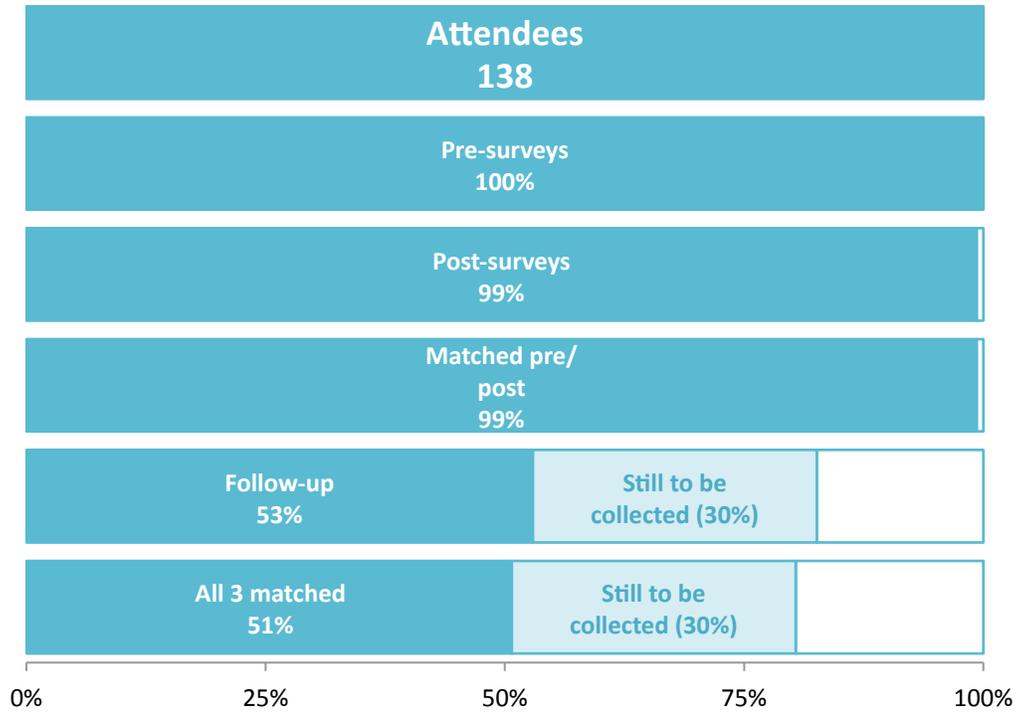
All four workshops were organized into four main types of sessions: (1) Reading sessions - where participants read and discussed research about IBL and active learning, (2) Video sessions - where participants watched and analyzed IBL classes, (3) Nuts & Bolts sessions - where participants and staff discussed how to structure and run an IBL class, and (4) Course Content sessions - where participants worked in small groups, along with staff guidance, to develop materials to use in their own courses. Throughout the course of the SPIGOT project, organizers used feedback from each workshop to make improvements to the model for the next workshop. Since this report serves as the cumulative report for the SPIGOT workshop, we will highlight the main, data-driven changes made throughout the project and draw attention to key takeaways from the SPIGOT workshop series.

Key data-driven actions organizers took throughout the project:

- 1) Used experience and evaluation results to identify participants' common concerns about IBL. Targeted discussions and examples to address those concerns, and developed takeaways for participants to create, such as a student buy-in plan.
- 2) Provided examples of various styles of IBL being used in different contexts so that participants could learn how to adapt IBL to their own classes.
- 3) Built in discussion prompts and identified takeaways for each session so that time was well-spent and participants were appropriately supported.
- 4) Provided participants with ongoing support after the workshop through a group listserv. Responded to participant concerns and discussions with relevant resources and advice.

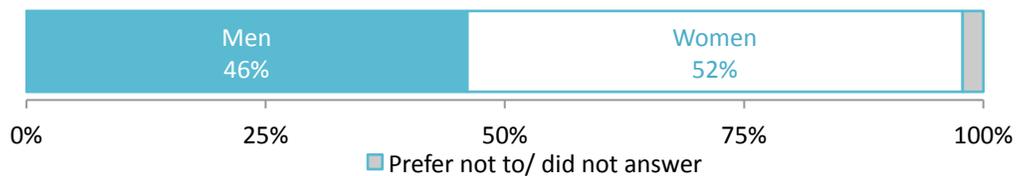
SPIGOT CUMULATIVE Pre-Workshop Surveys

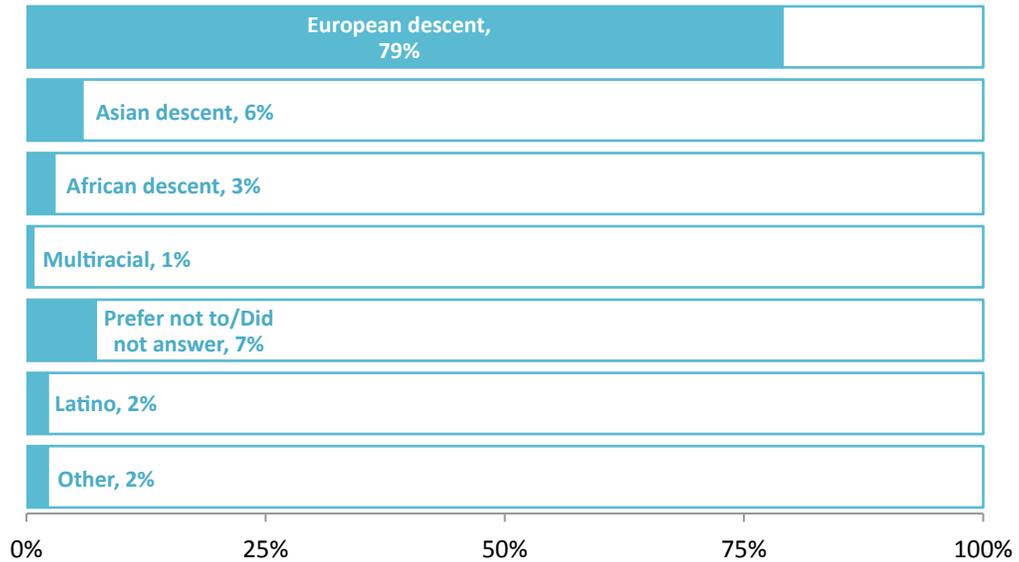
Attendance and Survey Response Rates



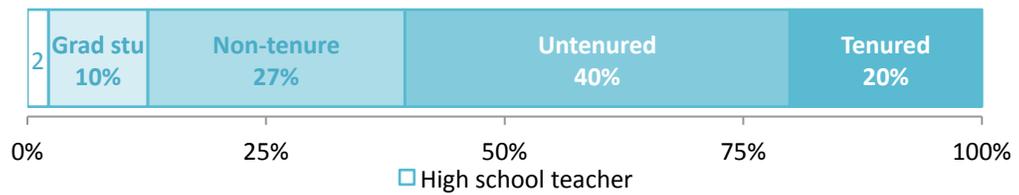
Follow-up surveys cannot be collected for the 2015 workshop until the Fall of 2016. If all participants respond to the follow-up surveys, the project totals for follow-up surveys can be as high as 83% and matched surveys may be as high as 81%. If rates stay the same as the first three workshops, the follow-up response rate will be 75% and the matched surveys will be 72%.

Demographics

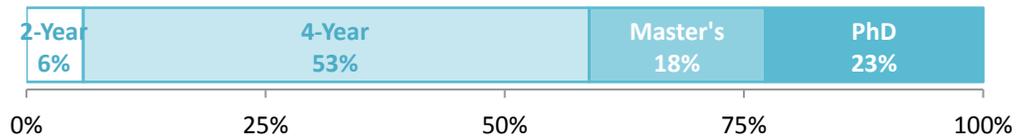




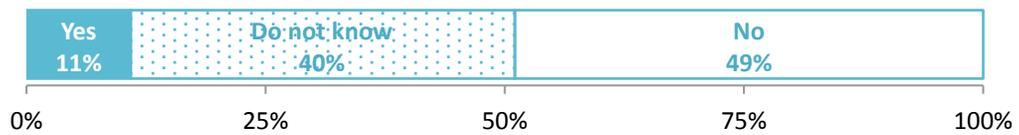
Appointment



Institution type



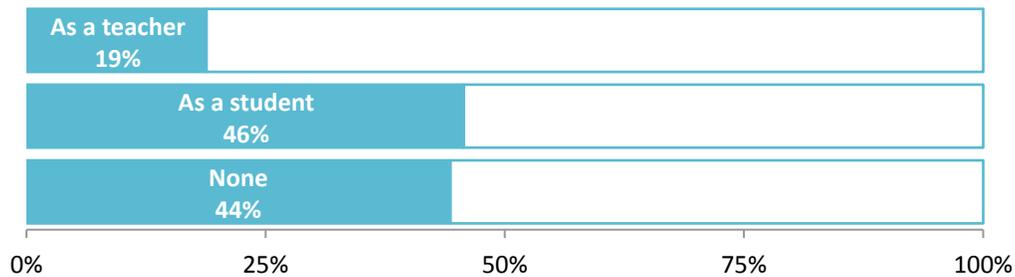
Minority-serving institution



Teaching experience



Previous experience with IBL



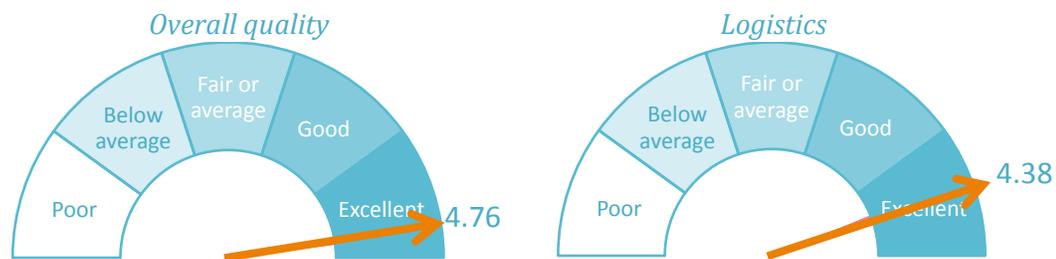
Overall, the SPIGOT project met its attendance goals. The workshops served 138 participants, which is 18 more than the original goal of 120. The project also aimed for at least 60% of participants to be early-career faculty. In fact, 61% of faculty were in the first 5 years of their teaching careers. It is remarkable that 100% of participants completed the workshop pre-surveys and 99% completed the post-surveys. Response rates this high are almost unheard of.

While participants did come with some prior knowledge and experience of IBL both as teachers and students, the teaching practices they reported using were largely traditional and instructor-centered (data will be presented later in the report). The results from these workshops show us what is possible with professional development for interested and willing volunteers. Experience seems to show that the supply of interested and willing volunteers is far from being exhausted, and the need for these workshops is still high. The lessons learned here can also be leveraged to help provide successful professional development in other contexts.

Post-Workshop Surveys

Bulleted lists in this section are from open-ended prompts. They list the most frequent responses and the number of participants (in parentheses) who mentioned each item.

Quality of the Workshop



The most common reason participants gave for the high ratings of workshop quality and logistics related to the schedule. Participants appreciated that staff stuck to the schedule and provided many breaks. Participants mentioned that they had time to process what they were learning, especially by revisiting ideas over the course of the workshop. In total, 51 participants made comments about the schedule. By comparison, the next most commonly mentioned topic was the food, about which 25 participants made comments.

Workshop as a Learning Experience

Best aspects

- Helpful & approachable staff (53)
- Chance to discuss with staff/peers (47)
- Videos/seeing IBL in action (49)

Needs improvement

See note below.

Throughout all of the workshops, participants identified the same aspects as being the best aspects; namely, the helpful staff, the open discussions, and the examples of IBL in action during the video sessions. These features should continue in future workshops.

Participants identified different areas needing improvement for each workshop, and each time, the staff responded by improving those areas. By the final workshop, the only consensus on needed improvements was that participants wanted more - more examples, more videos, and more time. Overall, this is very encouraging. It suggests the workshop model has been finely tuned and is ready for propagation.

Each year, staff learned some important lessons from participant feedback. We identify them below as a record of the learning and improvements so that these elements may be replicated in future workshops:

- Logistics: Care should be taken to make sure that the room(s) are big enough for participants to comfortably engage with each other and move around. Audio and visual should be clear. Information about resources including wi-fi, housing, and dining should be clear and easily available. Access to resources should be trouble free.
- Full group discussions: Workshop staff should be mindful of the frequency with which they talk during discussions. Staff should aim to minimize their own participation in order to encourage workshop participants to be active in the discussions.
- Small group discussions: Staff should be mindful of how many groups are asked to report back to the full group. There should be enough so that valuable ideas are shared and participants are given an opportunity for their ideas to be heard, but not so much sharing as to become tedious with repetition.
- Modeling: Staff should use workshop time to model examples of good classroom strategies for managing and encouraging participation, presentations, and discussions.
- Scaffolding: Work sessions and discussions should each have an identified goal or takeaway to help focus participants' effort. The level of scaffolding can decrease over time as participants become more independent.
- Nuts & Bolts: As most participants are new to IBL, Nuts & Bolts sessions are particularly useful to provide participants with specific IBL strategies and techniques, such as how to develop inquiry-based problem sequences, how to manage and assess student presentations, and how to develop a grading scheme that encourages student engagement with the IBL structure. It is also helpful to provide examples of syllabi and course notes from IBL classes so that participants can use these as example to help develop their own courses.

Concerns About Implementing IBL

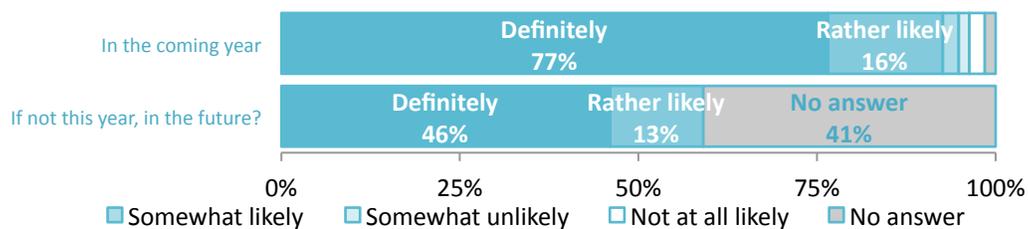
Participants shared concerns on both pre- and post-workshop surveys. *Raised* concerns were mentioned on post- but not pre-, *Dispelled* concerns were mentioned on pre- but not post-, and *Lingering* were mentioned on both.

| Concern | Raised | Dispelled | Lingering |
|----------------------------------|-----------|-----------|-----------|
| • Lack of skill to implement IBL | 33 | 13 | 16 |
| • Student resistance to IBL | 28 | 29 | 32 |
| • Harder to cover material | 14 | 24 | 15 |
| • Increased time/workload | 23 | 13 | 5 |
| Totals | 98 | 79 | 68 |

For each workshop, we compared participants' reported concerns before and after the workshop. These concerns can be indicative of participants learning in different ways. For example, concerns may be *raised* as participants become more familiar with IBL or concerns may be *dispelled* if the workshop helps them to overcome the concern. On the whole, patterns in the frequencies of concerns remained relatively stable over the four workshops and reveal topics that all workshops should address:

- **Lack of skill to implement IBL:** The instructor skillset needed for an IBL class is different than in a lecture class. Participants need to learn the skills of an IBL instructor and they should be provided with IBL-specific classroom strategies and 'Nuts & Bolts.'
- **Student resistance:** Participants need to develop a pro-active strategy to introduce IBL methods to students and get students to 'buy in' to the methods. IBL may be new to many students and may seem more difficult than taking notes in a traditional lecture-based class, so instructors need to help students understand why they are using IBL and how it can benefit students.
- **Coverage:** IBL can often move at a slower pace than lecture classes, so participants will likely be worried about being able to cover all of the required topics. Workshop staff should address this issue and discuss it frequently with participants.

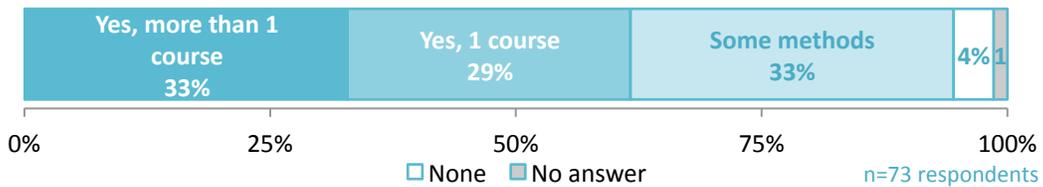
Plans for Implementing IBL



Follow-Up Survey Outcomes

Results shared throughout this section are only for the current follow-up survey respondents (73 of 97, 75%), except where noted. Implementation rates for all participants may differ from those values presented here, as we do not know if survey non-respondents implemented in the same ways that survey respondents did. Additionally, the 41 participants from the 2015 workshop will not receive their follow-up surveys until the Fall of 2016, and are therefore not included in this section.

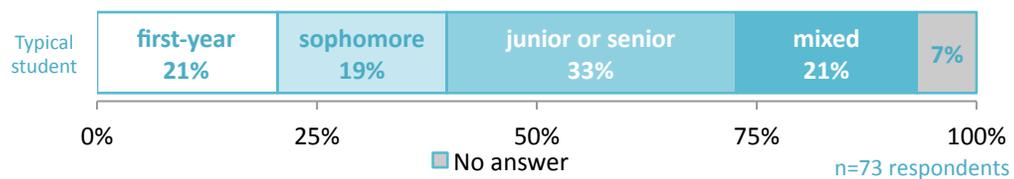
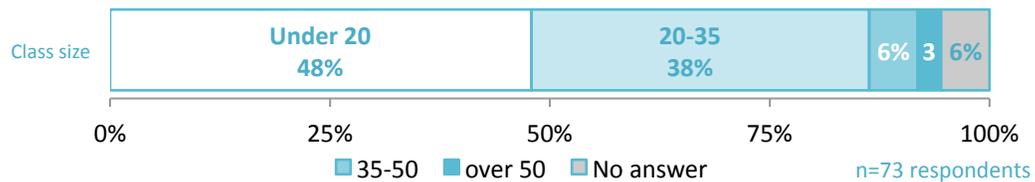
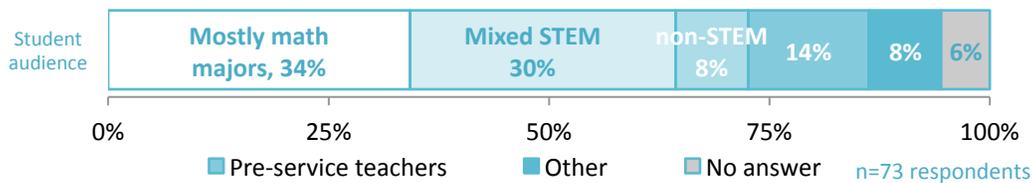
Implementation



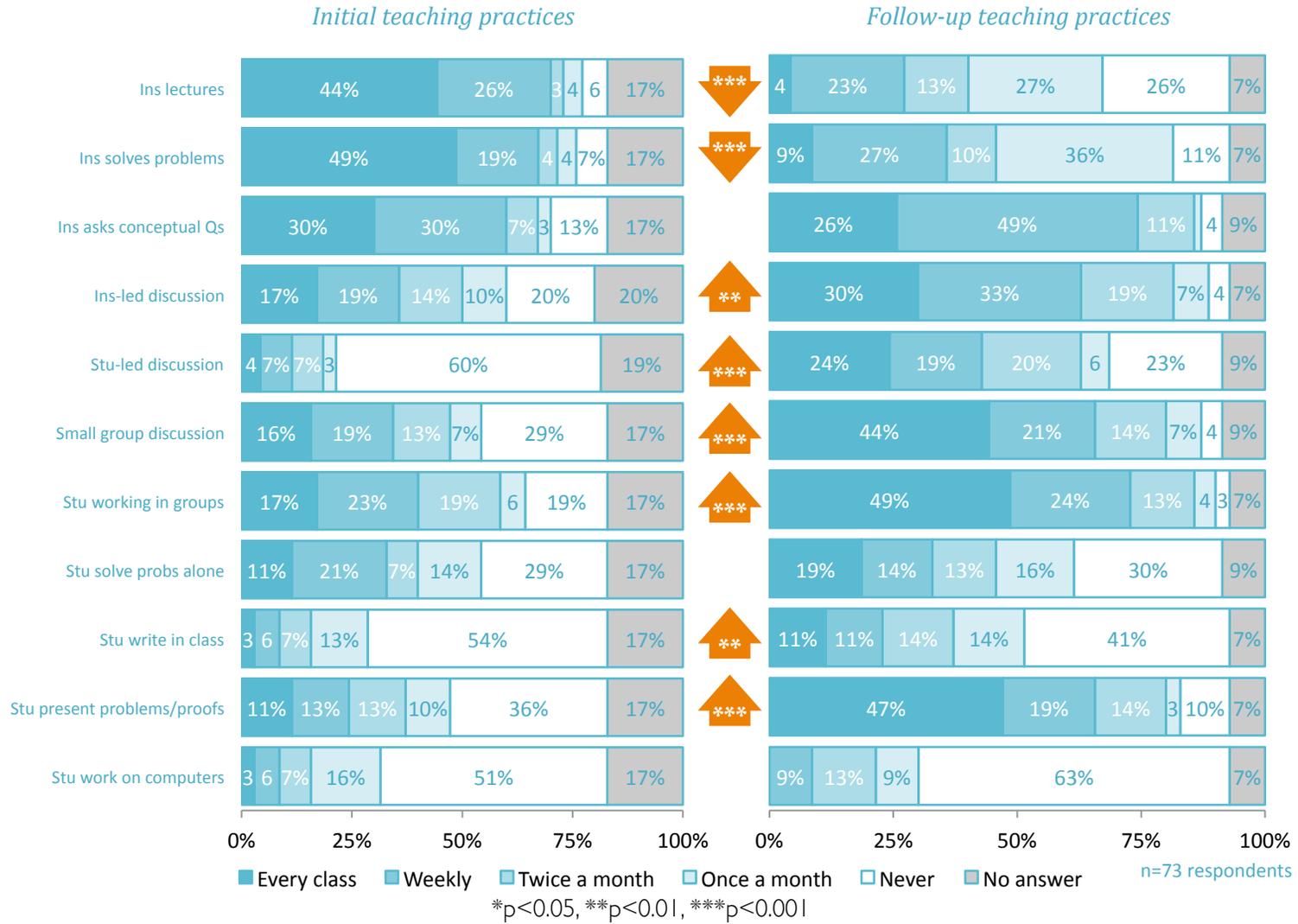
Spreading IBL to:

180+ classes
in the first year following the workshop.

4600+ students



Changes in Teaching Practices



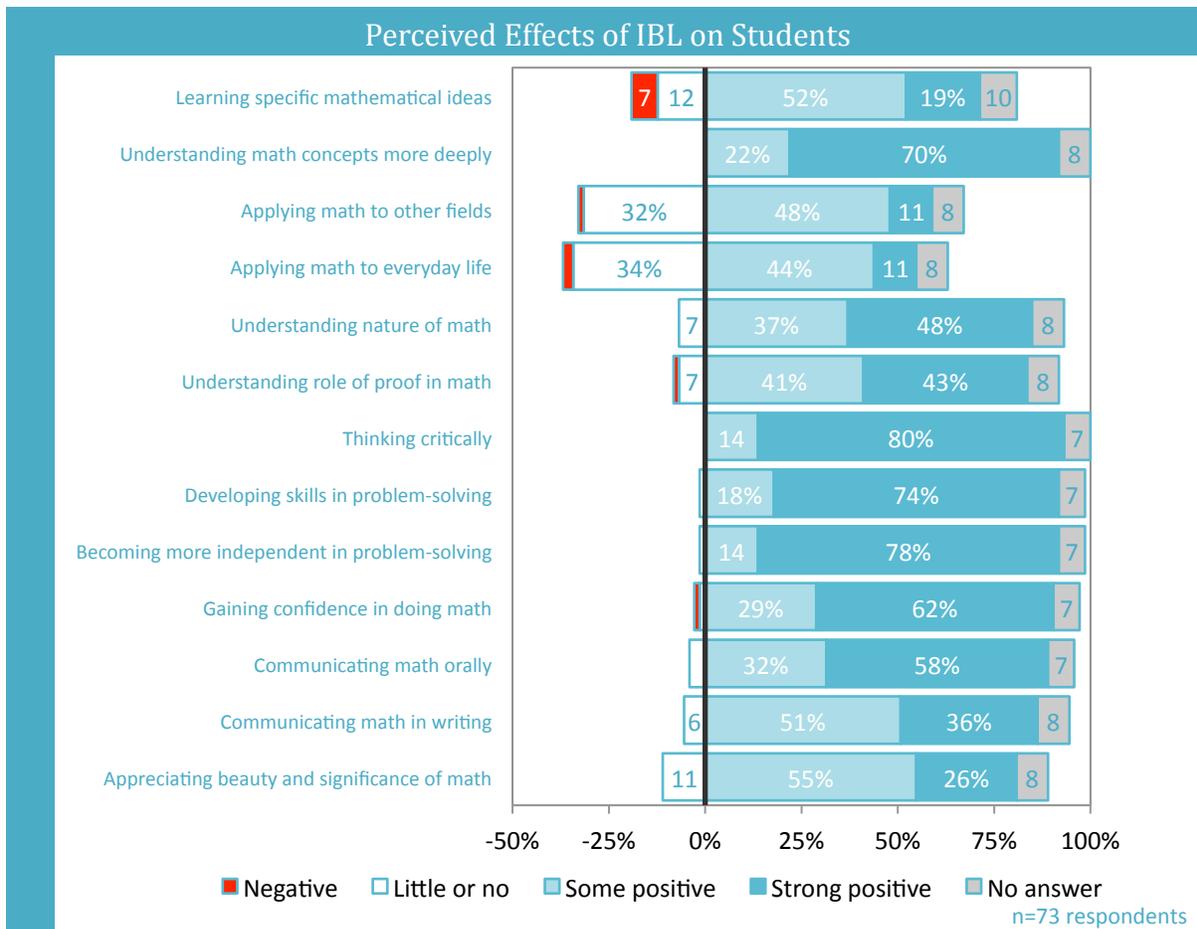
Of those who responded to the follow-up surveys, 95% reported implementing at least some IBL methods. Overall, this means at least 71% of the 97 participants from the first three workshops have implemented some IBL in the year following the workshop. We also analyzed listserv traffic for these three workshops to measure implementation. In total, 90% of all participants from the first three workshops were active on the listserv, and 76% of all participants made comments indicating that they were implementing IBL.

Changes in teaching practices also revealed a shift towards IBL pedagogies with significant decreases in instructors lecturing and solving problems, and significant increases in student-centered activities including instructor and student-led whole class discussions, small group discussions, group work, individual writing in class, and student presentations.

The instructors who did implement IBL have exposed over 4600 students to IBL methods in over 180 classes in just the first year after the workshop. Participants are now in their second or third academic years following the workshops, so the impact is likely now even greater. While most participants tended to use IBL in smaller classes of 35 students or less (86% of respondents) for upper-level (54%) math and STEM majors (64%), there were instructors who reported using IBL in a wide variety of classes including pre-service teacher courses, non-math-major courses, and first-year courses.

Open-ended prompts:

Throughout the remainder of the report, we share responses to open-ended prompts, as well as to multiple choice survey items. For each open-ended prompt, the numbers in parentheses indicates how many of the 73 follow-up survey completers responded to the prompt and the number of topics that were coded in all responses. (Participants sometimes included multiple topics in their response to a prompt.) The bulleted lists show the most frequent responses and the number of participants who mentioned each topic. The numbers in the lists provide an estimate of relative importance.



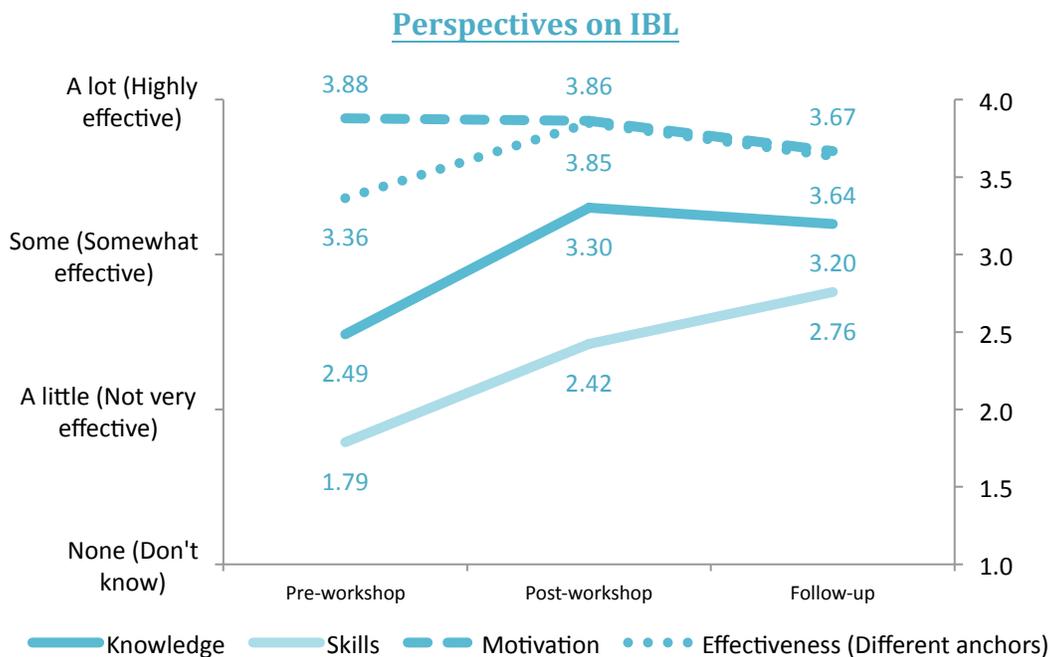
Greatest student benefit (58 respondents, 90 coded topics)

- Deeper mathematical understanding (23)
- Independence (17)
- Behave like mathematicians/ do real mathematics (14)
- Improved confidence (13)

Concerns about what students may NOT gain (56 respondents, 59 coded topics)

- Coverage/exposure to certain topics (24)
- Students don't completely buy in and benefit from IBL method (8)
- Students are too independent (can't judge correctness, don't learn formal names/procedures, etc.) (8)

Respondents felt that IBL had many positive effects on students, both in terms of mathematical content and affective gains. In multiple choice responses and open-ended comments, some of the strongest reported effects were that students became more independent in problem-solving and improved their critical thinking. Few participants felt that IBL had negative effects, but across the workshops, coverage remained as the highest ongoing concern for participants. Participants perceived some of the weakest effects on applying math to everyday life and to other fields.



Overall, patterns in participants' reported knowledge, skills, motivation, and belief in the effectiveness of IBL were highly consistent across the workshops. Patterns indicate that participants learned a lot about IBL during the workshop. They felt they gained skill in using IBL by attending and they continued to gain skills as they implemented IBL in their own classrooms. Participants entered the workshop reporting high levels of motivation to use IBL. Although participants' reported motivation to use IBL did drop slightly after implementing it in their own classrooms, it still remained almost at the very top of the scale. Participants entered the workshops feeling IBL was an effective teaching method. Their beliefs in its effectiveness increased after the workshop, but then dropped slightly after implementing IBL. These patterns make sense for participants in their first year of implementing a new teaching method; while they are gaining skills, they are probably also finding it challenging. Ongoing support may be helpful for participants to work through difficulties and continue using IBL.

Feedback on the Workshops

Most useful aspect of workshop for implementing IBL (61 respondents, 89 coded topics)

- Video sessions (22)
- Examples of how to do IBL, learning specific strategies (16)
- Planning time (14)
- Experienced staff to share ideas (12)

Use of materials participants developed at the workshop (60 respondents, 72 coded topics)

- Used materials to teach IBL course (24)
- Used selected activities (18)
- Did not use the materials (13)
- Plan to use in the future (11)

Taken together, open-ended feedback suggests that one year later, participants felt that the workshop had been useful in helping them implement IBL in their own classrooms. The video sessions in particular seem to be very helpful. Participants also valued the wealth of examples of IBL strategies shared at the workshops, and found the afternoon content planning time helpful to start incorporating their learning into plans for their own courses. In fact, many participants reported using the materials they developed at the workshop.

At the first workshop, participants most frequently identified the staff as the most helpful aspect of the workshop. However, participants from later workshops identified the video sessions, examples of specific strategies, and planning time more frequently than they did the staff. This may be due to the reworking and strengthening of the video, Nuts & Bolts, and content sessions that organizers did between workshop 1 and 2. However, it also suggests that the most useful aspects of the workshops have shifted to the features of the workshop model itself, rather than the individuals running the workshops. This is an encouraging finding for the upcoming ProDUCT project, which aims to train others to implement the SPIGOT workshop model.

Implementation of IBL

Personal gains for instructors (54 respondents, 72 coded topics)

- Helped me be a better teacher/understand student thinking (32)
- More enjoyable way to teach (16)
- Better relationships with students (12)
- Improved instructor's own mathematical ability (7)

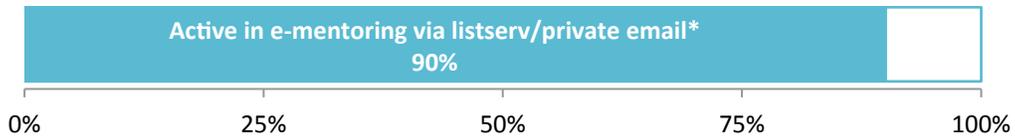
Problems experienced (59 respondents, 79 coded topics)

- Student resistance (36)
- Implementing IBL is challenging (e.g. managing group work & presentations) (13)
- Coverage/exposure to certain topics (12)

Overall, many instructors felt they were better teachers through using IBL. The main problems they experienced were the same as those concerns that respondents shared on pre-workshop and post-workshop surveys: student resistance, the difficulty of implementing IBL, and coverage. These continue to be challenges for instructors, but on the whole, did not stop them from using IBL methods. In fact, despite 36 participants who reported they experienced problems with student resistance, only 8 reported that it was still a concern. This suggests that participants anticipated and felt equipped to deal with student resistance. Ongoing support should continue to provide advice and resources to help participants manage these challenges and improve their skills as IBL instructors.

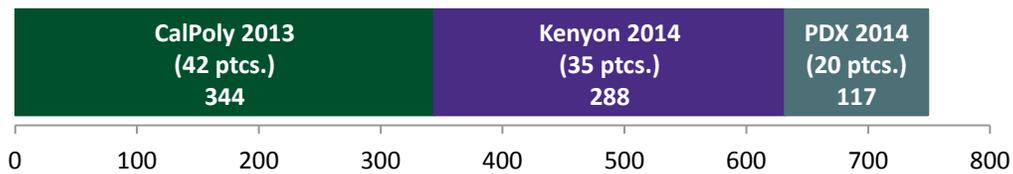
Ongoing Support

Workshop Resources

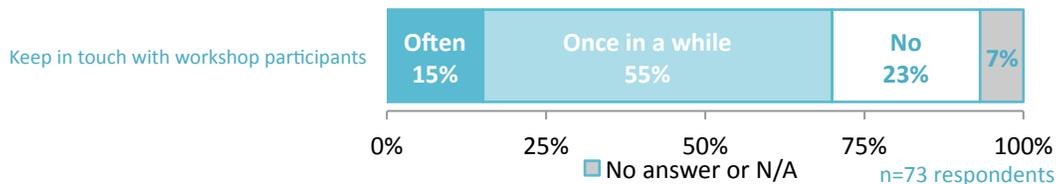
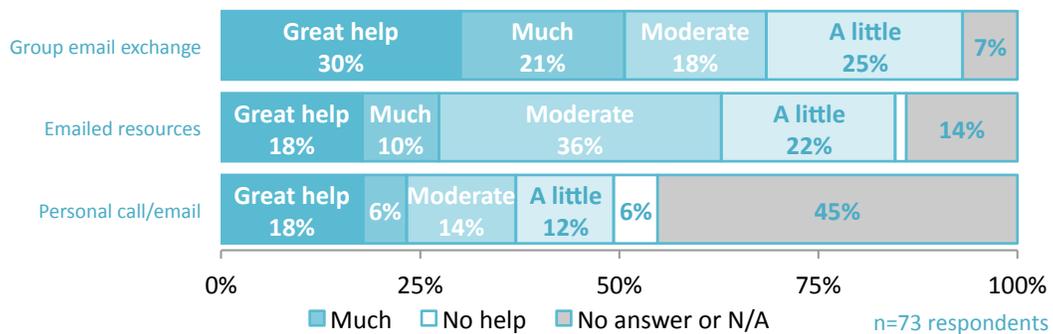


*n=97 participants

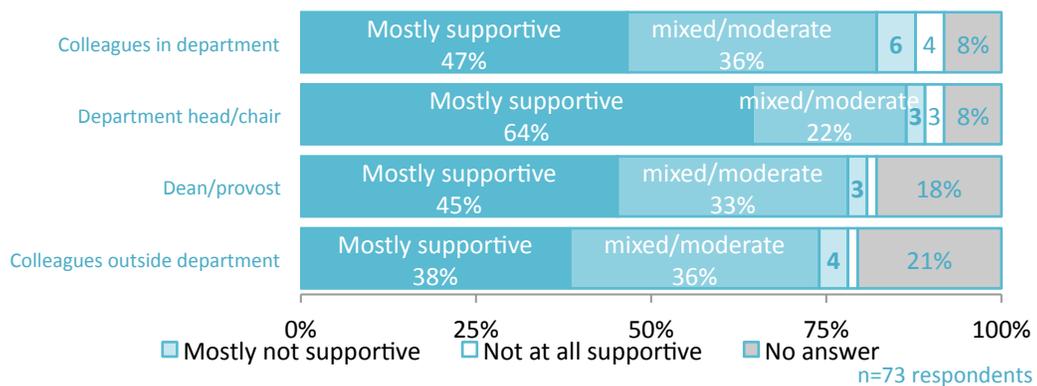
Group listserv messages in one year following workshop



Helpfulness of e-mentoring activities



Institutional Support



Descriptions of departmental/institutional IBL support (47 respondents, 52 coded topics)

- Encouragement - other instructors use IBL or financial support/resources (24)
- Freedom to 'do what I want' (14)
- Doubtful or discouraging colleagues (7)

Other IBL Supports

IBL events



n=73 respondents

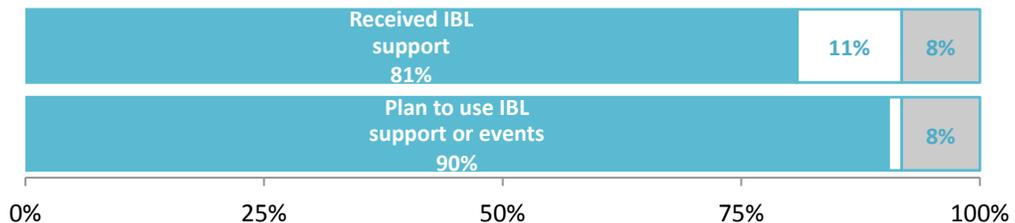
Attended

- IBL sessions at JMM (21)
- IBL session at MAA meeting (17)
- Legacy of R.L. Moore/IBL Conference (13)
- IBL booth at MathFest (12)
- IBL session at MathFest (3)
- IBL poster at MathFest (7)
- Other (4)

Presented

- IBL sessions at JMM (8)
- Legacy of R.L. Moore/IBL Conference (7)
- IBL session at MAA meeting (6)
- IBL booth at MathFest (6)
- IBL poster at MathFest (5)
- IBL session at MathFest (2)
- Other (0)

Use of IBL supports



□ No ■ No answer

n=73 respondents

Supports used

- Read workshop listserv (54)
- Contributed to listserv (34)
- Used notes from JIBLM (24)
- Received AIBL minigrant (11)
- Used AIBL mentor program (8)
- Applied for AIBL minigrant but did not receive (4)

Supports plan to use in the future

- Will use notes from JIBLM (43)
- Will read workshop listserv (52)
- Will attend Legacy of R.L. Moore/IBL Conference (40)
- Will attend IBL session at JMM (41)
- Will contribute to listserv (36)
- Will apply for AIBL minigrant (33)
- Will attend IBL session at MAA (32)
- Will submit notes to JIBLM (25)
- Will attend IBL session at MathFest (29)
- Will use AIBL mentor program (16)
- AIBL visiting speaker's bureau (4)

Like participants' open-ended feedback on the workshop, these items also indicate that many participants took advantage of the resources available from the workshop, as well as those offered by the Academy of Inquiry Based Learning (AIBL). It appears that more participants used easily accessible, electronic resources such as the listserv and JIBLM, and fewer did more intensive activities like attending conferences. In the future, most participants plan to use some items from the suite of resources, including many who plan to attend IBL events at conferences. Given the variety of resources participants intend to use, it may be critical that they have the option to choose among many resources in order to find whichever one is best suited to their own needs.

Despite participants expressing concern over departmental or institutional skepticism about IBL, many reported feeling supported by their colleagues, department chairs, and deans. This may indicate that the wider perception of IBL is improving and acceptance and support for it are growing.

Conclusion

Results from the follow-up surveys help to learn about the impact of the workshop on participants' teaching practices. At least 71% of all workshop participants reported using at least some IBL methods in the year following the workshop. In total, participants have spread IBL methods to over 4600 students in more than 180 courses in just the first year following the workshop.

In our previous work on IBL workshops, we identified 5 key features that help participants to implement IBL in their own classrooms. These included:

- (1) 'Big tent,' inclusive definitions of IBL - a variety of styles allows for individual instructors to find one that is comfortable
- (2) Examples of IBL in diverse contexts - diverse examples allow participants to learn how to best tailor IBL to be successful in their own context
- (3) Time - the longer duration of the workshop allows time for participants to revisit and process learning
- (4) Common concerns - discuss and provide strategies for dealing with participants' most common concerns: coverage, student resistance, and lack of skill to implement
- (5) Ongoing support - support helps participant to implement IBL successfully

The SPIGOT workshop model incorporated all five of these features in numerous ways throughout its design, which likely contributed to the strong implementation outcomes participants reported. Beyond incorporating these features of previous workshops, SPIGOT also improved upon them. For example, organizers developed detailed strategies for helping participants to develop their own action plans for proactively addressing student resistance. The model has been finely tuned and all evaluation results show that it is ready to be taught to and implemented by other faculty developers.

Where SPIGOT has really improved our knowledge of professional development is in the importance of ongoing support. Other workshop projects have aimed to incorporate ongoing support, but not to the extent that SPIGOT did. The ongoing support is a critical feature of the SPIGOT model, and may be the reason SPIGOT's implementation rates are even higher than those from previous projects. We are currently engaged in a more detailed analysis of activity from the listservs in order to better understand this component and how it functions to support participants.

Additionally, the SPIGOT project has carefully measured participants' uses of other forms of IBL support, such as IBL-themed conferences, Academy of Inquiry-Based Learning programs, and community resources like JIBLM. From the evaluation, it is evident that these instructors new to IBL methods took advantage of many of the resources available. While the workshops seem particularly effective for providing the necessary push to 'get over the hump' to implement IBL initially, the other community resources help to sustain that use over time and enhance instructors' skills and successes even further. No one resource met all participants' needs. Moreover, many participants reported using multiple resources, possibly to address different needs. Therefore, to support new IBL users and solidify their efforts to incorporate IBL into their teaching, it is essential that the suite of resources within the IBL community remain intact.

Acknowledgements

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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
October 2013

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

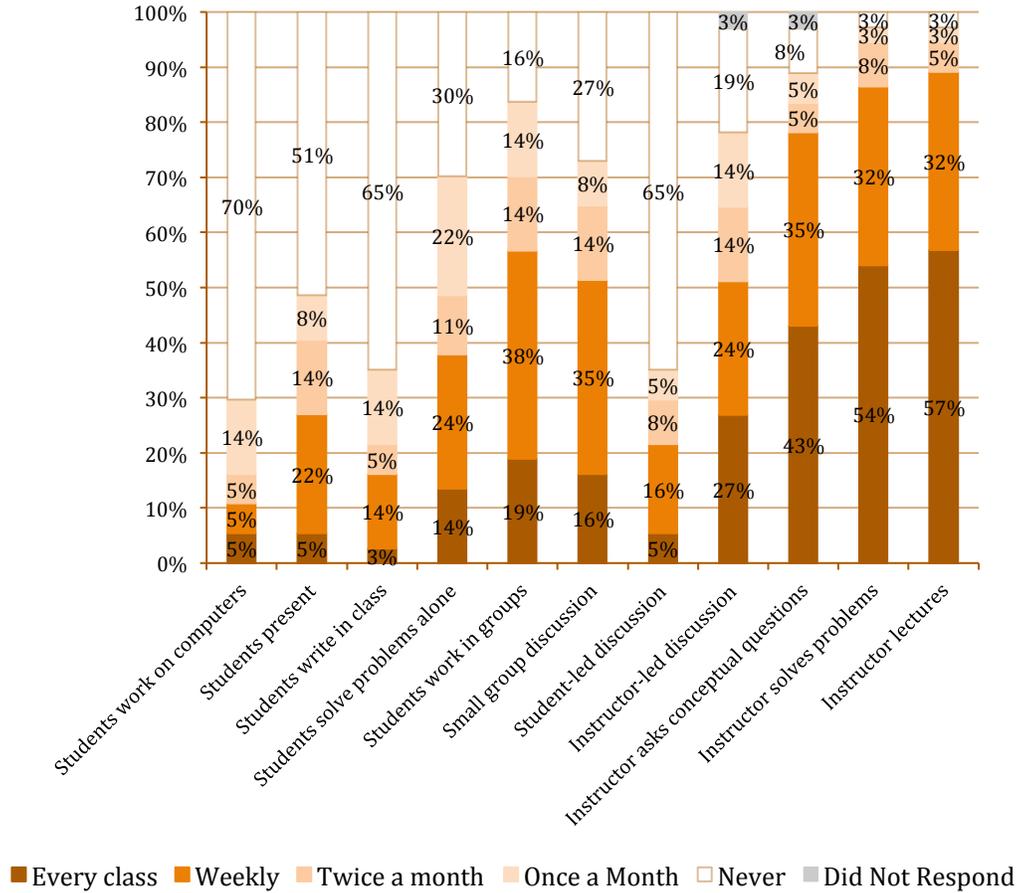
Attendees were asked to rate the frequency of their use of various teaching practices (never, about once a month, about twice a month, weekly, every class).² The most commonly reported strategies were traditional teaching methods: 57% of the respondents lectured in every class session, 54% solved problems 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 | <i>Not very important</i> | <i>Somewhat important</i> | <i>Quite important</i> | <i>The most important</i> |
|--|---------------------------|---------------------------|------------------------|---------------------------|
| 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.

| | <i>Poor</i> | <i>Below average</i> | <i>Fair or average</i> | <i>Good</i> | <i>Excellent</i> |
|---|-------------|----------------------|------------------------|-------------|------------------|
| 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 | <i>Did not respond</i> | <i>Not at all likely</i> | <i>Somewhat unlikely</i> | <i>Somewhat likely</i> | <i>Rather likely</i> | <i>Definitely</i> |
|-------------------------------------|------------------------|--------------------------|--------------------------|------------------------|----------------------|-------------------|
| 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 | <i>Not likely to participate</i> | <i>Somewhat likely to participate</i> | <i>Very likely to participate</i> |
|---|----------------------------------|---------------------------------------|-----------------------------------|
| 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 |
|--|--------|------------------------------------|---------------------------|---------------------------|-------------------------|-------------|----------------------------------|
| | | <i>None</i> | <i>A little</i> | <i>Some</i> | <i>A lot</i> | | |
| <i>Knowledge about inquiry</i> | Pre | 2% | 57% | 38% | 2% | 2.40 | <i>p</i> <0.001 |
| | Post | 0% | 5% | 57% | 38% | 3.33 | |
| <i>Skill in inquiry-based teaching</i> | Pre | 36% | 45% | 19% | 0% | 1.83 | <i>p</i> <0.001 |
| | Post | 7% | 38% | 55% | 0% | 2.48 | |
| <i>Belief in effectiveness of IBL</i> | | <i>Don't know</i> | <i>Not very effective</i> | <i>Somewhat effective</i> | <i>Highly effective</i> | | |
| | Pre | 7% | 0% | 38% | 55% | 3.40 | <i>p</i> <0.010 |
| Post | 0% | 0% | 21% | 79% | 3.79 | | |
| <i>Motivation to use IBL</i> | | <i>Not at all</i> | <i>A little bit</i> | <i>Somewhat motivated</i> | <i>Highly motivated</i> | | |
| | Pre | 0% | 0% | 24% | 76% | 3.76 | <i>p</i> =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 | 34 | <i>Totals</i> 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.

Acknowledgements

The workshop was supported by the National Science Foundation through collaborative grants to the host university and institutions of the facilitators (DUE-1225833, DUE-1225820). This evaluation was supported by the NSF under grant DUE-1225658. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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Hayward, C., Kogan, M., & Laursen, S. (2012). *Collaborative Research: Research, Dissemination, and Faculty Development of Inquiry-Based Learning (IBL) Methods in the Teaching and Learning of Mathematics. Evaluation Report: University of California, Santa Barbara (June 2012)*. Report prepared for the NSF. Boulder, CO: Ethnography & Evaluation Research.

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National Science Foundation. (2008a). *TABLE 3. Employed doctoral scientists and engineers in 4-year educational institutions, by broad field of doctorate, sex, faculty rank, and years since doctorate: 2008*. Retrieved July 29, 2013, from Characteristics of Doctoral Scientists and Engineers in the United States: 2008: <http://www.nsf.gov/statistics/nsf13302/pdf/tab3.pdf>

National Science Foundation. (2008b). *TABLE 4. Employed doctoral scientists and engineers, by selected demographic characteristics and broad field of doctorate: 2008*. Retrieved July 29, 2013, from Characteristics of Doctoral Scientists and Engineers in the United States: 2008: <http://www.nsf.gov/statistics/nsf13302/pdf/tab4.pdf>

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

Evaluation Report 2: February 2015

Charles Hayward and Sandra Laursen

Ethnography & Evaluation Research, University of Colorado Boulder

This evaluation report covers data from two workshops: (1) Pre- and post-workshop surveys from Workshop 2, June 23-26, 2014 at Kenyon College, Gambier, OH, and (2) Pre- and post-workshop surveys from Workshop 3, August 3-6, 2014 in Portland, OR.

It is presented in a new 'dashboard' format to streamline the process and quickly deliver key takeaways. Detailed descriptions of the project, the data set, and the research methods are available in the previous report (Hayward & Laursen, 2013). The data set and methods remain unchanged for these new workshops.

SLO 2013

KENYON 2014

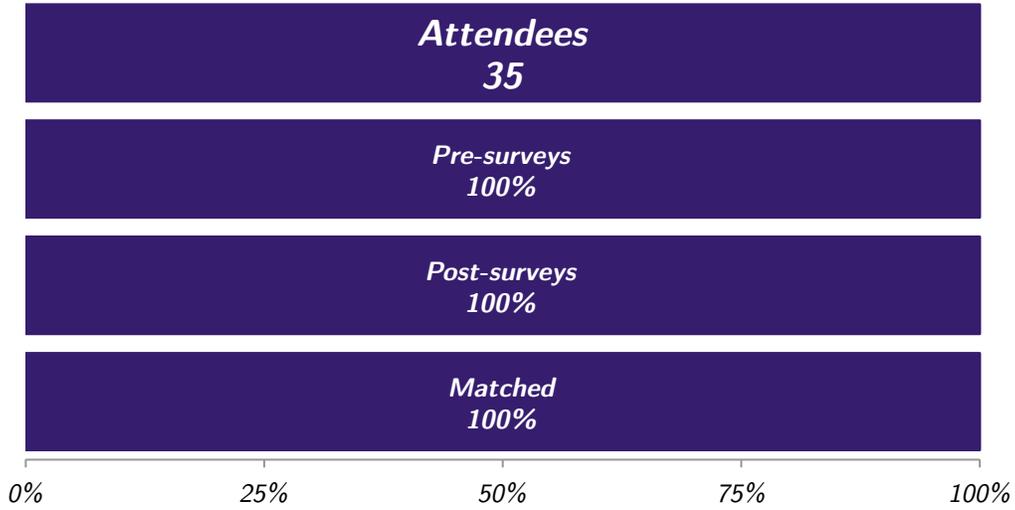
Key Changes

The Kenyon workshop was held June 23-26, 2014 and served 35 participants. Using feedback from participants from the 2013 workshop at California Polytechnic State University in San Luis Obispo, the SPIGOT leaders planned some improvements to their workshop for the upcoming 2014 workshops, including:

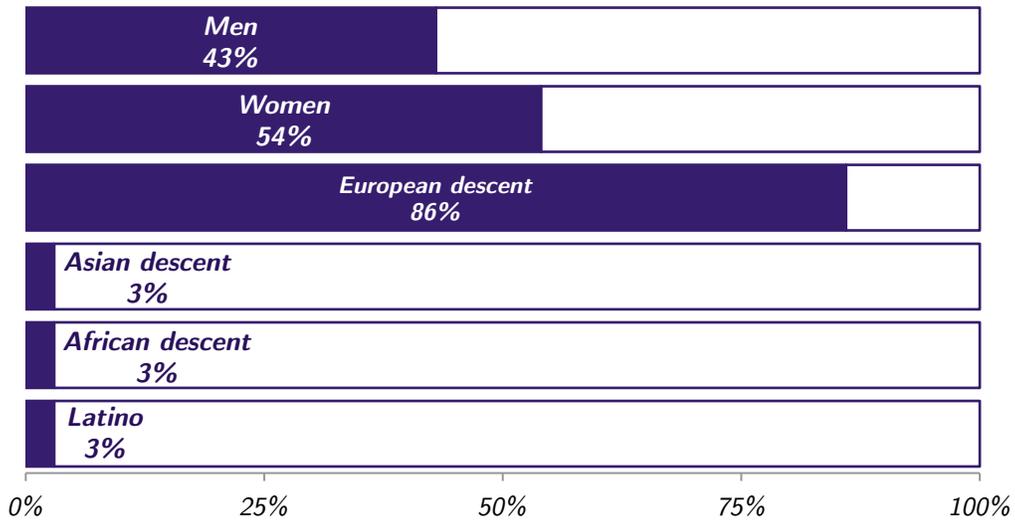
- 1) Focusing discussions during reading sessions with thoughtful discussion prompts.
- 2) Providing specific strategies in Nuts & Bolts sessions to deal with lingering concerns such as student and departmental resistance, specific IBL classroom skills, and sharing sample syllabi and grading rubrics.
- 3) Including examples in the video sessions of more instructors, more diverse class types, and 'stop and go' snippets showing ways to manage student difficulty.
- 4) Scaffolding the content sessions by starting with small, targeted activities that later build to making notes for an entire course.
- 5) Adding Natalie LaRosa, the AIBL Administrative Assistant, to the workshop staff in order to help with logistics and keep track of individual participants throughout the workshop.

KENYON 2014
Pre-Workshop Surveys

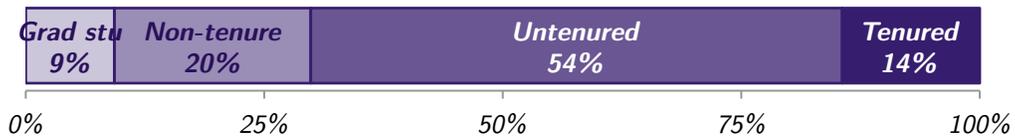
Attendance and Survey Response Rates



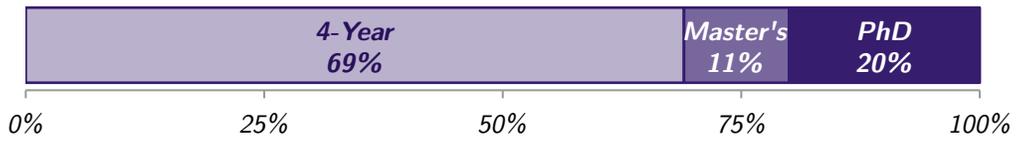
Demographics



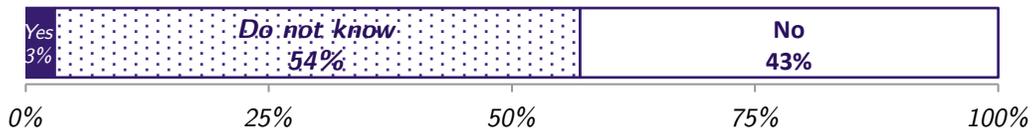
Appointment



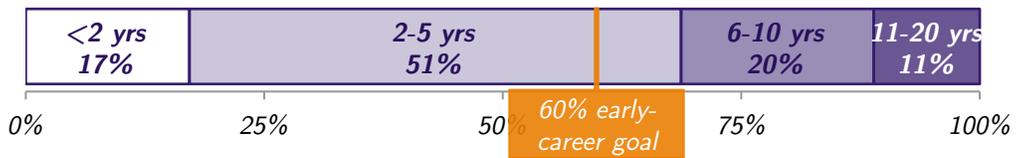
Institution type



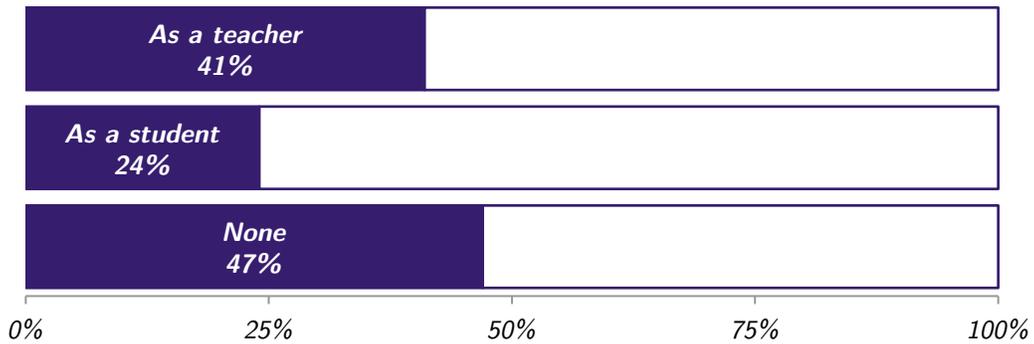
Minority-serving institution



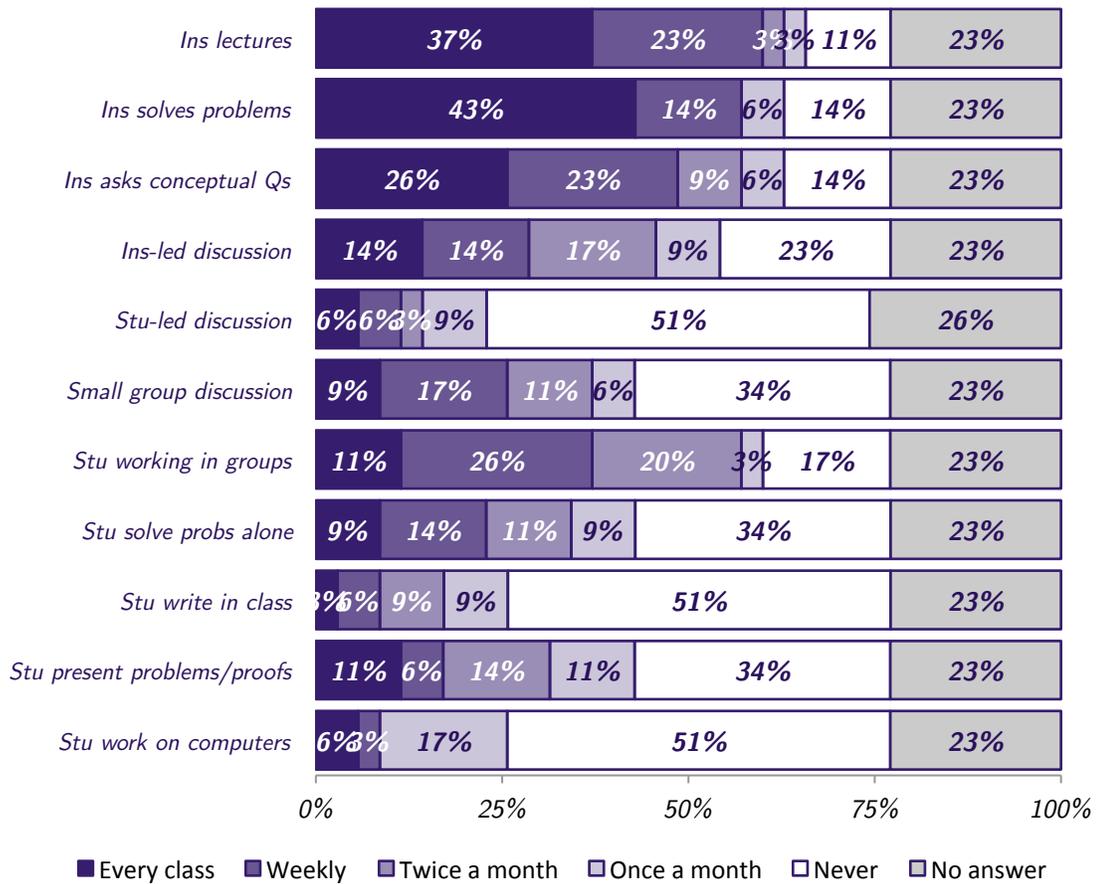
Teaching experience



Previous experience with IBL



Initial Teaching Practices



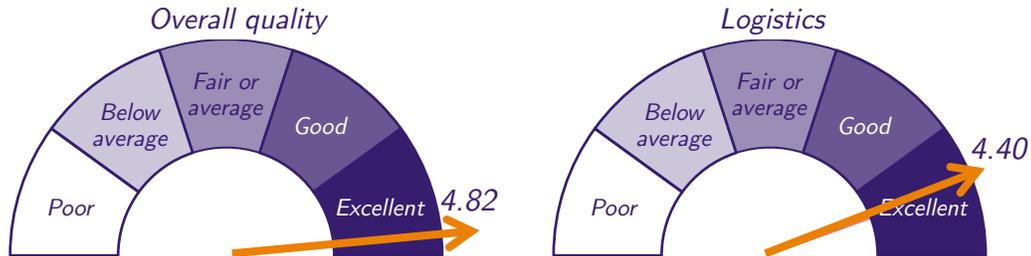
Due to 100% response rates on both pre- and post-workshop surveys, results shared here are representative of the workshop attendees. Overall, participants entered the workshop with relatively little experience using IBL techniques. While 41% said they had used IBL techniques in the past, the teaching practices they reported using were more consistent with traditional instruction. For example, instructor lecturing and solving problems were the most frequently used techniques, with 60% and 57%, respectively, reporting using those techniques at least weekly.

Of note, this workshop met the project's goal of enrolling at least 60% early-career faculty since 68% of attendees had 5 or fewer years of teaching experience.

Post-Workshop Surveys

Bulleted lists in this section are from open-ended prompts. They list the most frequent responses and the number of participants (in parentheses) who mentioned each item.

Quality of the Workshop



- Good scheduling with ample time for breaks (16)
- Positive comments about facilities (12)
- Negative comments about facilities (8)
- Kenyon was a great location (7)

Workshop as a Learning Experience

Best aspects

- Videos/seeing IBL in action (18)
- Chance to discuss with staff/peers (12)
- Helpful & approachable staff (8)

Needs improvement

- Reading sessions (12)
- Content sessions (9)
- More/less time for certain sessions (9)

Open-ended feedback shows that participants were satisfied with the workshop and the logistics. Taken together, participants' comments indicate that the workshop was well-structured and the schedule allowed ample time for appropriate activities for learning how to implement IBL, and time to discuss and digest what they were learning.

Like past workshops, participants found the staff helpful and approachable, and cited discussions with the staff as one of the best opportunities for learning. One participant also identified the best aspect as, *"the modeling of various approaches/techniques in our session."* Based on feedback from last year's workshop, leaders made efforts to strengthen the video sessions this year. This seems to have worked, as participants cited the videos as the best aspect of the workshop more than anything else. Workshop leaders also aimed to provide more structure for the content sessions in order to make them more productive. Seven participants mentioned this time as being one of the best aspects, and one specifically commented on the scaffolded approach, saying *"I liked how the level of structure for the course materials sessions decreased over time."*

While participants again cited the reading sessions as most needing improvement, many of these comments were about ways to improve it rather than remove it, such as spending less time on the reading sessions, having a shorter discussion with better prompts, or wanting a summary of the research to take with them. It is also likely that the utility of the reading sessions may not be realized until participants return to their home institutions and begin to use the research to help justify their use of IBL with students and colleagues. Other suggested improvements, including those about the content sessions, tended to reflect personal preferences or unique situations (e.g. content sessions were not useful to one participant because he/she already had a curriculum from an IBL colleague), rather than larger trends that should be addressed.

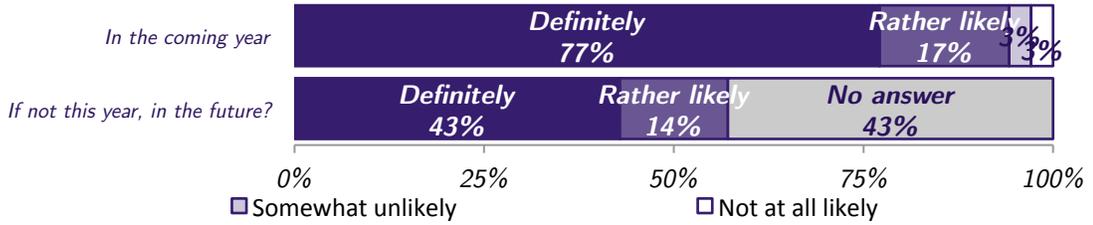
Concerns About Implementing IBL

Participants shared concerns on both pre- and post-workshop surveys. Raised concerns were mentioned on post- but not pre-, Dispelled concerns were mentioned on pre- but not post-, and Lingering were mentioned on both.

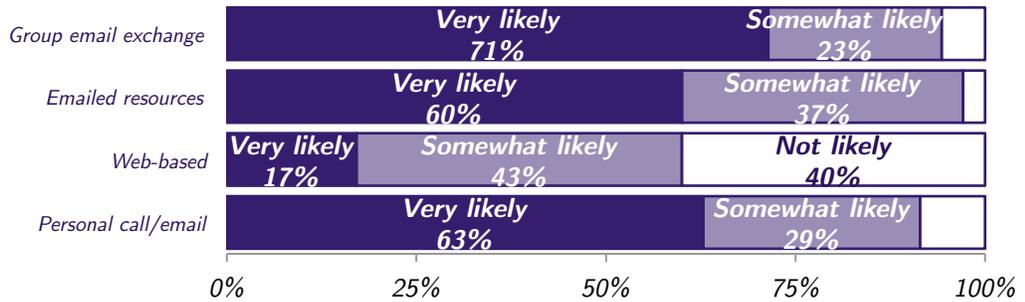
| <i>Concern</i> | <i>Raised</i> | <i>Dispelled</i> | <i>Lingering</i> |
|----------------------------------|---------------|------------------|------------------|
| ● Student resistance to IBL | 10 | 9 | 8 |
| ● Lack of skill to implement IBL | 9 | 4 | 7 |
| ● Harder to cover material | 1 | 7 | 5 |
| ● Student success with IBL | 1 | 10 | 1 |
| ● Increased time/workload | 7 | 2 | 1 |
| <i>Totals</i> | <u>28</u> | <u>32</u> | <u>22</u> |

Like last year, the greatest number of concerns were *dispelled* by the workshop. Especially important is the large number of dispelled concerns about student success with IBL, as this can be a major barrier for adopting IBL. Student resistance again was the most frequent concern, and remains a challenge for IBL instructors. However, the workshop provided opportunities to discuss how to avoid and manage student resistance. While many concerns over skill were raised and lingering, this is to be expected given that these instructors have not yet had a chance to practice implementing IBL. Though in prior years coverage has remained a major concern even after the workshop, it appears to be less prominent for this group. Perhaps this is due to organizers' efforts to specifically address this issue.

Likelihood of Implementing IBL

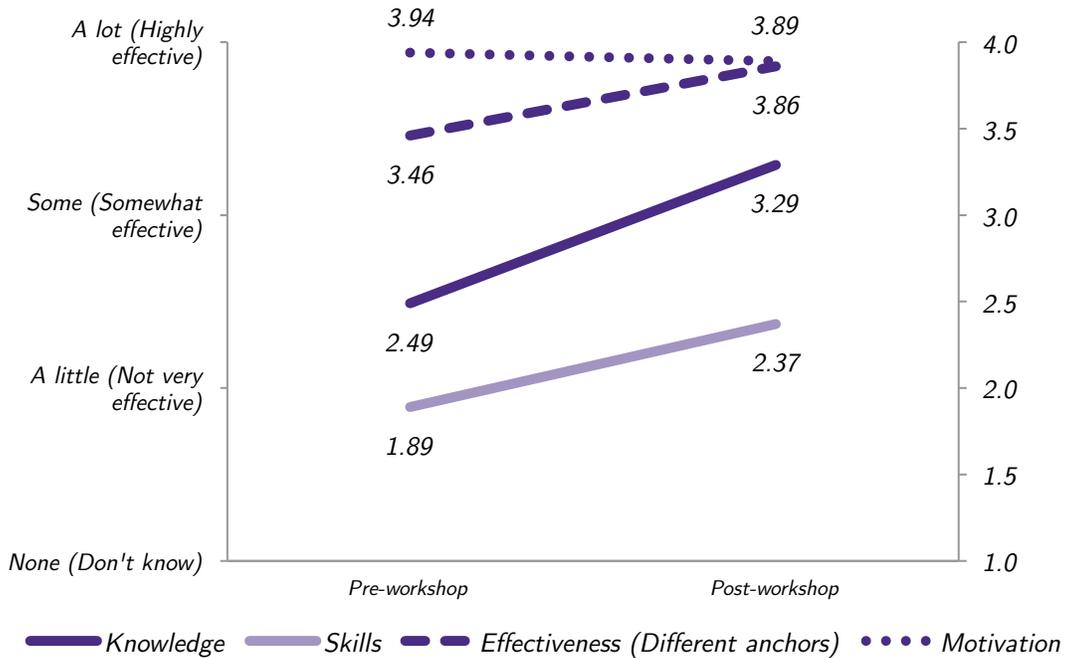


Support and Keeping in Touch



Pre-/Post- Comparisons

Immediate Workshop Outcomes



Reported levels of knowledge of IBL, skill in using IBL, belief in the effectiveness of IBL, and motivation to use IBL were similar to those reported in the previous workshop. Additionally, changes were consistent with those of the previous year as well. Rises in knowledge, skills, and effectiveness were statistically significant, but the slight drop in motivation was not statistically significant. While knowledge and skills both increased, the relatively lower ratings of skills may be due to the fact that participants have not yet had a chance to practice using IBL. Skills may continue to develop as participants begin to use IBL. Participants entered with very high motivation to use IBL, and reported almost the same level after the workshop.

These findings are interesting considering participants' comments that the reading sessions were not useful because they were "already bought in" to IBL. On the whole, belief in the effectiveness of IBL rose significantly. Also, most participants' concerns about student success with IBL were dispelled. So, although participants seem to prefer the more implementation-focused content and video sessions, the reading sessions may serve an important purpose by strengthening beliefs and increasing the likelihood of implementing IBL, in addition to providing research evidence that can be used to justify its use, as discussed earlier.

Conclusion

The workshop served a diverse set of 35 mathematics instructors and met its goal of enrolling at least 60% early-career faculty. All markers indicate that the workshop was well-received and that participants gained knowledge, skills, and strengthened beliefs in IBL. Like last year, participants again felt the workshop staff's knowledge and approachability were key to supporting their learning.

Efforts to improve sessions based on last year's feedback seem to have paid off. In general, this was evidenced by fewer suggested improvements, and in some cases, more positive comments. The video sessions became participants' favorite aspect of this workshop; they made more positive comments and did not suggest any improvements other than wanting more. Participants highlighted specific videos that the leaders added based on feedback, such as the video of an entire class session.

The content, Nuts & Bolts, and reading sessions also showed improvements. While last year participants wanted more structured discussions and more examples of how to use IBL in non-proof-based courses, those concerns were almost nonexistent this time. Again, participants highlighted features that reflected specific changes workshop leaders made, such as the scaffolding of the content sessions. Taken together, feedback from this workshop was even more positive than last year's workshop. More long-term outcomes will be measured on follow-up surveys next fall.

KENYON 2014

PORTLAND 2014

Key Changes

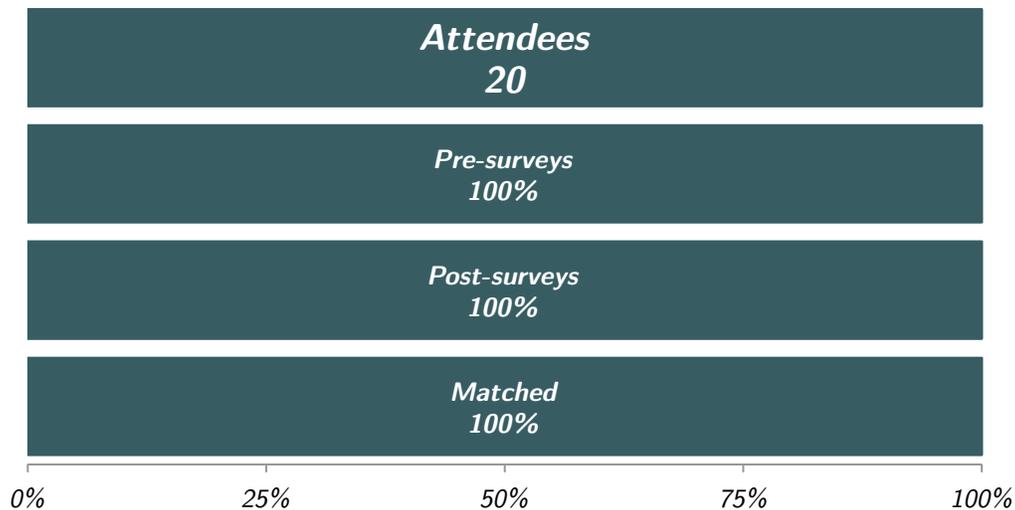
The Portland workshops ran from August 3-6, 2014 and served 20 participants. It ran directly before MathFest so that participants could combine travel to both events. In order to hold two workshops in the same summer, and because the workshop model has already been refined over multiple years, the format of the Portland workshop was almost identical to that of the Kenyon workshop. There were however some changes from the Kenyon model, including:

- 1) Facilitators from Westfield State did not attend the Portland workshop and did not present their plenary talk on using IBL in Math for Liberal Arts courses.
- 2) Angie Hodge and Dana Ernst delivered a split plenary talk covering, among other topics, their individual approaches to IBL. Angie talked about implementing IBL in large courses (such as introductory calculus) and Dana covered an 'IBL-lite' format.
- 3) The workshop served a smaller group (20 participants) than other workshops (35-40 participants) due to funding and logistics of running the workshop in conjunction with MathFest.

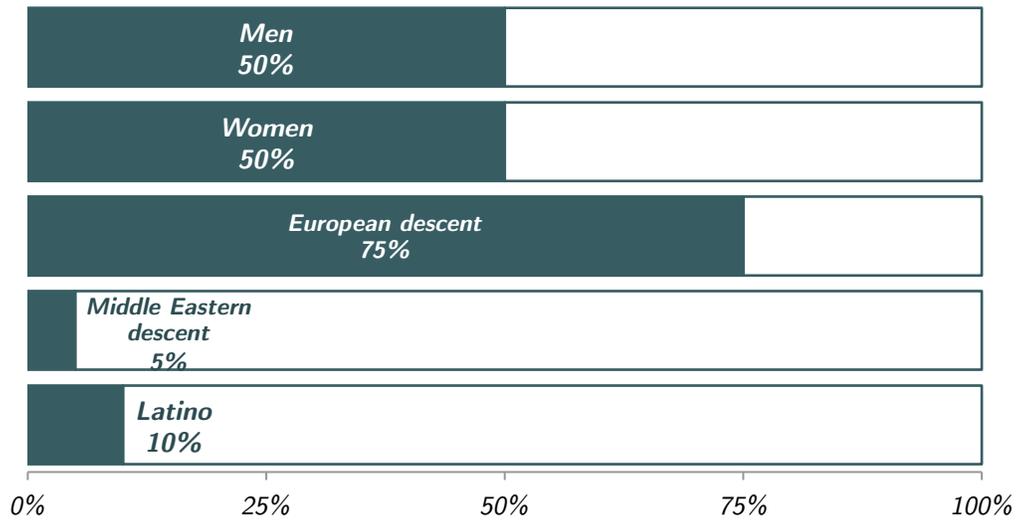
PORTLAND 2014

Pre-Workshop Surveys

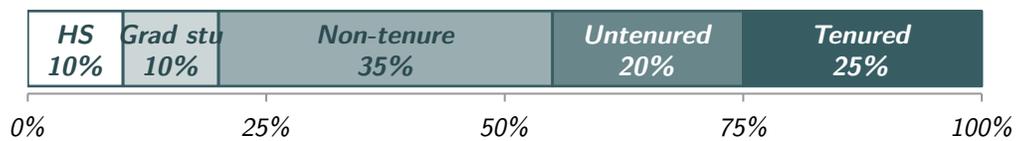
Attendance and Survey Response Rates



Demographics



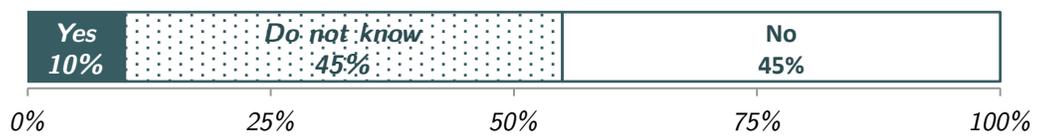
Appointment



Institution type



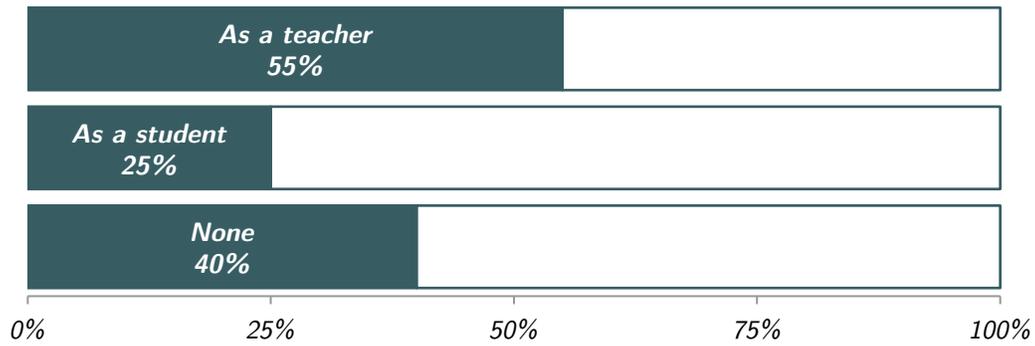
Minority-serving institution



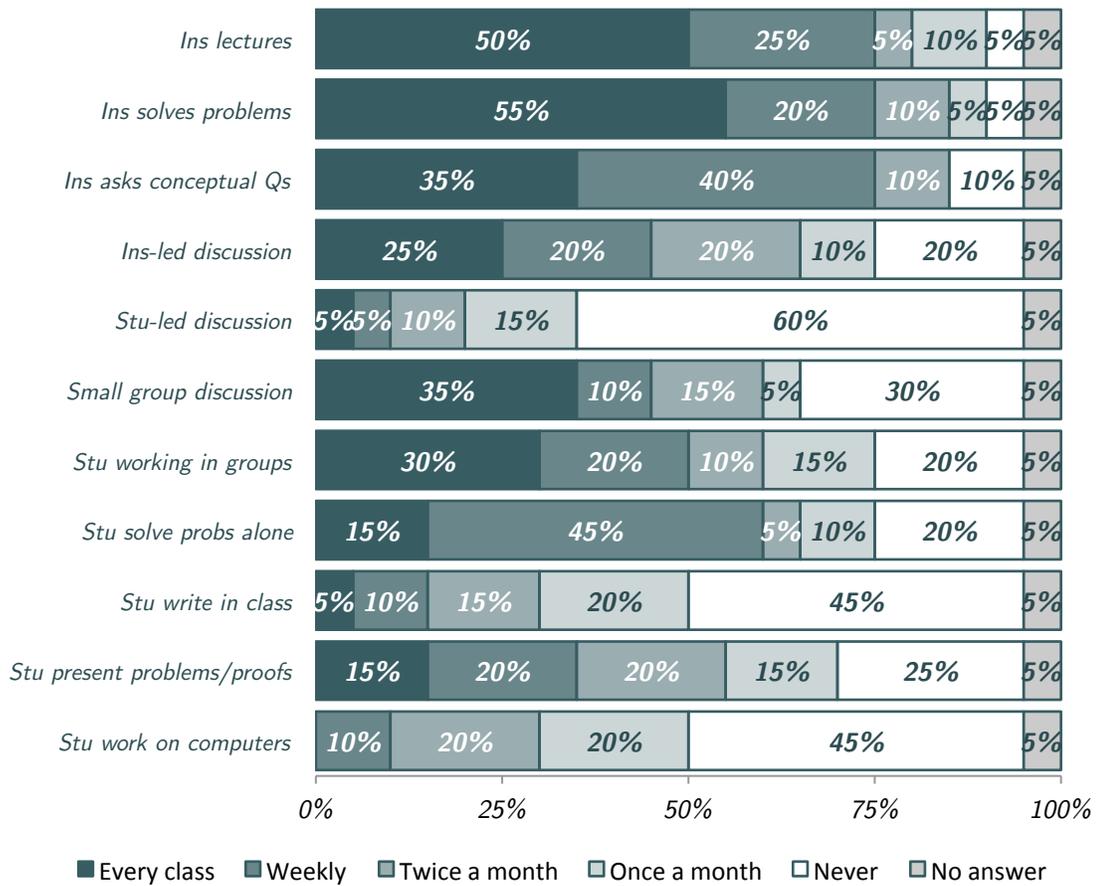
Teaching experience



Previous experience with IBL



Initial Teaching Practices



Again, due to 100% response rates on both surveys, results shared here are representative of the workshop attendees. While this group did seem to be more experienced with IBL and with teaching in general than the cohort from the Kenyon workshop, they still reported using largely traditional instructional practices. Instructor-led practices like lecturing and solving problems were the most prevalent, with 75% of participants reporting using them at least weekly.

While this workshop was below the project's goal of enrolling at least 60% early-career faculty (5 or fewer years of teaching experience), the overall project is still meeting the goal as 61% of the 97 participants have been early-career.

Post-Workshop Surveys

Bulleted lists in this section are from open-ended prompts. They list the most frequent responses and the number of participants (in parentheses) who mentioned each item.

Quality of the Workshop



- Good scheduling with ample time for breaks (6)
- Positive comments about facilities (4)
- Great workshop staff (4)

Workshop as a Learning Experience

Best aspects

- Chance to discuss with staff/peers (10)
- Videos/seeing IBL in action (9)
- Helpful & approachable staff (9)

Needs improvement

- Content sessions (9), specifically more structure (5)
- More variety of IBL examples (3)

Participants at the Portland workshop again reported high satisfaction with the workshop and logistics. Like the previous SPIGOT workshops, participants were grateful that the schedule allowed ample time for discussion and digestion of material, as well as needed breaks. Although the workshop was about half the size of previous workshops, it appears that discussions were still helpful for participants. In fact, one participant cited the small group size of 20 as the best aspect of the workshop. Again, participants found the staff helpful and approachable, and cited discussions with the staff as the best opportunities for learning. Like the Kenyon workshop earlier in the summer, participants considered the video sessions the most helpful.

Interestingly, the only common suggested improvement was the content sessions, of which about half of the comments were that they needed more structure. While the content sessions at this workshop followed the same structure that participants at the Kenyon workshop liked, participants here seem less satisfied. This may be in part due to the smaller group size. If participants had fewer same-course peers to plan with, this time may not have seemed as productive as it has to previous cohorts.

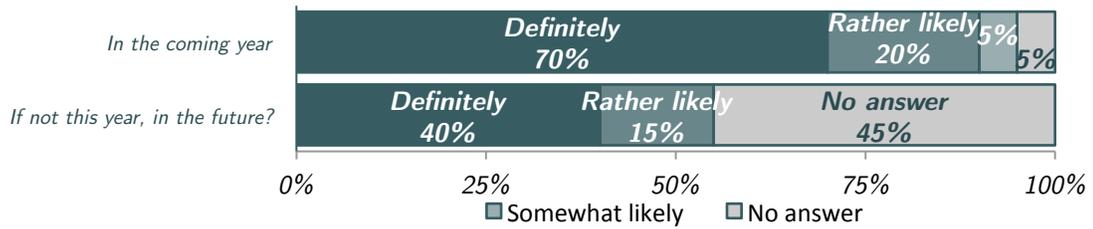
Concerns About Implementing IBL

Participants shared concerns on both pre- and post-workshop surveys. Raised concerns were mentioned on post- but not pre-, Dispelled concerns were mentioned on pre- but not post-, and Lingering were mentioned on both.

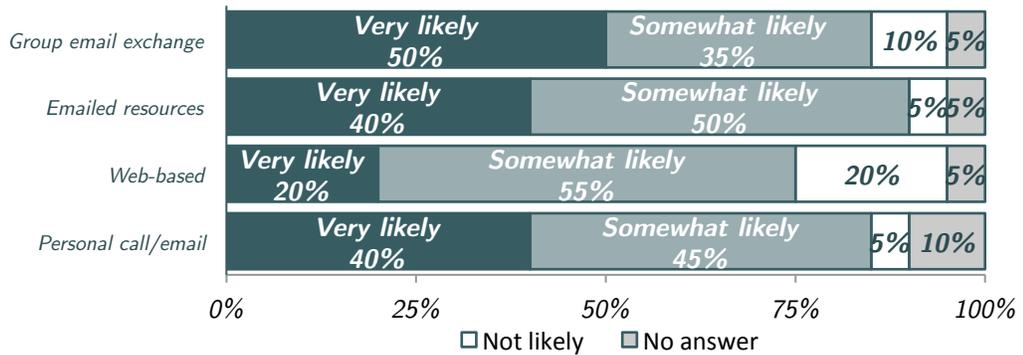
| <i>Concern</i> | <i>Raised</i> | <i>Dispelled</i> | <i>Lingering</i> |
|---------------------------------|---------------|------------------|------------------|
| ●Student resistance to IBL | 4 | 4 | 2 |
| ●Increased time/workload | 5 | 3 | 2 |
| ●Harder to cover material | 1 | 3 | 3 |
| ●Lack of skill to implement IBL | 2 | 1 | 3 |
| <i>Totals</i> | <i>12</i> | <i>11</i> | <i>10</i> |

Portland participants' concerns were very similar to those of the previous two workshops. Student resistance was again the greatest concern, as it has been for all previous IBL workshops. While concerns over the increases in time and workload for planning an IBL course are usually present, they were one of the greatest concerns at this workshop. Perhaps this is because the workshop was later in the summer and participants had less time for planning before classes began in September.

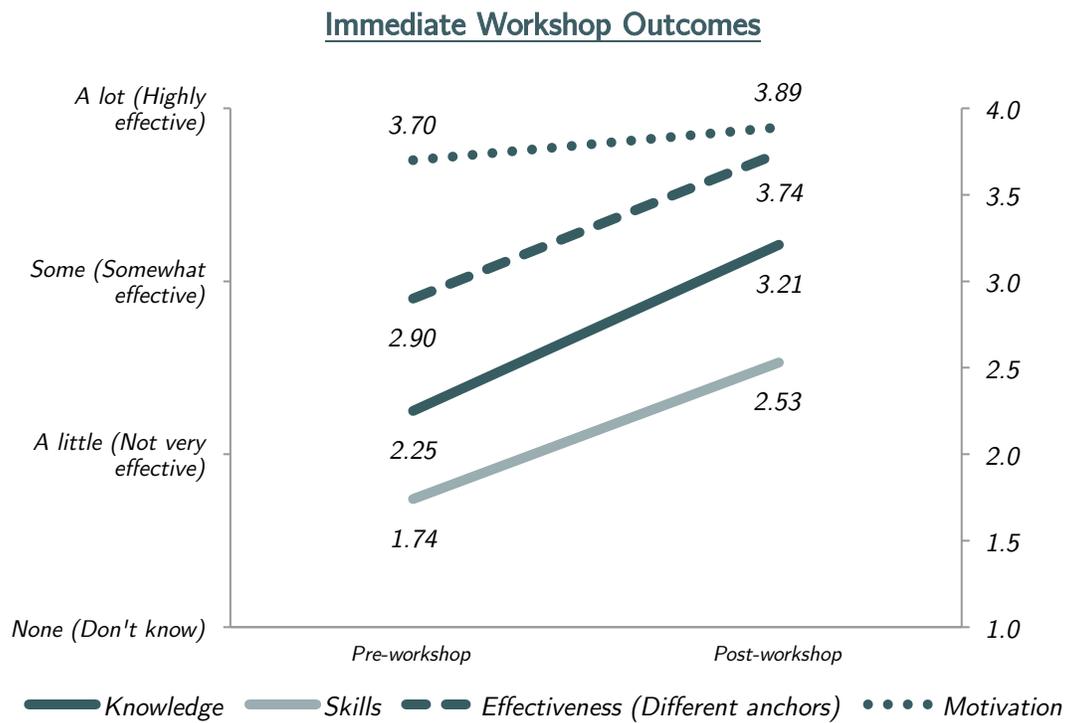
Likelihood of Implementing IBL



Support and Keeping in Touch



Pre-/Post- Comparisons



Reported levels of knowledge of IBL, skill in using IBL, and motivation to use IBL were similar to those reported in the previous workshop. Belief in the effectiveness of IBL started a bit lower than the previous two SPIGOT workshops (3.40 and 3.46, respectively). Changes were consistent with those of the previous year as well. Gains in knowledge, skills, and effectiveness were statistically significant, but the slight rise in motivation was not statistically significant.

While other cohorts have suggested that the reading sessions were not as useful, this cohort only made two comments about the reading sessions - one suggesting they be shorter, and one saying the participant's institution was already supportive. Even though participants at this workshop entered with lower beliefs in the effectiveness of IBL than the previous two workshop cohorts, their post-workshop level was consistent with the other two (3.79 and 3.86, respectively). Therefore, the evidence supporting IBL that was presented in the reading sessions may be particularly salient to less 'bought in' participants, and should be included in future efforts to spread IBL to a broader range of mathematics instructors.

Conclusion

Like the workshops before it, all markers indicate that participants were satisfied with this workshop and gained knowledge, skills, and strengthened beliefs in IBL. Again, staff were highlighted as key to supporting participants' learning.

While this workshop largely followed the same format as the successful Kenyon workshop one month before it, there were some differences. Most importantly, holding this workshop in conjunction with MathFest appears to have drawn a slightly different group than previous workshops - more experienced with general and IBL teaching, and with slightly lower beliefs in the effectiveness of IBL. These differences, while small, may indicate that these workshop models could be effective for other instructors that are not yet aware of, or interested in, using IBL methods.

Workshop organizers made an effort to develop less-experienced facilitators by having them run sessions at this workshop and deliver the plenary talk. Indicators of workshop quality and participant learning were consistent with those of the previous workshops, indicating that the SPIGOT workshop model may be portable to new facilitators and may be an effective means for training new faculty developers.

Taken together, the organizers' planned improvements to the workshop model seem successful. Efforts to focus discussions, provide specific strategies in the Nuts & Bolts sessions to address participant concerns, include more diverse video examples, and scaffold the content sessions were all reflected in more positive open-ended comments and fewer negative open-ended comments.

While ratings of workshop quality have remained steady across the three SPIGOT workshops offered, logistics ratings have increased significantly each time. This may be due to external circumstances (i.e. power and internet outages in workshop one, improving accommodations at each workshop), but also to organizers' efforts to improve. The organizers worked to improve pre-workshop communication, make resources readily available through Dropbox, and follow up with all participants.

Though it may not be clearly reflected in the survey results, organizers also made a concerted effort to make sure no participants 'fell through the cracks.' At the workshops, staff met each day to discuss how each participant was progressing and brainstorm ideas for supporting them. During ongoing follow-up efforts, staff have also been tracking who participates in the group email list, and checking in with individuals who have not been active in the group list. These efforts may be reflected more in the follow-up surveys to be conducted next fall, and may be good practices for faculty developers to personalize the workshop experience and support every participant in appropriate ways.

Collaborative Research: Supporting Pedagogical Innovation for a Generation of Transformation via Inquiry-Based Learning in Mathematics (SPIGOT) Evaluation Report 3: Workshop 4 October 2015

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

This evaluation report covers data from pre- and post-workshop surveys from the fourth SPIGOT workshop, held July 7-10, 2015 at California Polytechnic State University in San Luis Obispo, CA.

It is presented in our dashboard format to streamline the data analysis process and quickly deliver key takeaways. Detailed descriptions of the project, the data set, and the research methods are available in a previous report (Hayward & Laursen, 2013). The survey instruments and methods remain unchanged for these new workshops.

Portland 2014

CalPoly 2015

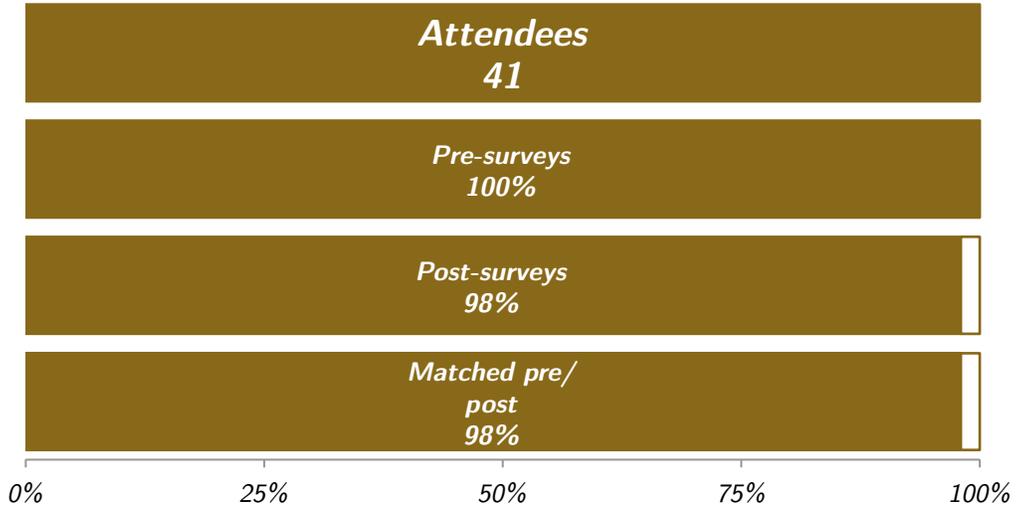
Key Changes

The CalPoly workshop was held July 7-10, 2015 and served 41 participants. Again, the workshop was broken into 4 main types of sessions: (1) Reading sessions - where participants read and discussed research about IBL and active learning, (2) Video sessions - where participants watched and analyzed IBL classes, (3) Nuts & Bolts sessions - where participants and staff discussed how to structure and run an IBL class, and (4) Course Content sessions - where participants worked in small groups, along with staff guidance, to develop materials to use in their own courses. Using feedback from participants from the three previous SPIGOT workshops, the leaders planned some improvements to their model for the 2015 workshop, including:

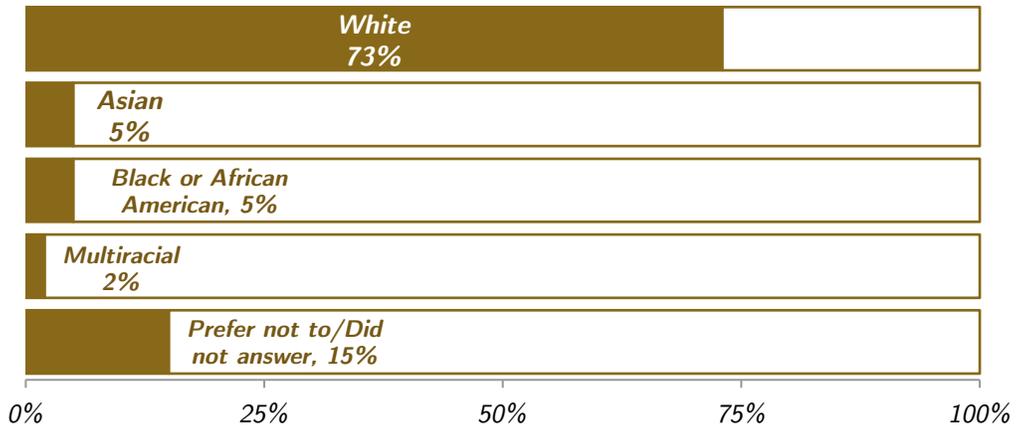
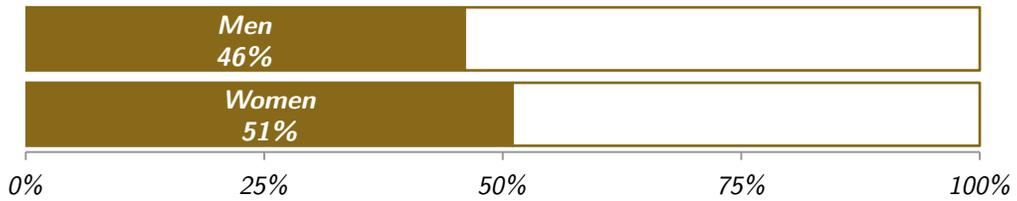
- 1) A more intentional approach for addressing student buy-in by discussing it in various sessions throughout the workshop and having participants draft their own student buy-in plans.
- 2) More focused discussions during the Reading sessions and activities to help participants translate the readings into usable takeaways, such as role playing how to use the research to address collegial pushback.
- 3) Housing as many participants and staff members as possible in shared dormitories to try to build community, similar to the Kenyon 2014 workshop.
- 4) Adding Danielle Champney, Todd Grundmeier, and Kyle Peterson as new facilitators.

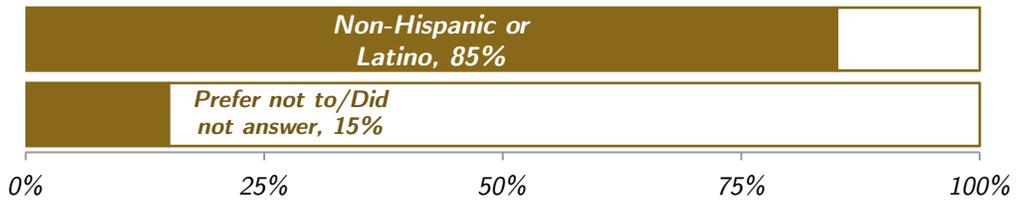
CalPoly 2015 Pre-Workshop Surveys

Attendance and Survey Response Rates

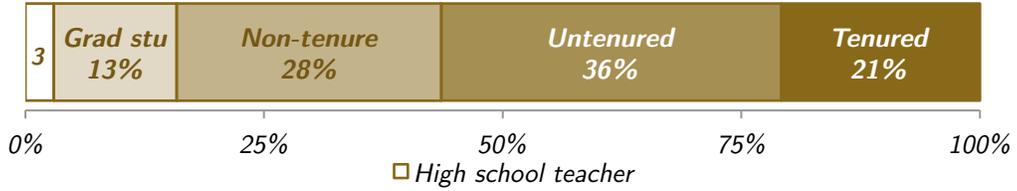


Demographics

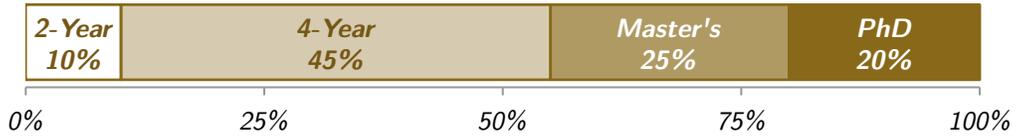




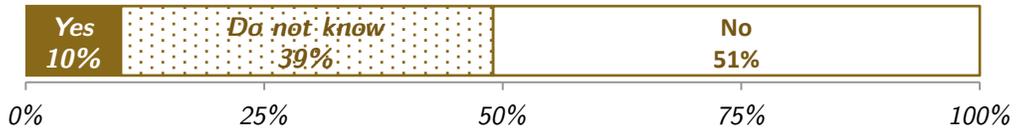
Appointment



Institution type



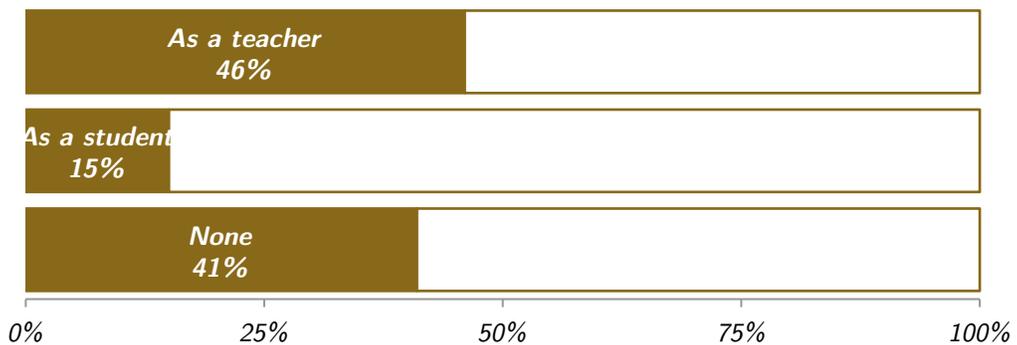
Minority-serving institution



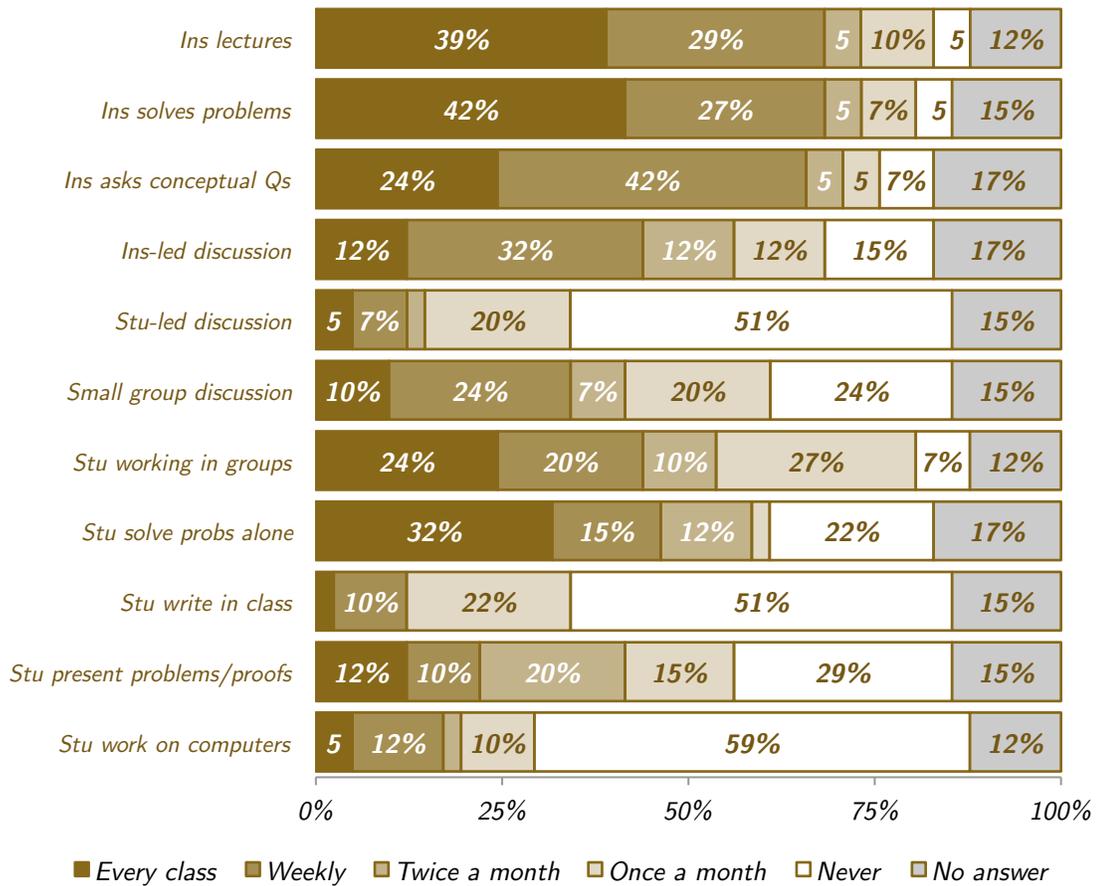
Teaching experience



Previous experience with IBL



Initial Teaching Practices



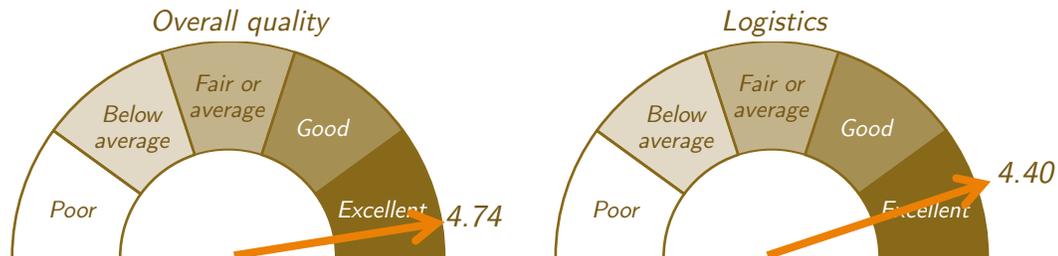
Due to very high response rates on both pre- and post-workshop surveys, results shared here are representative of the workshop attendees. Overall, participants entered the workshop with relatively little experience using IBL techniques. While 46% said they had used IBL techniques in the past, many commented that they hoped the workshop would help them get better at using IBL. The teaching practices they reported using were more consistent with traditional instruction, though group work was quite common as well.

Of note, this workshop met the project's goal of enrolling at least 60% early-career faculty since 61% of attendees had 5 or fewer years of teaching experience.

Post-Workshop Surveys

Bulleted lists in this section are from open-ended prompts. They list the most frequent responses and the number of participants (in parentheses) who mentioned each item.

Quality of the Workshop



- Good scheduling with ample time for breaks (16)
- Negative comments about food (11)
- Negative comments about schedule (8)
- Non-specific positive comments (7)

Workshop as a Learning Experience

Best aspects

- Preparing for an actual course (13)
- Chance to discuss with staff/peers (13)
- Videos/seeing IBL in action (11)

Needs improvement

- More about group style and non-proof-based courses (7)
- Discussions cut off too abruptly (5)
- More video examples (4)

Open-ended feedback shows that participants were satisfied with the workshop and the logistics. Taken together, participants' comments indicate that the workshop was well-structured and the schedule allowed ample time for appropriate activities for learning how to implement IBL, with time to discuss and digest the learning. Some feedback is similar to that from past workshops, such as participants wanting more examples of group work style IBL. Like past workshops, participants cited the open discussions with the staff and other participants as one of the best opportunities for learning, and also really appreciated seeing videos of IBL classes.

The differences between previous workshops and this one were most apparent in the feedback that was no longer present for this workshop. In the past, participants have felt that Course Content sessions lacked focus, and suggested various improvements to the Reading sessions. So, for this workshop, organizers worked to improve the Content and Reading sessions by giving participants explicit intended outcomes for each session, and by asking participants to generate specific products in some sessions. Overall, it appears organizers' efforts to improve these sessions were

successful, since this time, there were no suggested improvements to the Content sessions. In fact, preparing for their own courses in the Content sessions was the most frequently cited 'best aspect' of the workshop. Additionally, only four participants suggested improvements to the Reading sessions. Three of those just wanted more time for reading through the articles. (The other participant wanted a more holistic approach to the literature, rather than using it to address specific concerns about IBL.)

Broad consensus on comments can be revealing of areas that need change. However, for this workshop, there was little consensus on specific improvements needed, suggesting there were no commonly perceived concerns. The only emergent theme was that participants wanted more of what was being provided - more time to discuss, more examples of different IBL styles, and more videos. It is not possible to provide all of what participants asked for, but it is encouraging that participants are left wanting more.

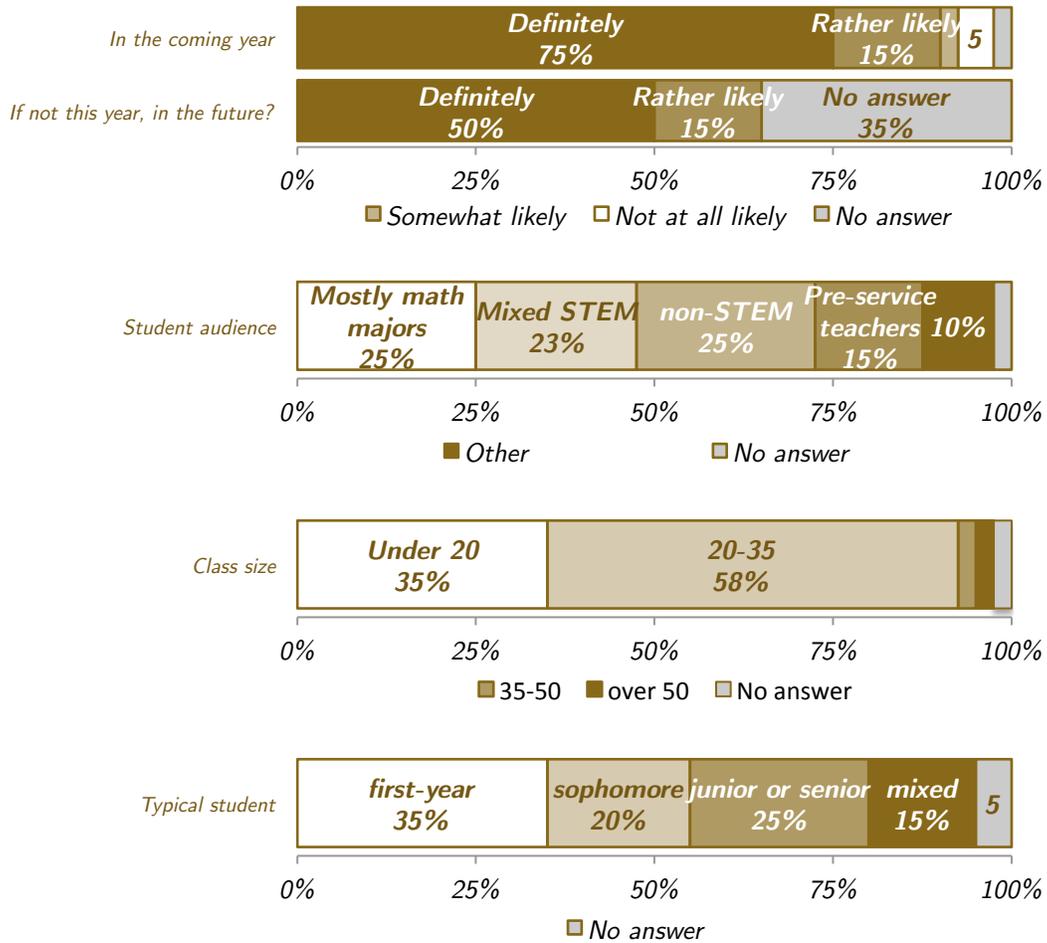
Concerns About Implementing IBL

Participants shared concerns on both pre- and post-workshop surveys. Raised concerns were mentioned on post- but not pre-, Dispelled concerns were mentioned on pre- but not post-, and Lingering were mentioned on both.

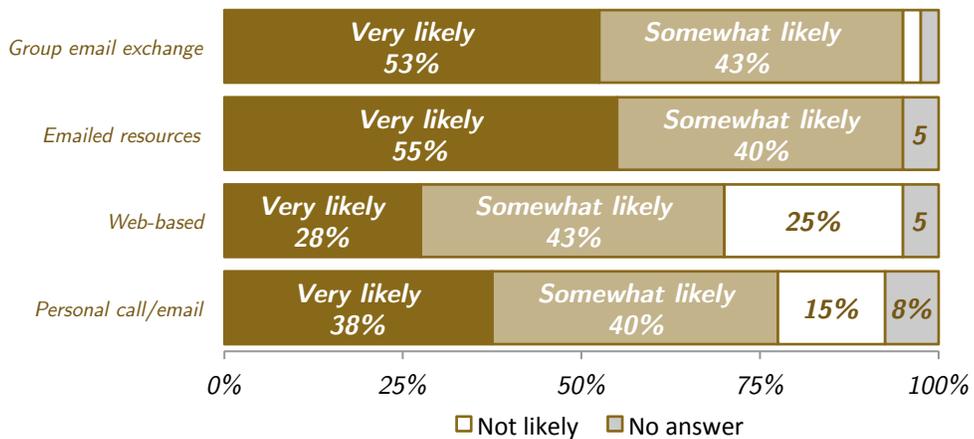
| <i>Concern</i> | <i>Raised</i> | <i>Dispelled</i> | <i>Lingering</i> |
|------------------------------------|---------------|------------------|------------------|
| ●Lack of skill to implement IBL | 16 | 4 | 4 |
| ●Student resistance to IBL | 6 | 7 | 7 |
| ●Harder to cover material | 5 | 5 | 4 |
| ●Increased time/workload | 5 | 7 | 0 |
| ●Student success with IBL | 1 | 6 | 0 |
| ●Collegial resistance/expectations | 6 | 0 | 1 |
| <i>Totals</i> | <i>39</i> | <i>29</i> | <i>16</i> |

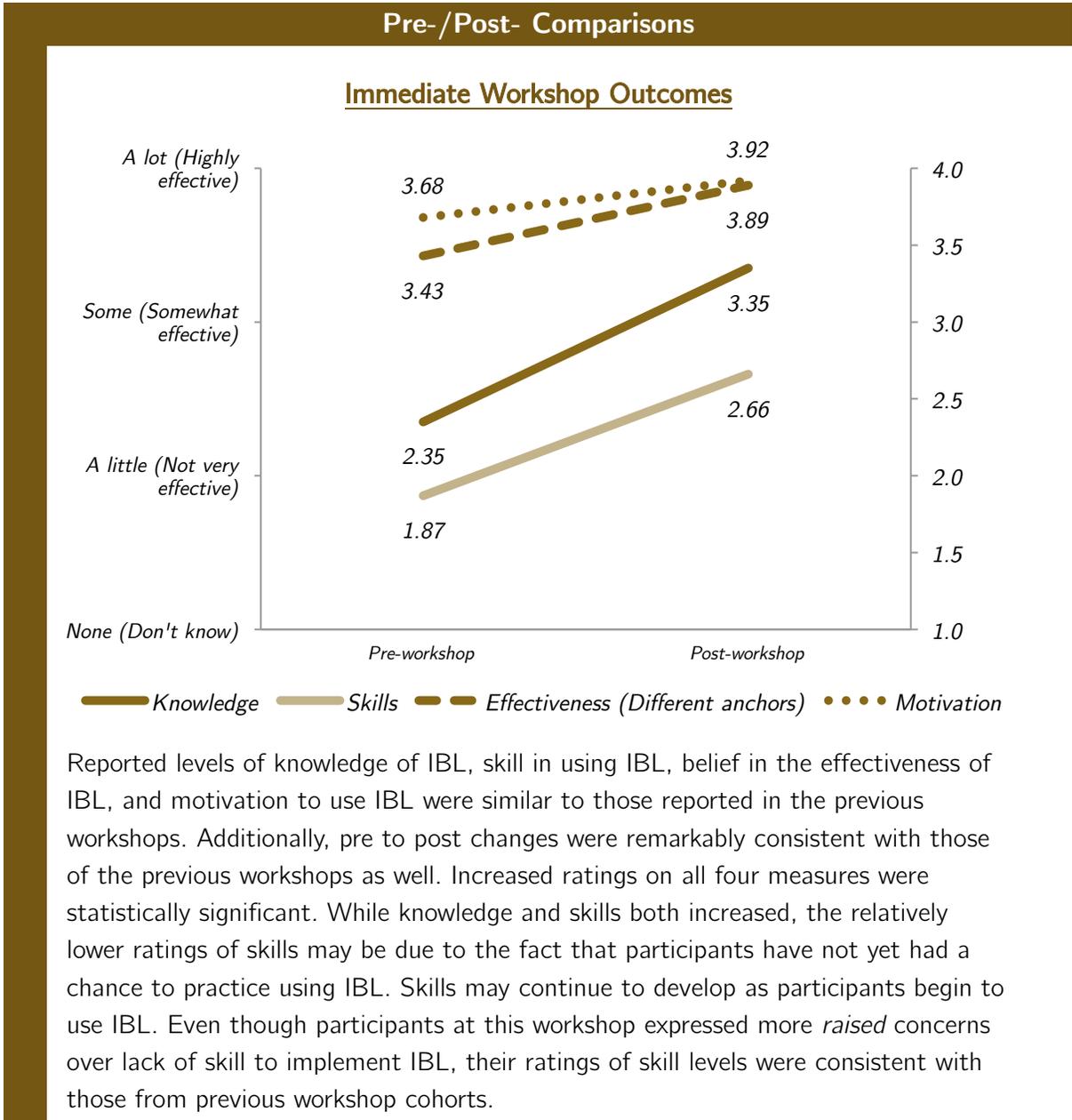
As in previous workshops, many concerns were *dispelled* by the workshop. Whereas *dispelled* concerns are normally the most numerous, this time *raised* concerns were the most numerous. This is largely due to concerns about the lack of skill to implement IBL, which surpassed the usual top-rated concern of student resistance. Concerns over lack of skill are not surprising given that these instructors have not yet had a chance to practice implementing IBL. In prior workshops, Nuts & Bolts sessions focused on the specific day-to-day skills of IBL, such as how to design a grading system or choose presenters. This year, the sessions approached 'teaching as a system,' and focused on how to make day-to-day decisions to meet overarching meta-goals. As a result, participants did not get as many examples of specific strategies. It is not yet clear whether or how this approach will impact participants' skills with implementing IBL, but it may explain some of the heightened anxiety.

Plans for Implementing IBL



Support and Keeping in Touch





Conclusion

The workshop served a diverse set of 41 mathematics instructors and met its goal of enrolling at least 60% early-career faculty. All markers indicate that the workshop was well-received and that participants gained knowledge, skills, and strengthened beliefs in IBL. Across all four SPIGOT workshops, participants have cited the workshop staff's knowledge and approachability as key to supporting their learning.

After the 2013 workshop, organizers used feedback to improve 2014's two workshops. Then, they used feedback from these two workshops to improve this 2015 SPIGOT workshop. After the 2013 workshop, organizers improved the Video sessions, but participants in 2014 still suggested improvements to the Content and Reading sessions. This year, organizers incorporated that feedback by assigning specific products for participants to create in the Reading and Content sessions. As a result, there were very few comments about more improvements that are still needed.

Overall, these examples highlight how the SPIGOT team has used participant feedback to improve their workshop model after each iteration. Quality of implementation has reached a point where participants give almost entirely positive feedback about the workshop. Over the course of the SPIGOT project, most of the main sessions (Content, Reading, and Video sessions) have been redesigned due to participant feedback. It appears organizers have successfully addressed participants' suggested improvements for these sessions.

The Nuts & Bolts sessions have been strong throughout the workshops, and were rarely the target of criticism. While participants did not suggest improvements to the Nuts & Bolts sessions, this year's shift to a macro approach of 'teaching as a system' may be related to the heightened anxiety participants expressed on surveys about their lack of skill to implement IBL. However, it is interesting that in person, participants seemed to express less anxiety at this year's workshop than at past ones.

Organizers suggested various theories about why participants seemed to have less anxiety, including changes to the Nuts & Bolts sessions. It may be that by not offering numerous examples of strategies, participants did not experience the paralysis of choice that participants may have felt in past workshops. Alternatively, it was suggested that perhaps by seeing fewer examples from experienced IBL practitioners, participants may not yet be fully aware of everything they still need to learn and the skills they still need to develop. We will analyze participants' responses

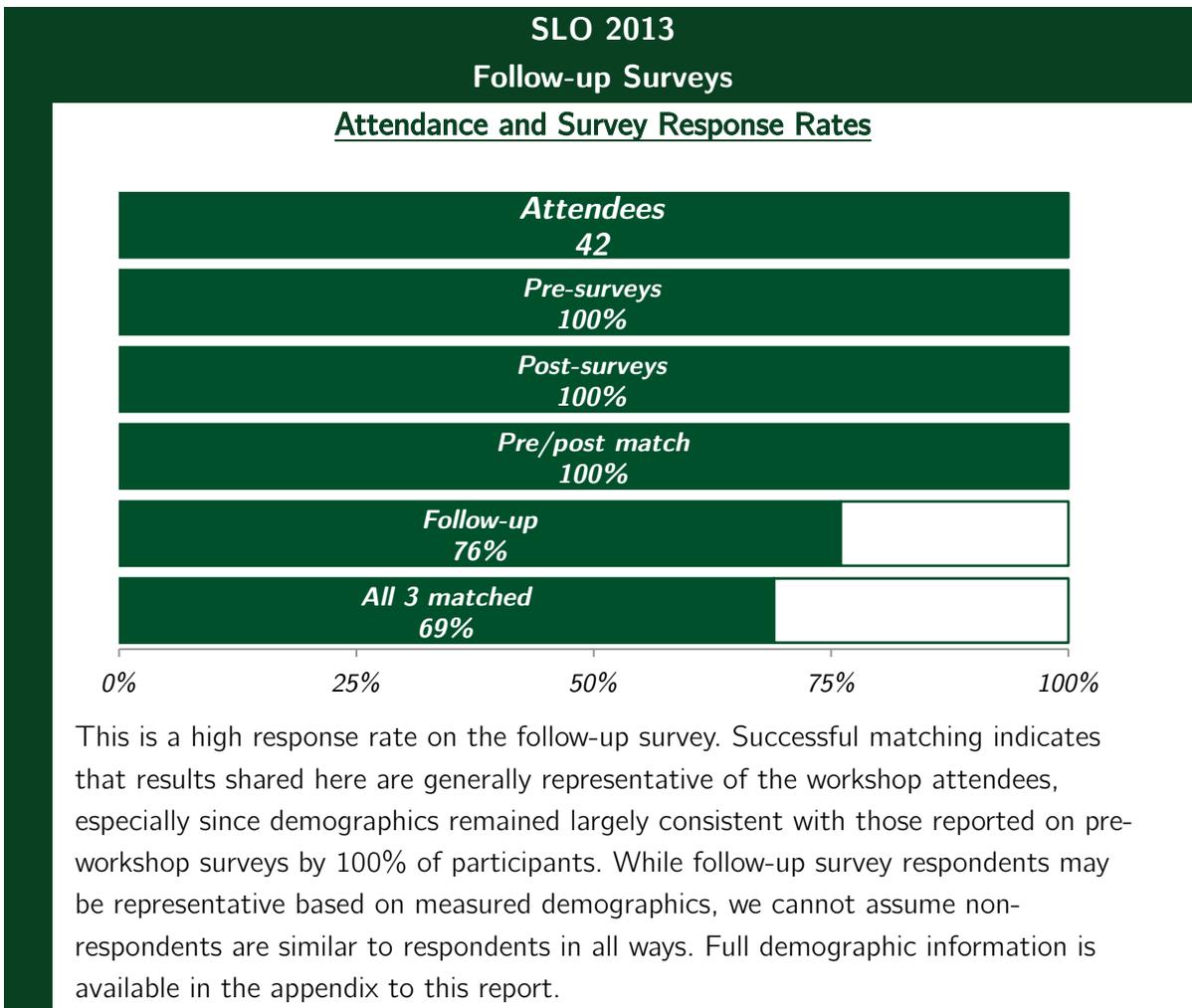
on follow-up surveys in Fall 2016 to see how these concerns will impact participants' implementation outcomes. We will compare them to the follow-up outcomes measured on one-year follow-up surveys from the other workshops. Initial outcomes for the first workshop in 2013 were strong and have been reported previously. Outcomes for the second and third workshops in 2014 will be assessed and reported later this fall.

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

Workshop 1 Follow-Up Report: May 2015

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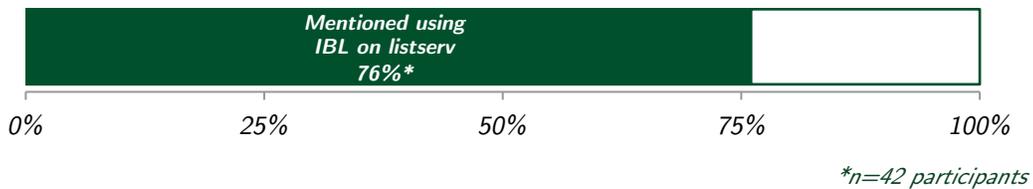
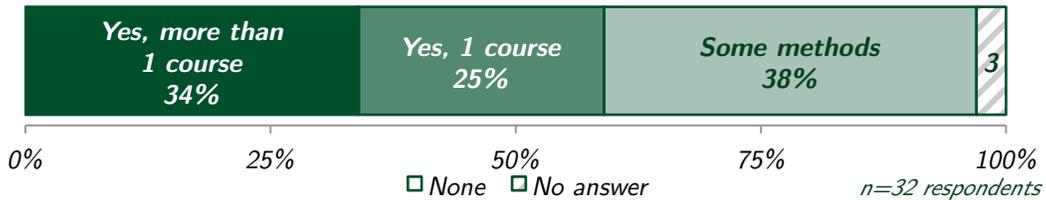
This evaluation report shares findings from a follow-up survey conducted with participants from Workshop 1, held June 24-27, 2013 at California Polytechnic State University, San Luis Obispo, CA. After a full academic year (about 15 months) following the workshop, we surveyed participants to see if they were using IBL methods in their classes and learn more about the outcomes from the workshop. Detailed descriptions of the project, the data set, and the research methods are available in the previous report (Hayward & Laursen, 2013). The follow-up surveys were administered through Survey Monkey.



Outcomes

Results shared throughout this report are only for the follow-up survey respondents (32 of 42, 76%), except where noted. Implementation rates for all participants may differ from those values presented here, as we do not know if survey non-respondents implemented in the same ways that survey respondents did.

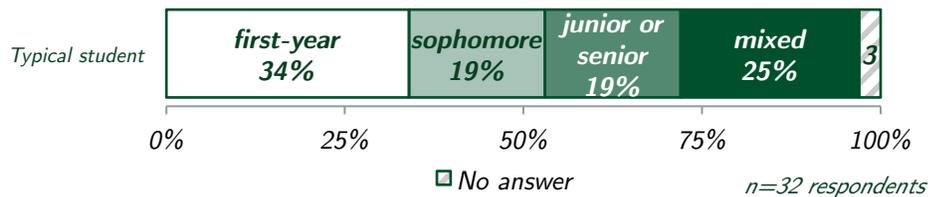
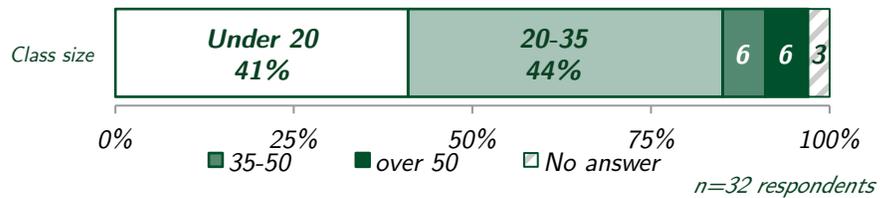
Implementation



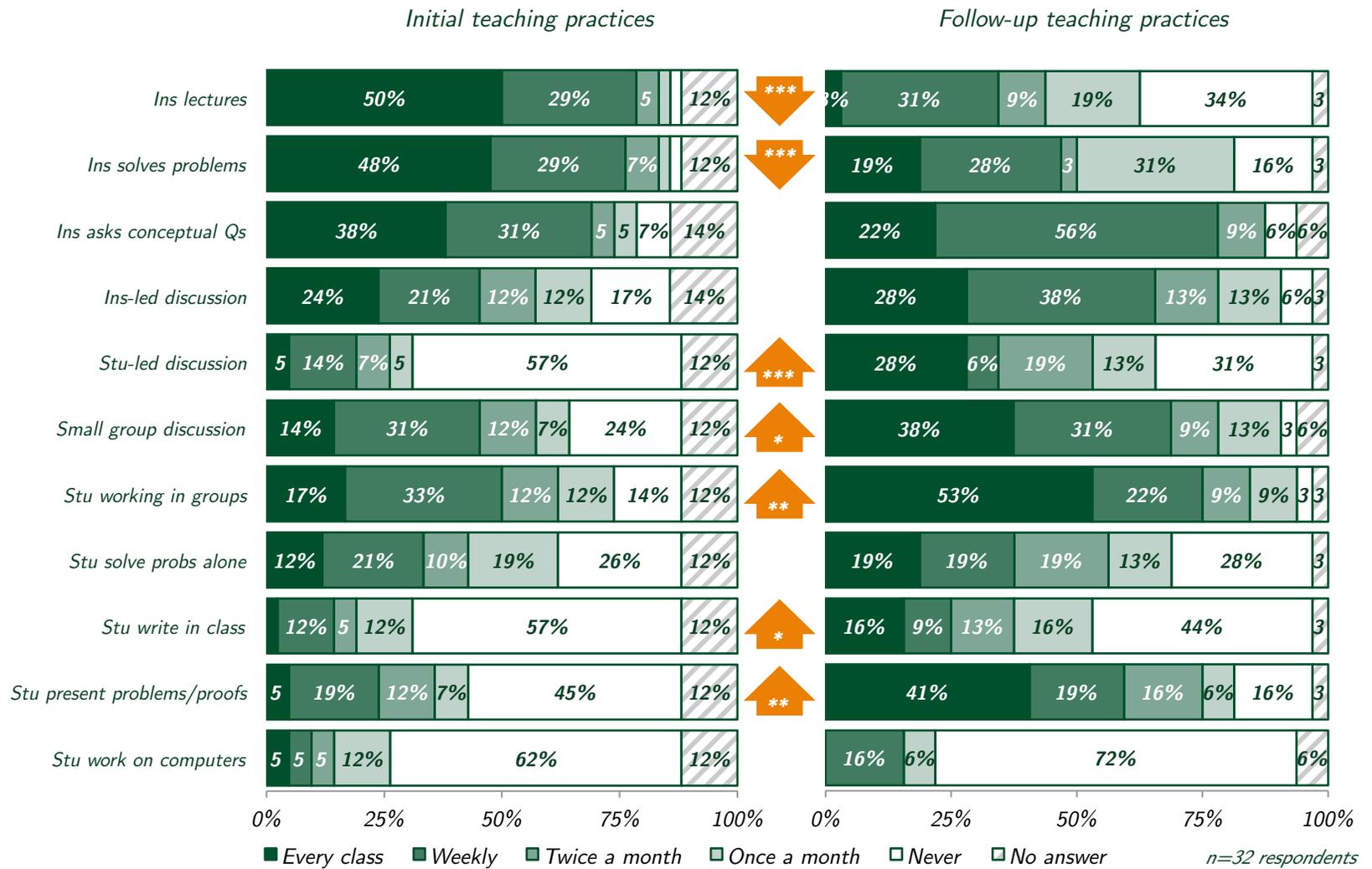
Spreading IBL to:

71+ classes **1876 students**

in the first year following the workshop.



Changes in Teaching Practices



Of those who responded to the survey, 97% reported implementing at least some IBL methods. Overall, this means at least 74% of the 42 workshop participants have implemented some IBL in the year following the workshop. This may be a low estimate, as some of the 26% who did not respond to the survey may also have implemented IBL. We also analyzed listserv traffic to measure implementation. In total, 86% of all workshop participants were active on the listserv, and 76% of all participants made comments indicating that they were implementing IBL. Again, we do not know about non-respondents, but both measures indicate at least about 75% of participants implemented IBL.

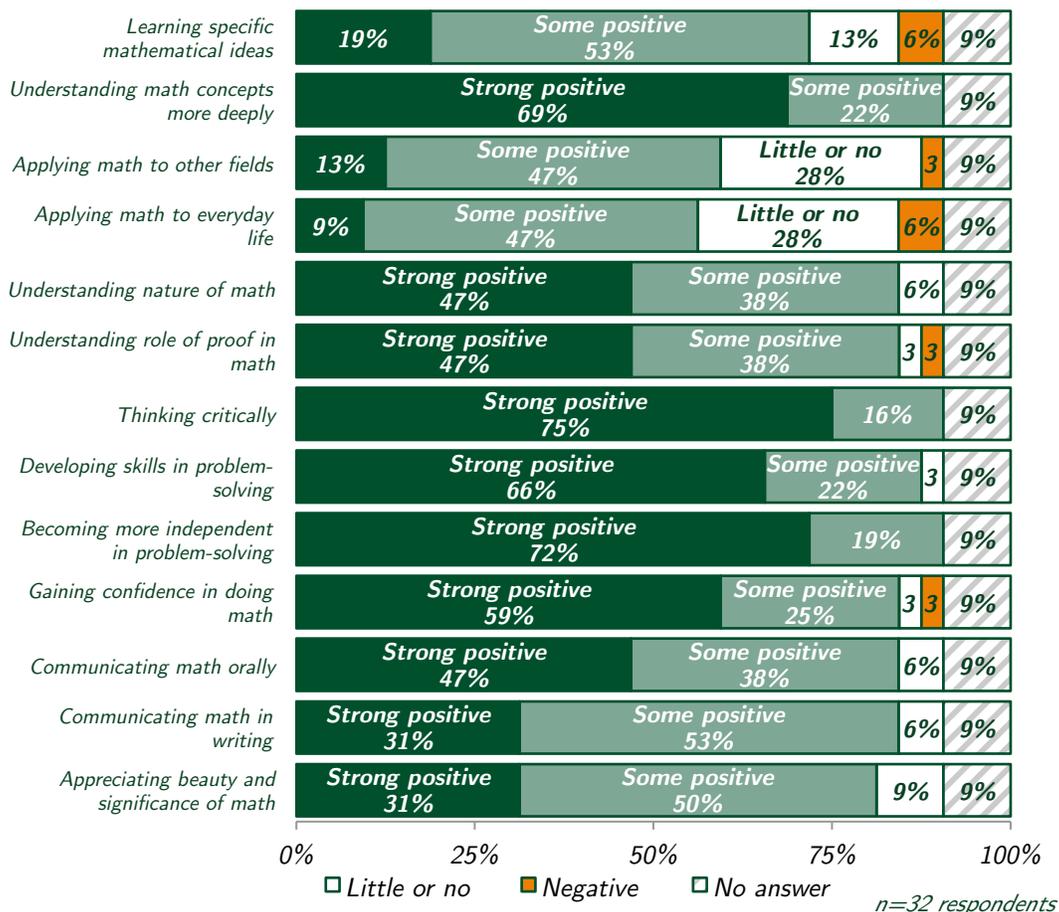
Changes in teaching practices also revealed a shift towards IBL pedagogies with significant decreases in instructor lecturing and problem solving, and significant increased in student-centered activities including student-led whole class discussions, small group discussions, group work, student individual writing in class, and student presentations.

The instructors who did implement IBL have exposed almost 1900 students to IBL methods in over 70 classes in just the first year after the workshop. Most commonly, they taught small to midsize classes (under 35 students) for math and other STEM majors of all levels. Many participants implemented IBL in calculus-track courses (10) as well as a variety of other courses such as introductions to proof (4) and abstract algebra (3). Many tried it in the fall term right after the workshop (66%).

Open-ended prompts:

Throughout the remainder of the report, we share responses to open-ended prompts, as well as to multiple choice survey items. For each open-ended prompt, the numbers in parentheses indicates how many of the 32 survey completers responded to the prompt and the number of topics that were coded in all responses. (Participants sometimes included multiple topics in their response to a prompt.) The bulleted lists show the most frequent responses and the number of participants who mentioned each topic. The numbers in the lists provide an estimate of relative importance.

Perceived Effects of IBL on Students



Greatest student benefit (26 respondents, 43 coded topics)

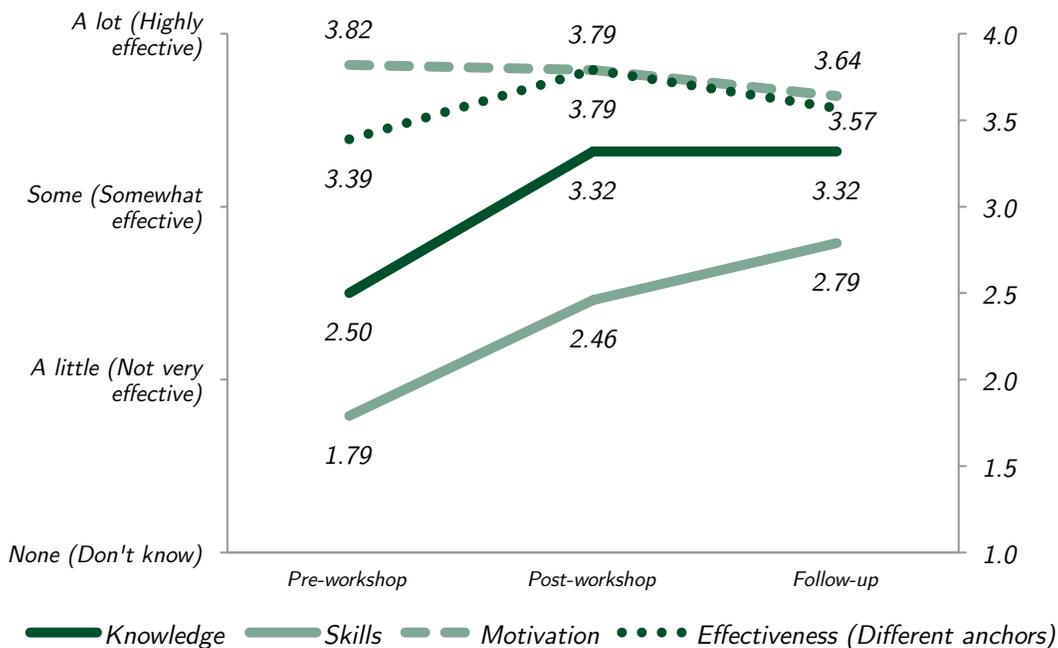
- Independence (12)
- Confidence (9)
- Deeper mathematical understanding (8)
- More engagement in class (5)

Concerns about what students may NOT gain (26 respondents, 27 coded topics)

- Coverage/exposure to certain topics (11)
- Sacrifice proficiency, i.e. need more skill practice (4)
- Not all students benefit, e.g. ESL students or more passive students (3)
- None (3)

Respondents felt that IBL had many positive effects on students, both in terms of mathematical content and affective gains. In multiple choice responses and open-ended comments, some of the strongest reported effects were on understanding concepts more deeply and becoming more independent in problem-solving. Few participants felt that IBL had negative effects, but some were concerned about coverage and reported some of weakest effects on students learning specific ideas.

Perspectives on IBL



Knowledge of IBL increased significantly post-workshop and then did not change during the follow-up period. IBL skills increased after the workshop, and increased again during the follow-up period. After increasing post-workshop, belief in the effectiveness of IBL experienced a slight, but non-significant decrease during the follow-up period. Belief in the effectiveness of IBL on the follow-up survey was not significantly different than on the pre-workshop survey. Motivation to use IBL decreased modestly on each survey, but none of these differences were significant.

Overall, these patterns indicate that participants learned a lot about IBL during the workshop. They felt they gained skill in using IBL by attending and they continued to gain skills as they implemented IBL in their own classrooms. Participants entered the workshop reporting high levels of motivation to use IBL, and these remained consistently high. Participants also entered feeling IBL was an effective teaching method. Their beliefs in its effectiveness increased after the workshop, but returned to about pre-workshop levels after implementing IBL. These patterns make sense for participants in their first year of implementing a new teaching method; while they are gaining skills, they are probably also finding it challenging. Ongoing support may be helpful for participants to work through difficulties and continue using IBL.

Feedback on the Workshop

Most useful aspect of workshop for implementing IBL (27 respondents, 45 coded topics)

- Experienced staff to share ideas (9)
- Examples of how to do IBL, learning specific strategies (8)
- Video sessions (7)
- Planning time (6)
- Diversity of ideas/implementation (5)

Use of materials participants developed at the workshop (27 respondents, 33 coded topics)

- Used materials to teach IBL course (11)
- Did not use the materials (8)
- Used selected activities (6)
- Plan to use in the future (5)
- Great practice for learning to develop other courses (3)

Other helpful resources (13 respondents, 19 coded topics)

- IBL colleagues (6)
- IBL blogs (3) or books (3)
- JIBLM (3)
- Legacy conference (2)
- AIBL mini-grants (1)

Resources desired (12 respondents, 13 coded topics)

- Contact with other IBLers (3)
- Continue the listserv (2)
- More IBL materials (2)
- Time to develop courses (2)
- None (2)

Taken together, open-ended feedback suggests that one year later, participants felt that the workshop had been useful in helping them implement IBL in their own classrooms. Specifically, participants pointed out the wealth of ideas shared by experienced staff members and through seeing videos of IBL classes. The afternoon planning sessions were also useful, as many participants used the materials they had developed, and some continued to develop them further. Even among participants who did not use the exact materials they made, some of them felt the practice was helpful in teaching them how to develop materials for other courses.

Trends in comments on resources indicate that participants valued and made use of the strong community developed at the workshop, as well as the broader community of other IBL practitioners. Participants found conversations and advice with others useful, and also borrowed from the materials available from others.

Implementation of IBL

Personal gains for instructors (24 respondents, 32 coded topics)

- Helped me be a better teacher/understand student thinking (13)
- More enjoyable (7)
- Better relationships with students (6)

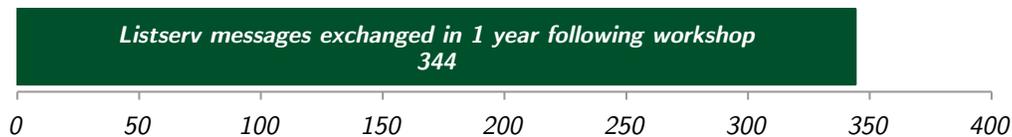
Problems experienced (27 respondents, 33 coded topics)

- Student resistance (14)
- Coverage/exposure to certain topics (6)
- IBL is challenging (4)
- Not all students benefit (4)

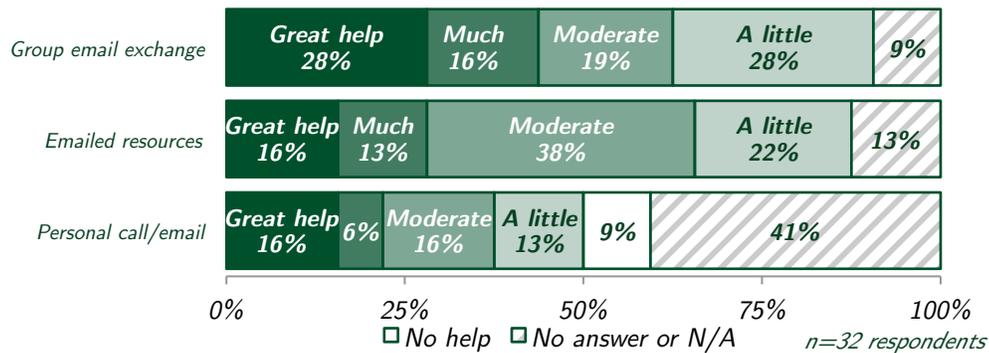
Overall, many instructors felt they were better teachers through using IBL. The problems experienced were the same as those concerns that respondents shared on pre-workshop and post-workshop surveys, coverage and student resistance. These continue to be real challenges for instructors, but on the whole, did not stop them from using IBL methods. Ongoing support should continue to provide advice and resources to help participants manage these challenges.

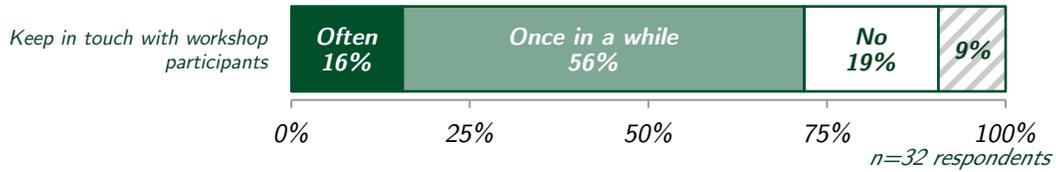
Ongoing Support

Workshop Resources

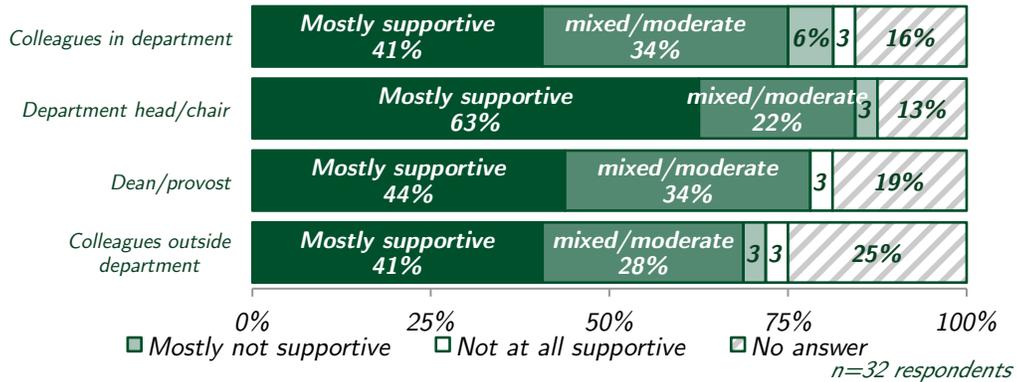


Helpfulness of e-mentoring activities





Institutional Support

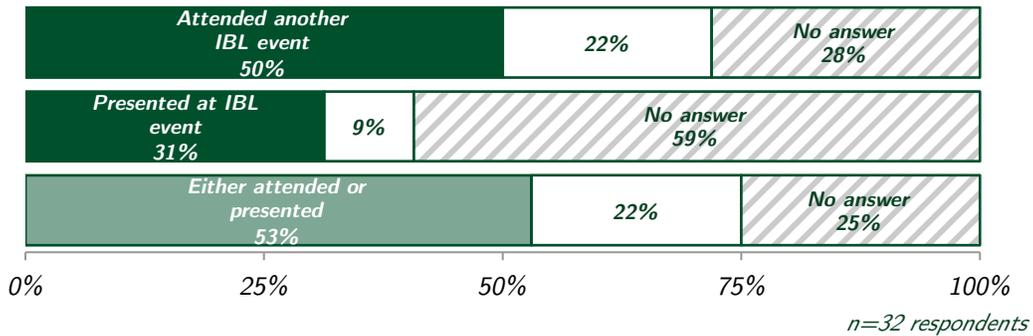


Descriptions of departmental/institutional IBL support (20 respondents, 22 coded topics)

- Encouragement - other IBL instructors or financial support/resources (10)
- Freedom to 'do what I want' (7)
- Doubtful colleagues (3)

Other IBL Supports

IBL events



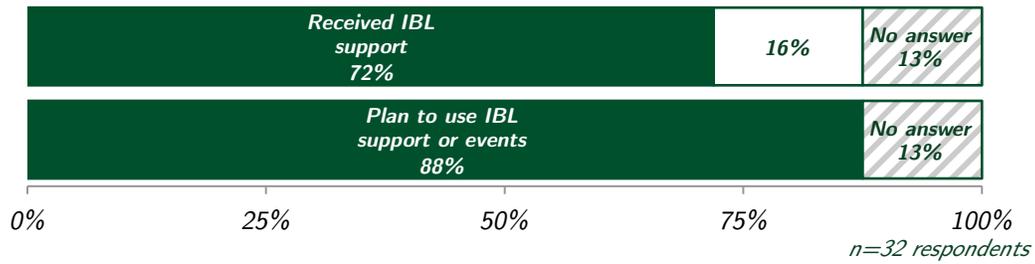
Attended

- IBL sessions at JMM 2014 (8)
- R.L. Moore Conference (7)
- IBL session at MAA meeting (6)
- IBL booth at MathFest 2014 (4)
- IBL session at MathFest 2013 (3)
- IBL poster at MathFest 2014 (3)
- Other (2)

Presented

- IBL booth at MathFest 2014 (5)
- IBL sessions at JMM 2014 (4)
- R.L. Moore Conference (3)
- IBL poster at MathFest 2014 (3)
- IBL session at MAA meeting (2)
- IBL session at MathFest 2013 (2)
- Other (0)

Use of IBL supports



Received

- Read workshop listserv (22)
- Contributed to listserv (14)
- Used notes from JIBLM (9)
- Received AIBL minigrant (7)
- Applied for AIBL minigrant (4)
- Used AIBL mentor program (4)

Plan to in the future

- Will read workshop listserv (26)
- Will attend R.L. Moore conference (18)
- Will attend IBL session at JMM (18)
- Will contribute to listserv (16)
- Will use notes from JIBLM (16)
- Will apply for AIBL minigrant (15)
- Will attend IBL session at MathFest (14)
- Will attend IBL session at MAA (14)
- Will submit notes to JIBLM (12)
- Will use AIBL mentor program (6)
- AIBL visiting speaker's bureau (2)

Like participants' open-ended feedback on the workshop, these items also indicate that many participants took advantage of the resources available from the workshop, as well as those offered by the Academy of Inquiry Based Learning (AIBL). It appears that more participants used easily accessible, electronic resources such as the listserv and JIBLM, and fewer did more intensive activities like attending conferences. In the future, most participants plan to use resources, including many who plan to attend IBL events at conferences.

Conclusion

The follow-up surveys do not offer formative feedback on the workshop like the post-workshop report did, but follow-up surveys do help organizers to understand what sticks with participants over time. Overall, the follow-up survey is most useful for learning about the impact of the workshop on participants' teaching practices. At least 74% of all workshop participants (97% of the 32 respondents) reported using at least some IBL methods in the year following the workshop. This proportion from survey self-report is almost the same as that found by analyzing messages sent through the group listserv (76% of all participants).

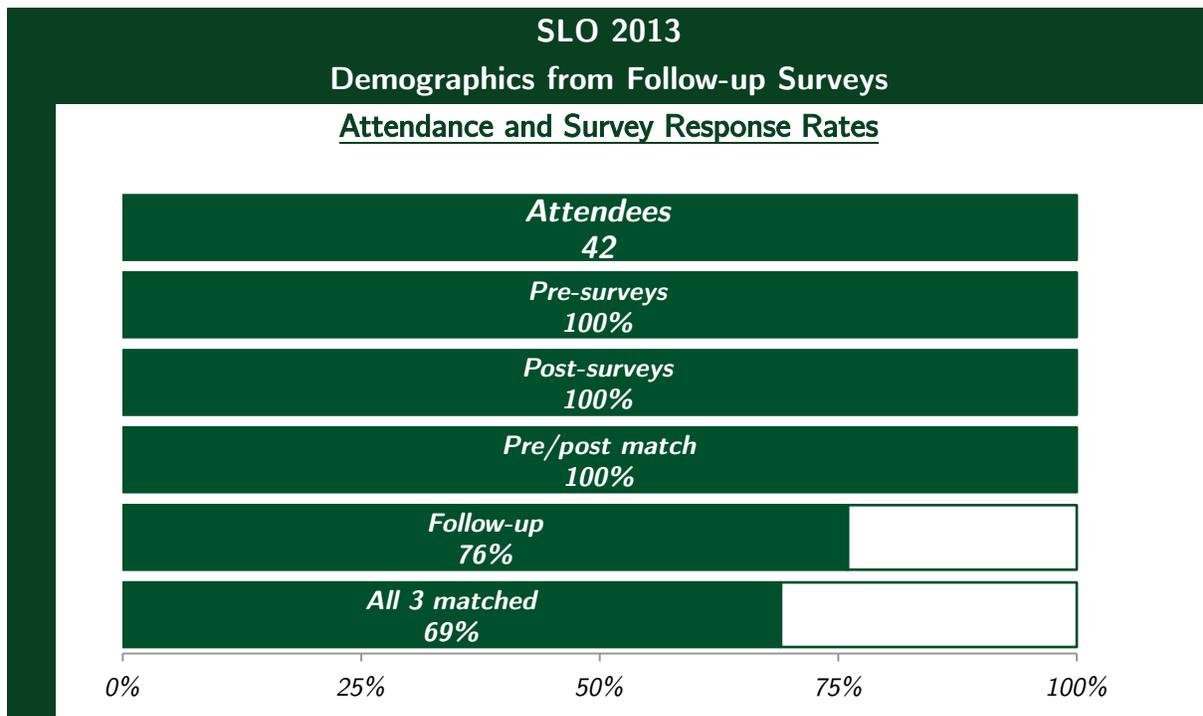
The participants have used IBL methods to teach almost 1900 students in over 70 courses in just the first year following the workshop. Despite common assumptions that IBL is just for very small upper-level math major courses, participants used IBL in a wide variety of courses. In fact, most courses did not match these assumptions as 56% of classes had 20 or more students, 63% served non-math majors, and 78% were not upper-level courses. Participants reported that using IBL had many positive effects on their students, especially deeper understanding of mathematical concepts and increased independence.

Results also indicate that follow-up support is important for participants. Almost all respondents (72%) reported using some form of support, and many used more than one. The workshop listserv was the most commonly used form of support, but patterns did not emerge with other supports. It may be important to have a variety of available supports available through the workshop, AIBL, and other sources, as it allows different participants to take advantage of whatever different resources they may find most helpful.

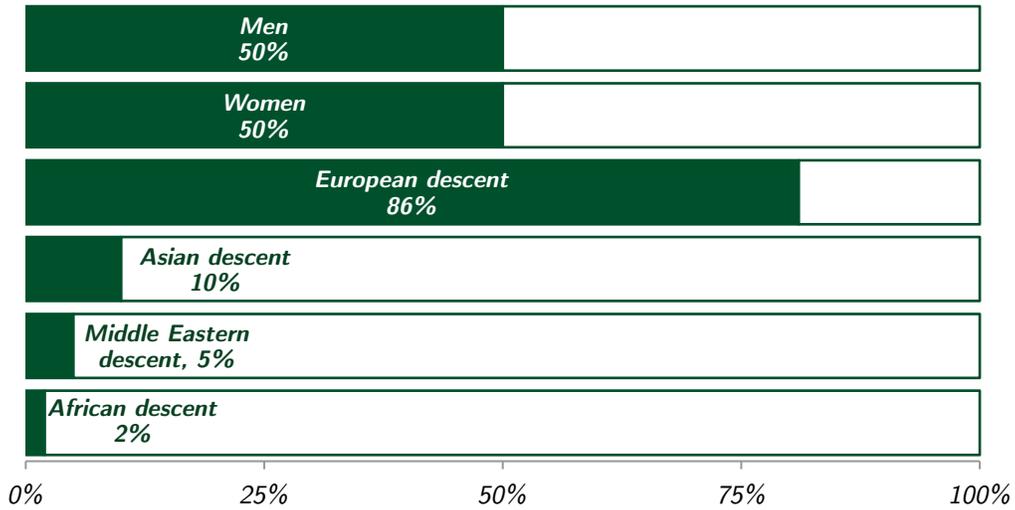
Similar to concerns noted on pre-workshop and post-workshop surveys, participants again reported student resistance and content coverage to be big concerns. While these concerns are no doubt real, participants may be perceiving them as worse than they are. For example, collegial expectations are often cited as a reason to be concerned about content coverage, but the majority of respondents reported feeling supported by their colleagues.

Appendix A: Demographic Information

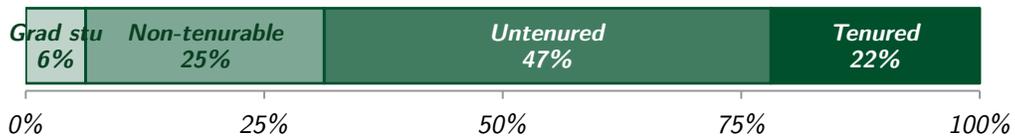
This appendix details demographic information as collected on the follow-up survey 15 months after the workshop. Overall, 76% of workshop participants responded to the online follow-up survey, and demographics are consistent with those reported by 100% of participants on the pre-workshop surveys (detailed in the workshop report, Hayward & Laursen, 2013). However, follow-up survey respondents may not be representative of all workshop participants and non-respondents may differ in ways other than measured demographic characteristics.



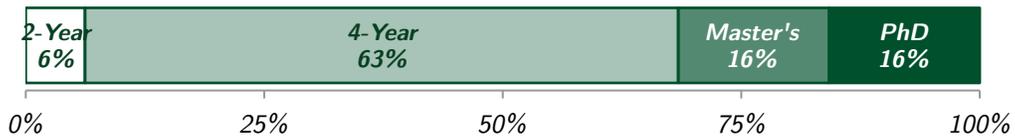
Demographics



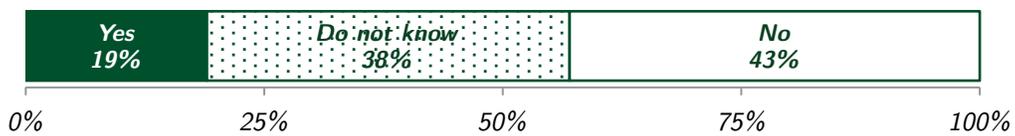
Appointment at follow-up



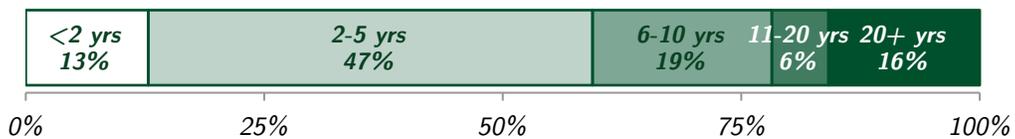
Institution type at follow-up

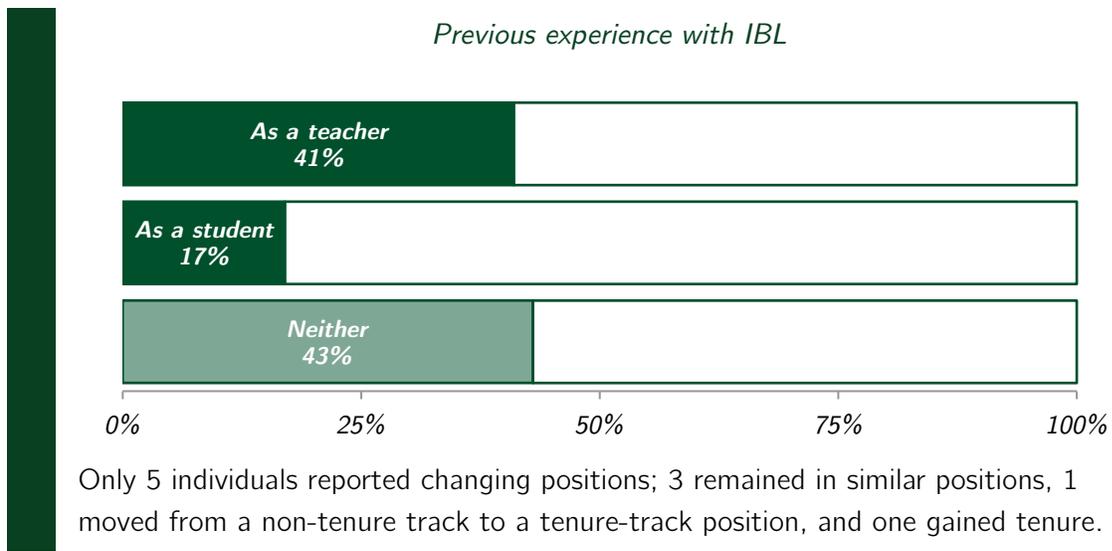


Minority-serving institution



Teaching experience at follow-up (1 year more than at pre-survey)





References

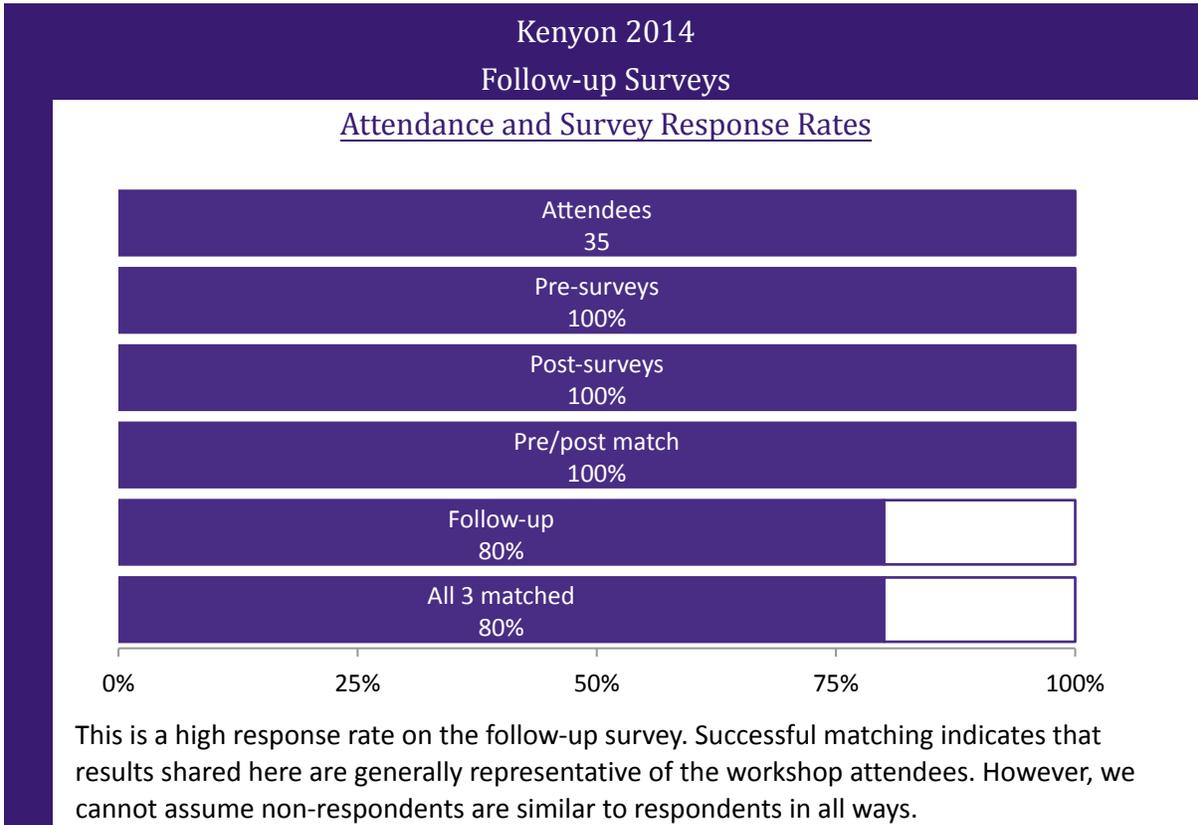
Hayward, C. & Laursen, S. (2013). *Collaborative research: Supporting pedagogical innovation for a generation of transformation via inquiry-based learning in mathematics (SPIGOT) evaluation report: Workshop 1 at California Polytechnic State University, San Luis Obispo, June 24-27, 2013*. Ethnography & Evaluation Research. Center to Advance Research and Teaching in the Social Sciences. University of Colorado Boulder.

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

Follow-Up Report 2: 2014 Workshops (#2 & #3) February 2016

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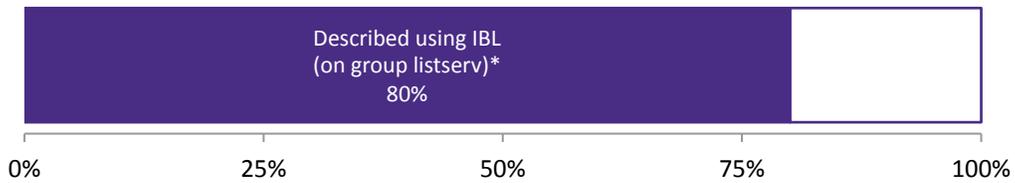
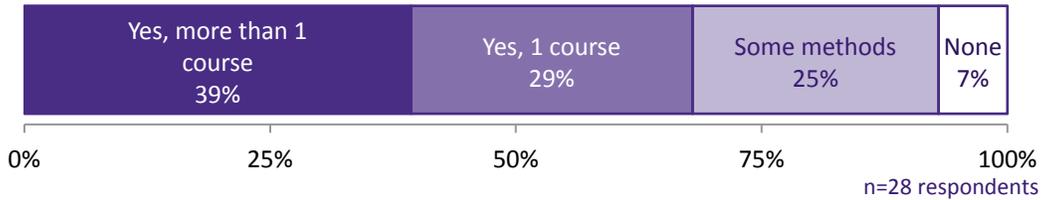
This evaluation report shares findings from the follow-up surveys conducted with participants from Workshop 2, held June 23-26, 2014 at Kenyon College, Gambier, OH, and from Workshop 3, held August 3-6, 2014 in Portland, OR. After a full academic year (about 15 months) following the workshop, we surveyed participants to see if they were using IBL methods in their classes and to learn more about the outcomes from the workshop. Detailed descriptions of the project, the data set, and the research methods are available in a previous report (Hayward & Laursen, 2013). The follow-up surveys were administered through Survey Monkey in November 2015. Results are presented separately for each of the workshops. A cumulative analysis is forthcoming.



Outcomes

Results shared throughout this report are only for the follow-up survey respondents (28 of 35, 80%), except where noted. Implementation rates for all participants may differ from those values presented here, as we do not know if survey non-respondents implemented in the same ways that survey respondents did.

Implementation



Spreading IBL to:

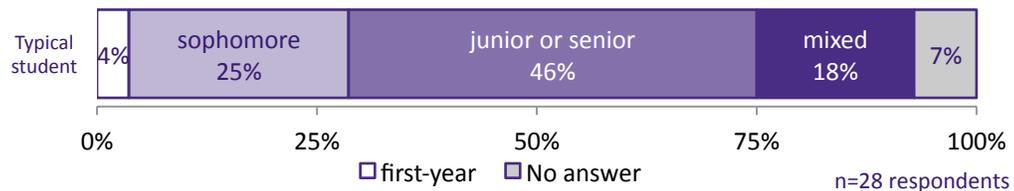
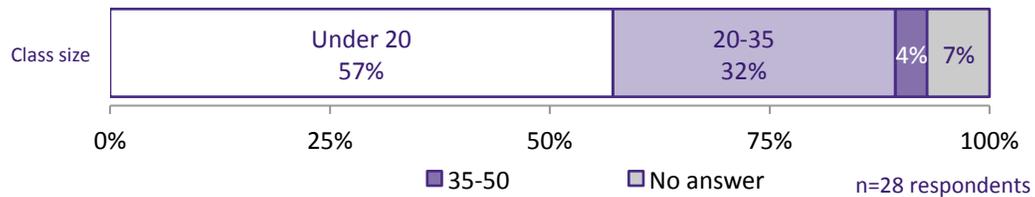
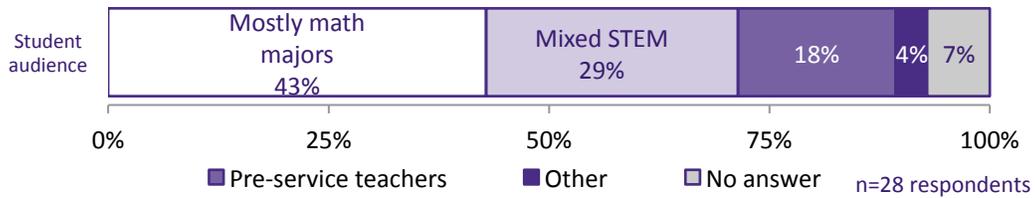
78+

classes

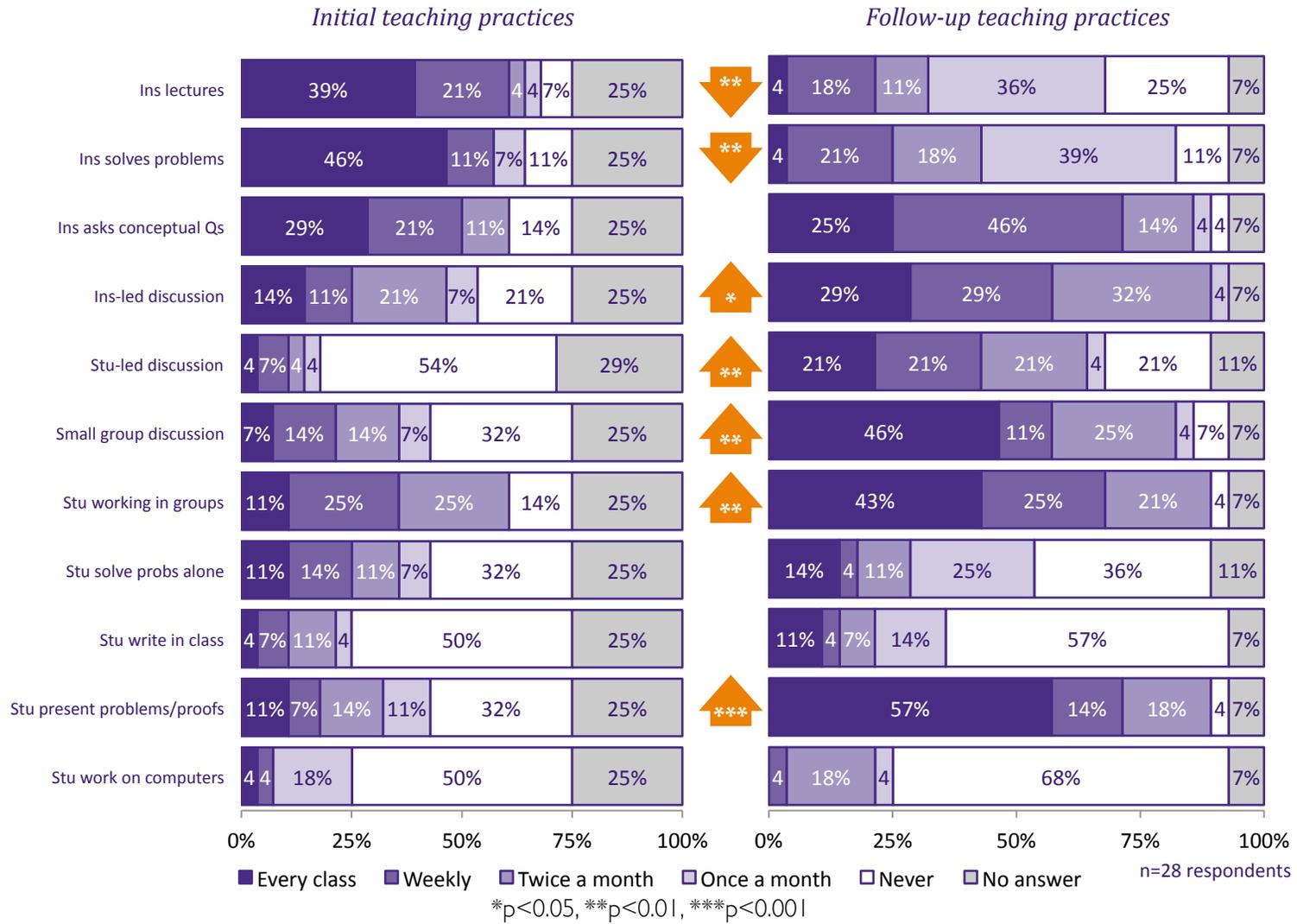
1880+

students

in the first year following the workshop.



Changes in Teaching Practices



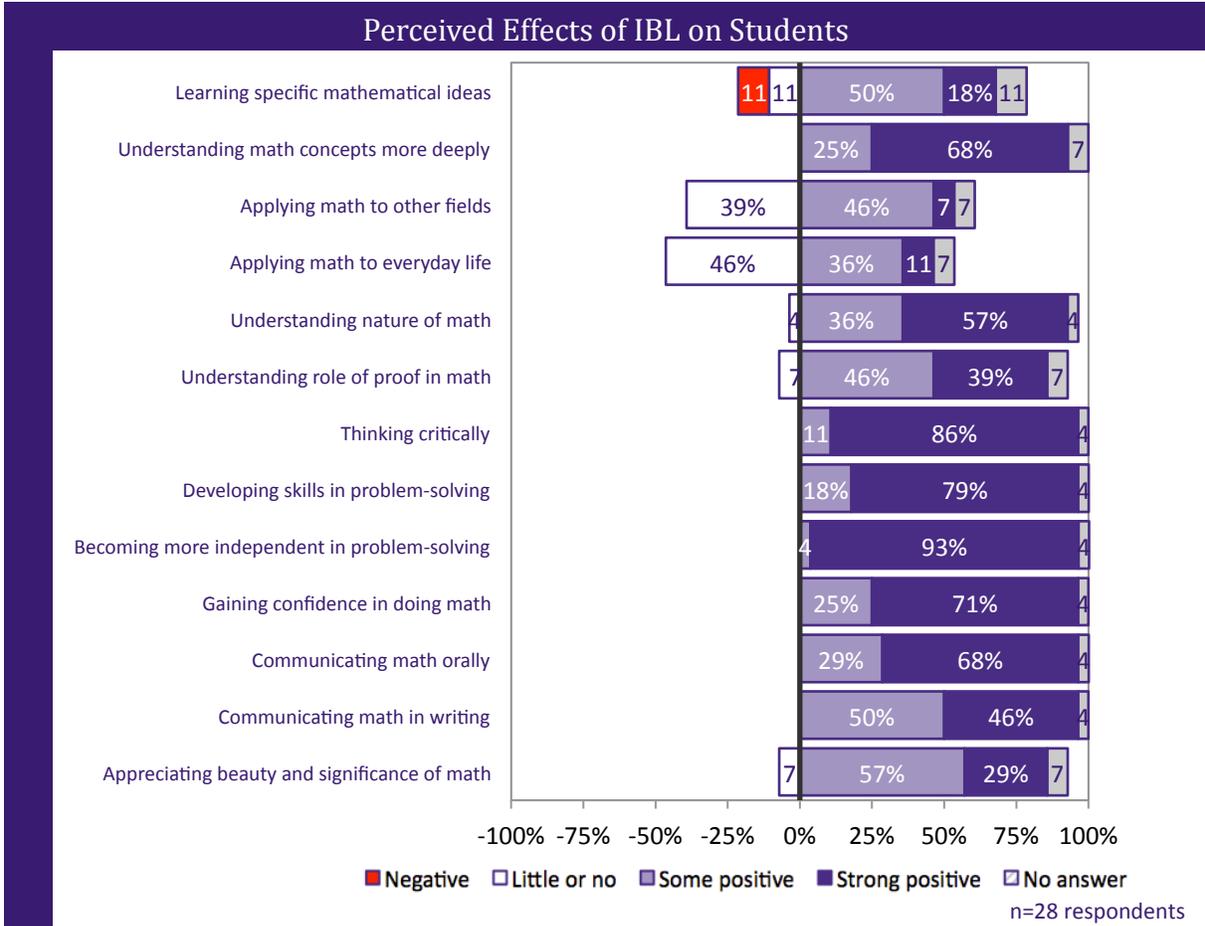
Of those who responded to the survey, 93% reported implementing at least some IBL methods. Overall, this means at least 74% of the 35 workshop participants have implemented some IBL in the year following the workshop. We also analyzed listserv traffic to measure implementation. In total, 91% of all workshop participants were active on the listserv, and 86% of all participants made comments indicating that they were implementing IBL. While we cannot directly compare survey answers with listserv implementation information, we can rule out non-responders to the two methods to get an overall implementation rate. Doing so indicates that the overall IBL implementation rate for all 35 participants is at least 89%.

Changes in teaching practices also revealed a shift towards IBL pedagogies with significant decreases in instructors lecturing and solving problems, and significant increases in student-centered activities including instructor and student-led whole class discussions, small group discussions, group work, and student presentations.

The instructors who did implement IBL have exposed almost 1900 students to IBL methods in over 78 classes in just the first year after the workshop. Most commonly, they taught small to midsize classes (under 35 students) for math and other STEM majors of all levels. Participants implemented IBL in a variety of courses, including calculus courses, linear algebra, Introduction to Proof, geometry, graph theory, and others. Many used IBL in the fall term right after the workshop (54%).

Open-ended prompts:

Throughout the remainder of the report, we share responses to open-ended prompts, as well as to multiple choice survey items. For each open-ended prompt, the numbers in parentheses indicates how many of the 28 survey completers responded to the prompt and the number of topics that were coded in all responses. (Participants sometimes included multiple topics in their response to a prompt.) The bulleted lists show the most frequent responses and the number of participants who mentioned each topic. The numbers in the lists provide an estimate of relative importance.



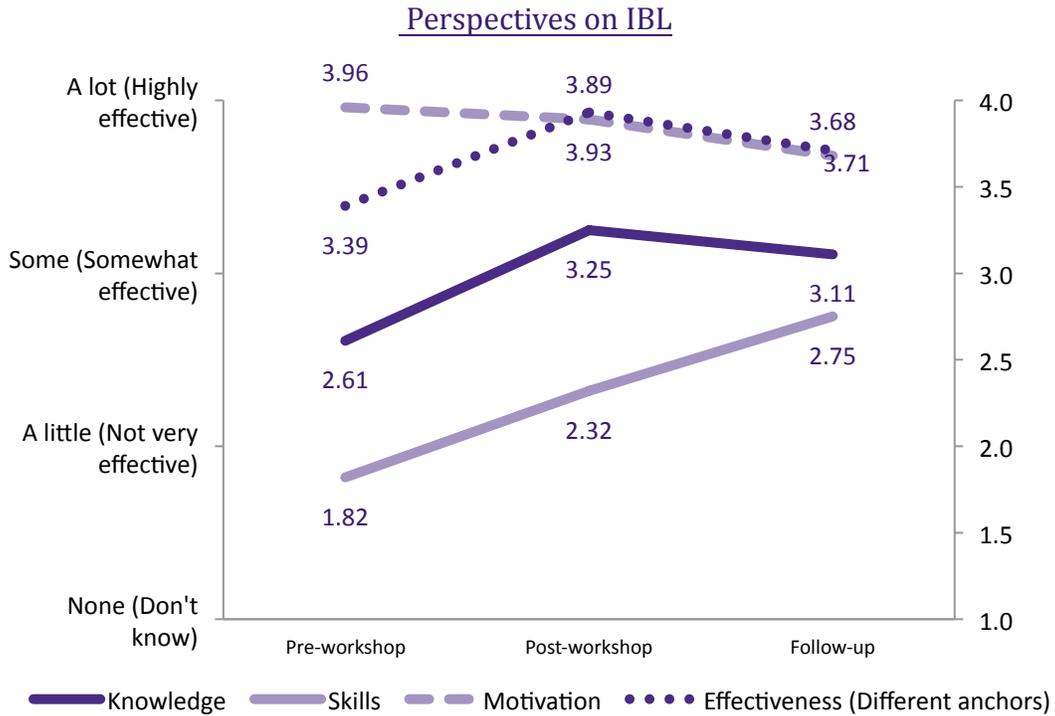
Greatest student benefit (22 respondents, 33 coded topics)

- Deeper mathematical understanding (12)
- Behave like mathematicians/ do real mathematics (6)
- More engagement in class (5)
- Improved confidence (3)

Concerns about what students may NOT gain (21 respondents, 23 coded topics)

- Coverage/exposure to certain topics (10)
- Student resistance to IBL (6)
- Students are too independent (can't judge correctness, don't learn formal names/procedures, etc.) (6)

Respondents felt that IBL had many positive effects on students, both in terms of mathematical content and affective gains. In multiple choice responses and open-ended comments, some of the strongest reported effects were that students became more independent in problem-solving and improved their critical thinking. Few participants felt that IBL had negative effects, but some were concerned about coverage and student residence. Participants reported some of weakest effects on applying math to everyday life and to other fields.



Knowledge of IBL increased significantly post-workshop and then did not change significantly during the follow-up period. IBL skills increased after the workshop, and increased again during the follow-up period. After increasing post-workshop, belief in the effectiveness of IBL experienced a slight decrease during the follow-up period. Belief in the effectiveness of IBL on the follow-up survey was not significantly different than on the pre-workshop survey. Motivation to use IBL decreased modestly on each survey, but these differences were not significant. However, motivation to use IBL was significantly lower on the follow-up survey than on the pre-workshop survey. These ratings and trends are consistent with those from previous IBL workshops.

Overall, these patterns indicate that participants learned a lot about IBL during the workshop. They felt they gained skill in using IBL by attending and they continued to gain skills as they implemented IBL in their own classrooms. Participants entered the workshop reporting high levels of motivation to use IBL. Although participants' reported motivation to use IBL did drop, it still remained quite high on the scale. Participants also entered feeling IBL was an effective teaching method. Their beliefs in its effectiveness increased after the workshop, but returned to about pre-workshop levels after implementing IBL. These patterns make sense for participants in their first year of implementing a new teaching method; while they are gaining skills, they are probably also finding it challenging. Ongoing support may be helpful for participants to work through difficulties and continue using IBL.

Feedback on the Workshop

Most useful aspect of workshop for implementing IBL (25 respondents, 33 coded topics)

- Video sessions (11)
- Examples of how to do IBL, learning specific strategies (6)
- Planning time (5)
- Experienced staff to share ideas (3)
- Motivation/ encouragement/ confidence to use IBL (3)

Use of materials participants developed at the workshop (24 respondents, 28 coded topics)

- Used materials to teach IBL course (10)
- Used selected activities (9)
- Plan to use in the future (4)
- Did not use the materials (3)

Other helpful resources (16 respondents, 23 coded topics)

- JIBLM/ other course notes (7) and IBL books (7)
- IBL colleagues (4)
- Legacy conference (2)

Resources desired (15 respondents, 16 coded topics)

- Contact/ networking with other IBLers (5)
- Time to develop courses (3)
- Advice and additional ideas for IBL courses (3)
- More IBL materials (2)
- Access to videos of IBL classes (2)

Taken together, open-ended feedback suggests that one year later, participants felt that the workshop had been useful in helping them implement IBL in their own classrooms. Whereas participants from the prior workshop most frequently identified the staff as the most helpful aspect of the workshop, participants from this workshop identified the video sessions, examples of specific strategies, and planning time more frequently than they did the staff. This may be due to the reworking and strengthening of the video, Nuts & Bolts, and content sessions that organizers did between workshop 1 and 2. However, it also suggests that the most useful aspects of the workshops have shifted to the features of the workshop model itself, rather than the individuals running the workshops. This is an encouraging finding for the upcoming ProDUCT project, which aims to train others to implement the SPIGOT workshop model.

Participants took advantage of other resources offered throughout the IBL community, including books and shared course notes. Participants valued the network of other IBLers they already had, but also wanted to meet and work with even more IBL practitioners.

Implementation of IBL

Personal gains for instructors (21 respondents, 30 coded topics)

- Helped me be a better teacher/understand student thinking (12)
- More enjoyable way to teach (8)
- Better relationships with students (4)
- Improved instructor's own mathematical ability (4)

Problems experienced (23 respondents, 34 coded topics)

- Student resistance (19)
- Implementing IBL is challenging (e.g. managing group work & presentations) (6)
- Coverage/exposure to certain topics (4)
- IBL takes more time to plan and implement (4)

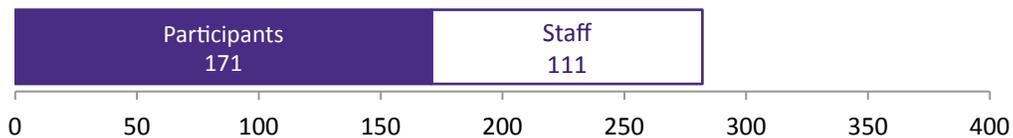
Overall, many instructors felt they were better teachers through using IBL. The main problems they experienced were the same as those concerns that respondents shared on pre-workshop and post-workshop surveys: coverage, the difficulty of implementing IBL, and student resistance. These continue to be challenges for instructors, but on the whole, did not stop them from using IBL methods. Ongoing support should continue to provide advice and resources to help participants manage these challenges and improve their skills as IBL instructors.

Ongoing Support

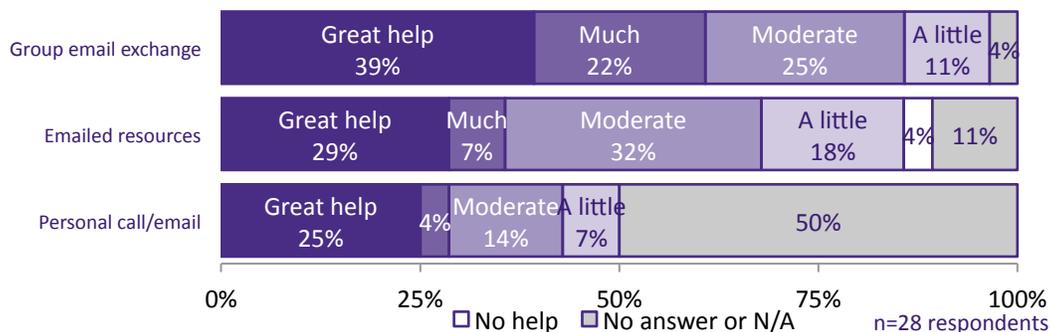
Workshop Resources

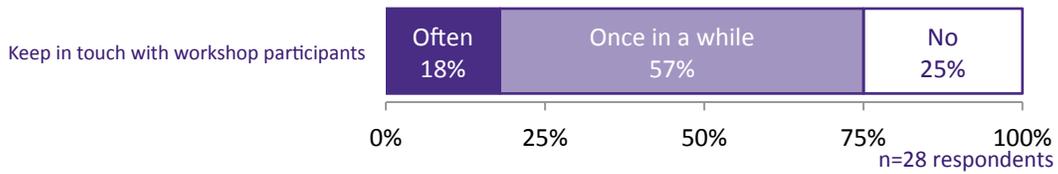


Group listserv messages in one year following workshop

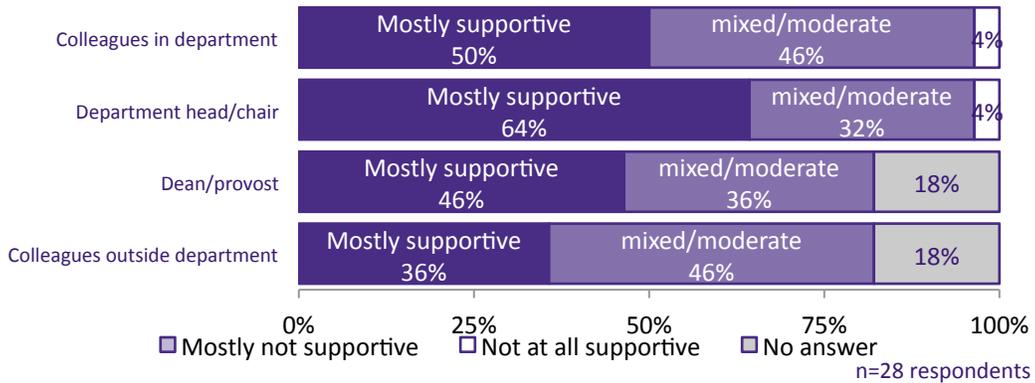


Helpfulness of e-mentoring activities





Institutional Support

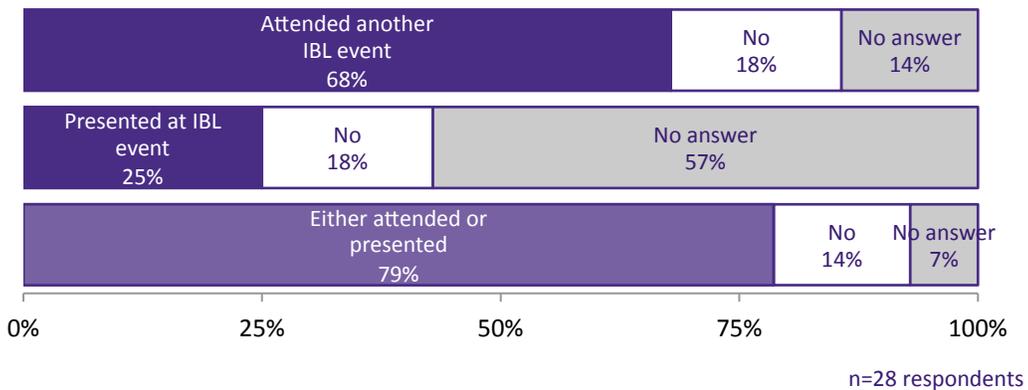


Descriptions of departmental/institutional IBL support (21 respondents, 23 coded topics)

- Encouragement - other IBL instructors or financial support/resources (12)
- Freedom to 'do what I want' (5)
- Doubtful or discouraging colleagues (3)

Other IBL Supports

IBL events



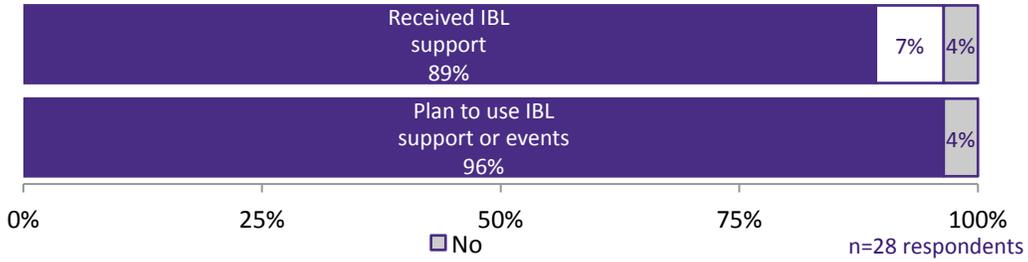
Attended

- IBL sessions at JMM 2015 (10)
- IBL session at MAA meeting (9)
- IBL booth at MathFest 2014 (6)
- Legacy of R.L. Moore/IBL Conference (5)
- IBL poster at MathFest 2014 (2)
- Other (2)

Presented

- Legacy of R.L. Moore/IBL Conference (4)
- IBL sessions at JMM 2015 (3)
- IBL session at MAA meeting (3)
- IBL booth at MathFest 2014 (1)
- IBL poster at MathFest 2014 (1)
- Other (0)

Use of IBL supports



Received

- Read workshop listserv (21)
- Contributed to listserv (13)
- Used notes from JIBLM (12)
- Used AIBL mentor program (4)
- Received AIBL minigrant (3)

Plan to in the future

- Will use notes from JIBLM (20)
- Will read workshop listserv (18)
- Will attend Legacy of R.L. Moore/IBL Conference (16)
- Will attend IBL session at JMM (15)
- Will contribute to listserv (15)
- Will apply for AIBL minigrant (13)
- Will attend IBL session at MAA (12)
- Will submit notes to JIBLM (10)
- Will attend IBL session at MathFest (8)
- Will use AIBL mentor program (8)
- AIBL visiting speaker's bureau (2)

Like participants' open-ended feedback on the workshop, these items also indicate that many participants took advantage of the resources available from the workshop, as well as those offered by the Academy of Inquiry Based Learning (AIBL). It appears that more participants used easily accessible, electronic resources such as the listserv and JIBLM, and fewer did more intensive activities like attending conferences. In the future, most participants plan to use some items from the suite of resources, including many who plan to attend IBL events at conferences. Given the variety of resources participants intend to use, it may be critical that they have the option to choose among many resources in order to find whichever one is best-suited to their own needs.

Conclusion

Results from the follow-up surveys help to learn about impact of the workshop on participants' teaching practices. At least 74% of all workshop participants (93% of the 28 respondents) reported using at least some IBL methods in the year following the workshop. This proportion from survey self-report is slightly lower than found by analyzing messages sent through the group listserv (86% of all participants), probably because more participants were active on the listserv (94%) than responded to the followup survey (80%). The implementation rates are similar to those from Workshop 1 from 2013 (74% and 76%, respectively).

Even though this workshop was slightly smaller than Workshop 1, participants have again spread IBL methods to about 1900 students in almost 80 courses in just the first year following the workshop. Despite common beliefs that IBL is just for very small upper-level math major courses, many courses did not match these assumptions. However, the classes participants reported using IBL in were slightly more aligned with these assumptions than those from Workshop 1, as only 36% of participants used IBL in classes that had 20 or more students, 51% in classes serving non-math majors, and 47% in non upper-level courses. Participants reported that using IBL had many positive effects on their students - in fact, almost all effects reported were positive - especially development of independence and critical thinking.

Again with Workshop 2, results indicate that follow-up support is important for participants. Almost all respondents (89%) reported using some form of support, and many used more than one. The workshop listserv was the most commonly used form of support, as 91% of participants were active on the listserv at least once. While staff often prompted discussions and responded to questions on the listserv, participants themselves were very active, sending an average of 4.9 messages per workshop participant. Participants either used or plan to use many of the available supports, so again, the variety of opportunities seems to allow each person to find one that works for him or her.

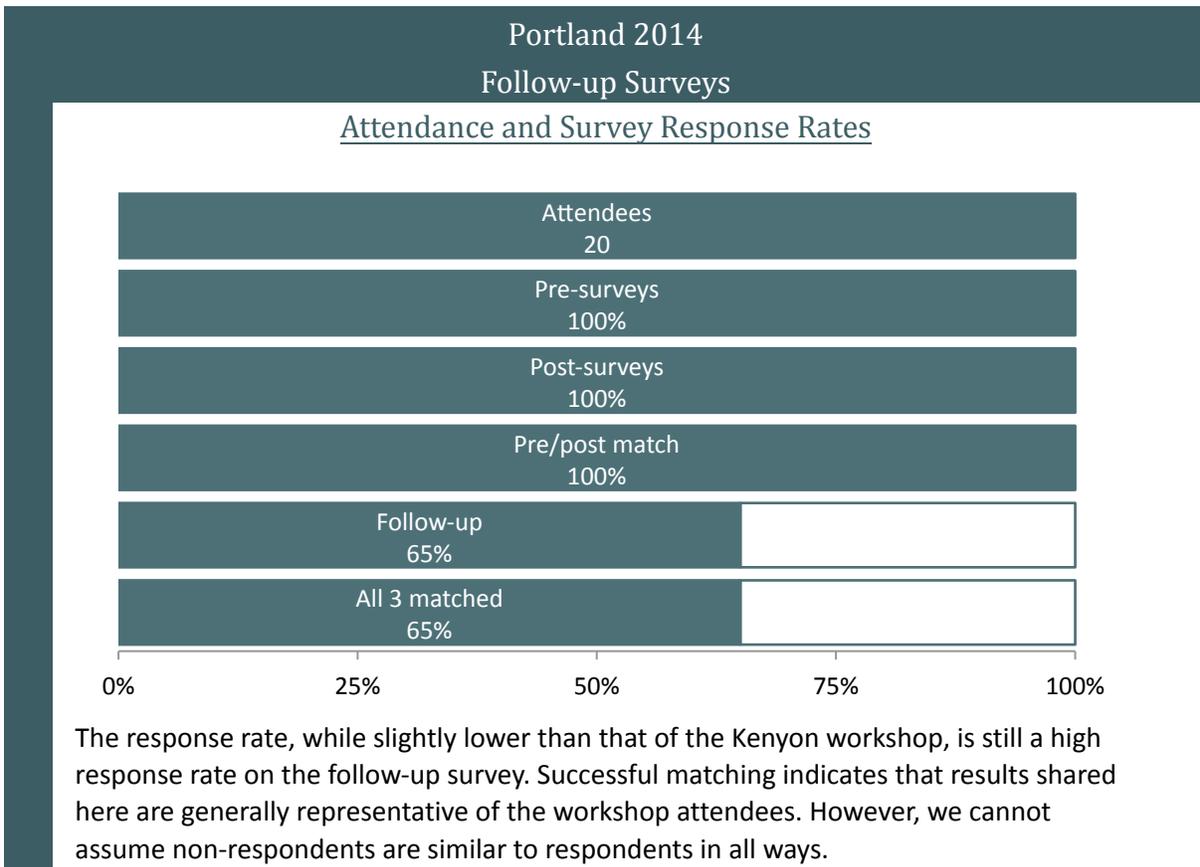
Like all previous workshop evaluation reports, student resistance and content coverage remain as challenges for participants implementing IBL. Given the focus on these topics at the workshop and the high rate of IBL implementation, it appears that participants felt prepared to manage these concerns.

References

Hayward, C. & Laursen, S. (2013). 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. Ethnography & Evaluation Research. Center to Advance Research and Teaching in the Social Sciences. University of Colorado Boulder.

Workshop 3: Portland, Follow-Up Report

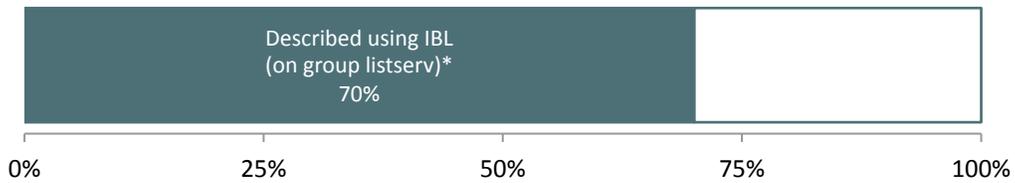
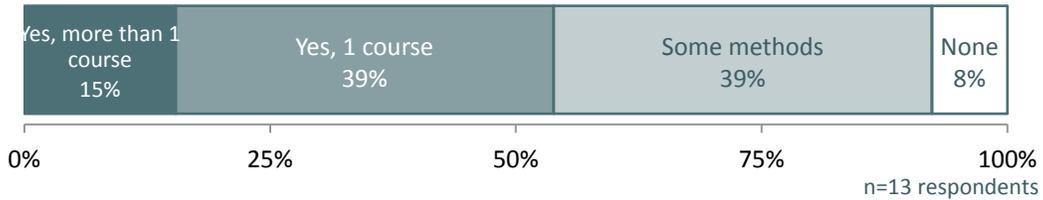
The Portland workshop was held about one month after the Kenyon workshop. It was held in conjunction with MathFest, also in Portland. In terms of content and structure, it was almost identical to the Kenyon workshop. Of note, the workshop was smaller than the prior two workshops. It served 20 participants, while the first two served 42 and 35, respectively. Demographically, the Portland group tended to be more advanced in their careers than the participants in the first two workshops were.



Outcomes

Results shared throughout this report are only for the follow-up survey respondents (13 of 20, 65%), except where noted. Implementation rates for all participants may differ from those values presented here, as we do not know if survey non-respondents implemented in the same ways that survey respondents did.

Implementation



Spreading IBL to:

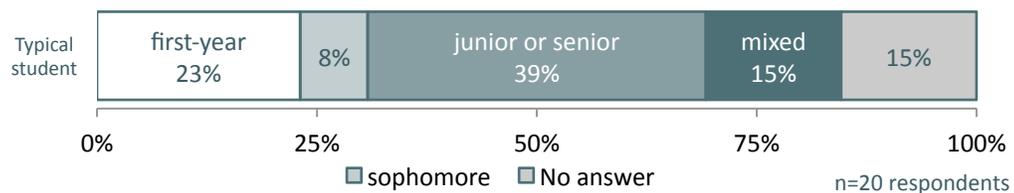
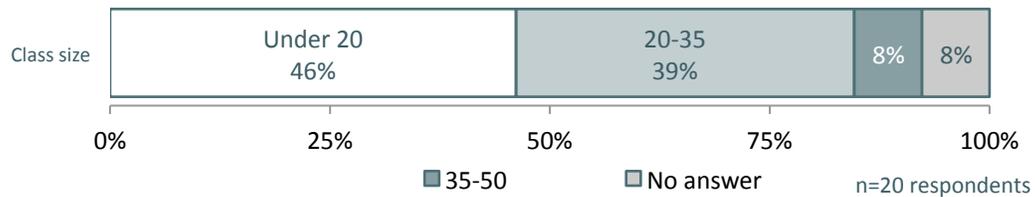
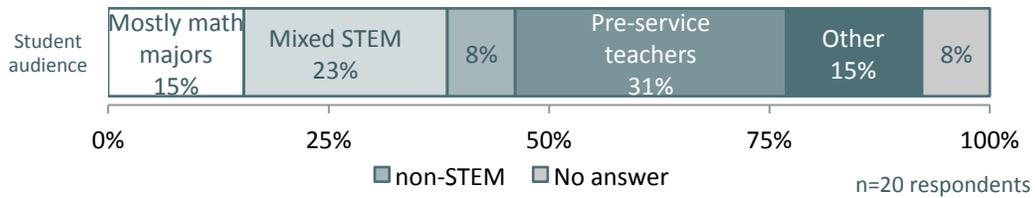
31+

classes

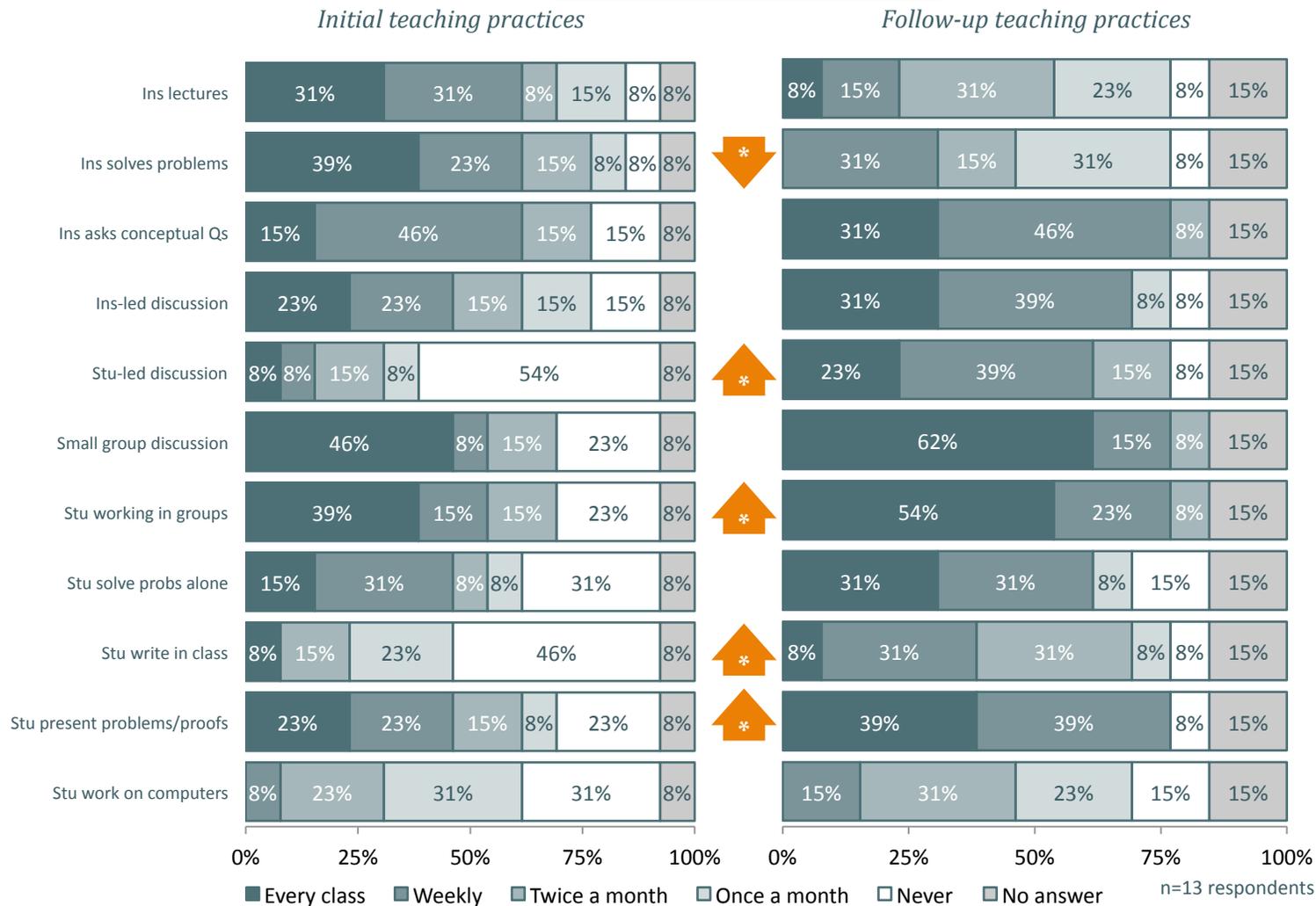
850+

students

in the first year following the workshop.



Changes in Teaching Practices



*p<0.05, **p<0.01, ***p<0.001

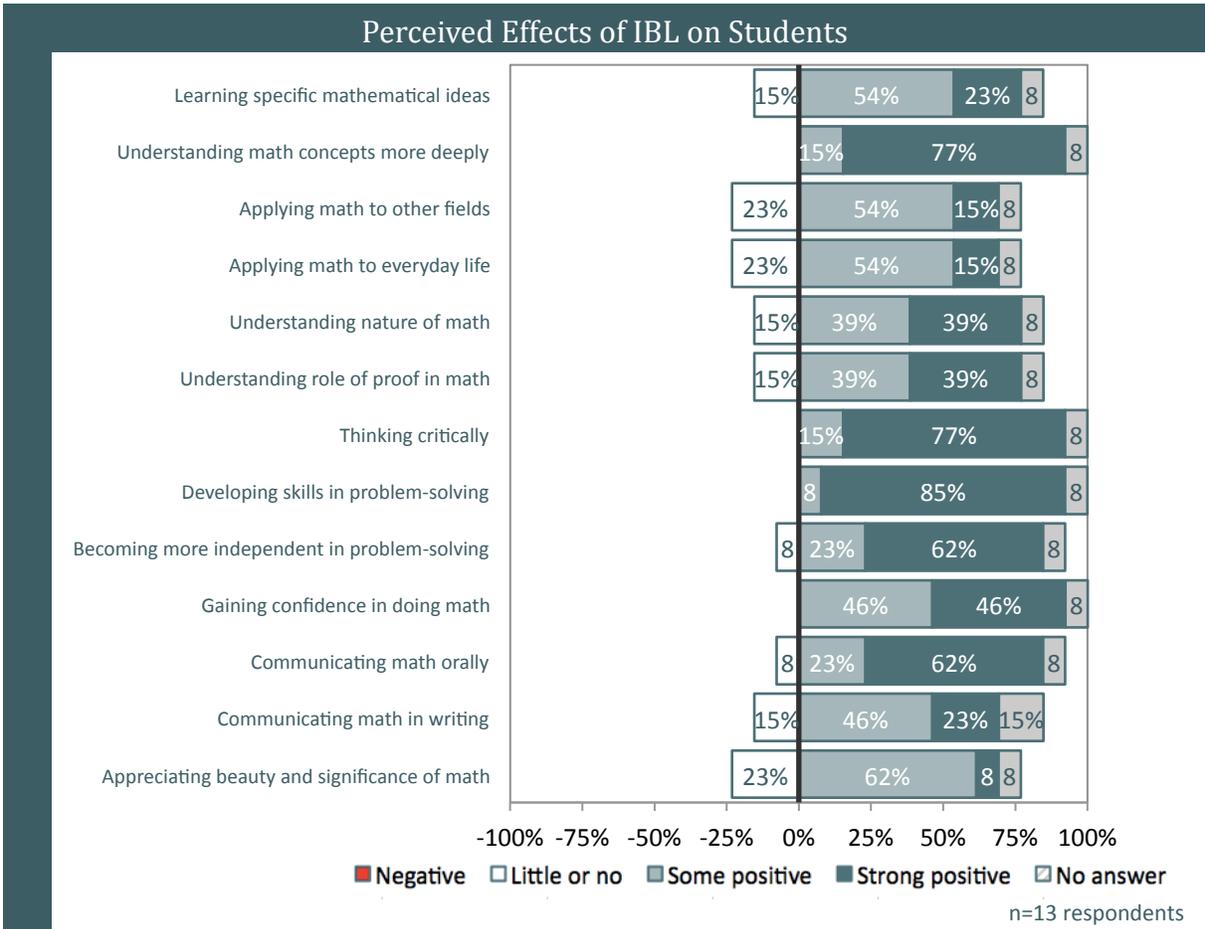
Of those who responded to the survey, 92% reported implementing at least some IBL methods. Overall, this means at least 60% of the 20 workshop participants have implemented some IBL in the year following the workshop. We also analyzed listserv traffic to measure implementation. In total, 90% of all workshop participants were active on the listserv, and 70% of all participants made comments indicating that they were implementing IBL. While we cannot directly compare survey answers with listserv implementation information, we can rule out non-responders to the two methods to get an overall implementation rate. Doing so indicates that the overall IBL implementation rate for all 20 participants is at least 80%.

Changes in teaching practices revealed shifts towards IBL pedagogies with significant decreases in instructors solving problems, and significant increases in student-centered activities including student-led discussions, group work, student writing in class, and student presentations. While many of these changes are consistent with previous workshops, some are not. For example, the frequency of lecturing did not decrease significantly as it has with every other workshop we have ever studied. This is most likely due to the small sample size (only 13 participants had matched surveys). In fact, many results were just outside the range of statistical significance, and those that were significant showed weaker significance than results from prior, larger workshops.

The instructors who did implement IBL have exposed more than 850 students to IBL methods in over 31 classes in just the first year after the workshop. While these numbers are less than previous workshops, they are on par for the smaller group size. Most commonly, participants taught small to midsize classes (under 35 students) for math and other STEM majors of all levels. Participants implemented IBL in a variety of courses, most commonly pre-service teacher courses (4), calculus track courses (3), and proof courses (2), as well as some others. Ten participants (77% of respondents) reported using IBL in the fall term right after the workshop.

Open-ended prompts:

Throughout the remainder of the report, we share responses to open-ended prompts, as well as to multiple choice survey items. For each open-ended prompt, the numbers in parentheses indicates how many of the 13 survey completers responded to the prompt and the number of topics that were coded in all responses. (Participants sometimes included multiple topics in their response to a prompt.) The bulleted lists show the most frequent responses and the number of participants who mentioned each topic. The numbers in the lists provide an estimate of relative importance.



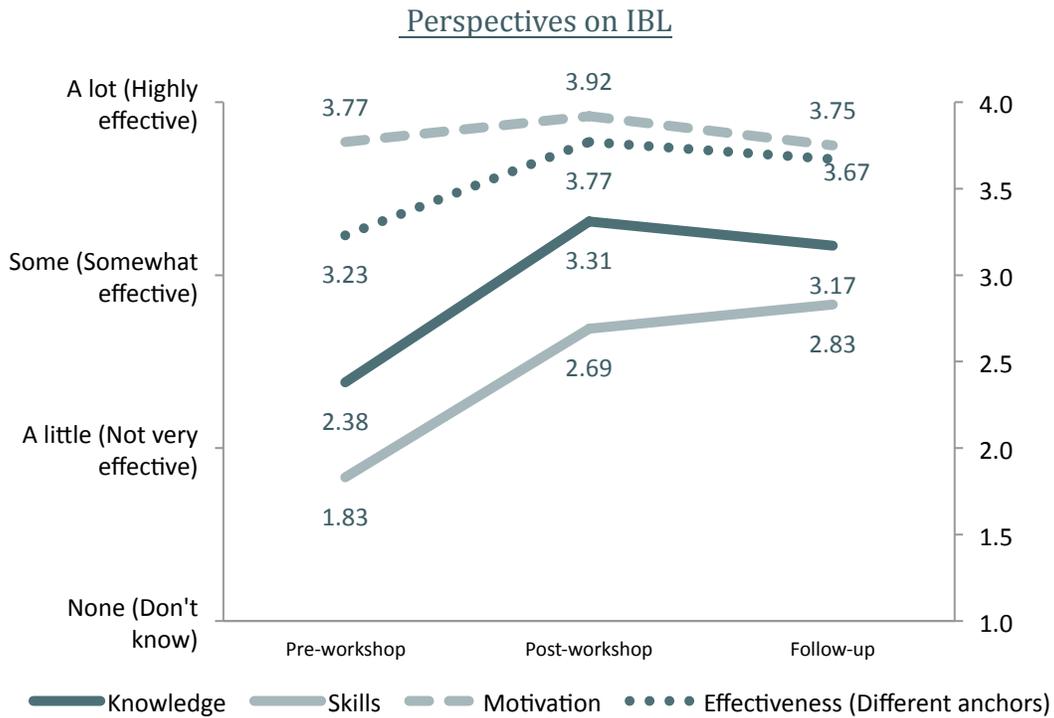
Greatest student benefit (10 respondents, 14 coded topics)

- Behave like mathematicians/ do real mathematics (4)
- Deeper mathematical understanding (3)
- More independence doing mathematics (3)

Concerns about what students may NOT gain (9 respondents, 9 coded topics)

- Coverage/exposure to certain topics (4)
- IBL doesn't fit with other lecture-based courses/ students not prepared for IBL (2)
- No concerns (2)

Respondents felt that IBL had many positive effects on students, both in terms of mathematical content and affective gains. Some of the strongest reported effects were that students improved their problem-solving and critical thinking abilities. No participants felt that IBL had negative effects, but some were concerned about coverage and how IBL will fit between other, more-traditional math courses. Like the Kenyon workshop, participants reported some of weakest effects on applying math to everyday life and to other fields.



Knowledge of IBL increased significantly post-workshop and then did not change significantly during the follow-up period. IBL skills increased significantly after the workshop, and then showed a non-significant increase during the follow-up period. After increasing post-workshop, belief in the effectiveness of IBL experienced a slight decrease during the follow-up period. Belief in the effectiveness of IBL on the follow-up survey was not significantly different than on the pre-workshop survey. Motivation to use IBL increased modestly after the workshop and decreased modestly by the follow-up survey, but these differences were not significant. Motivation to use IBL was not significantly different on the follow-up survey than on the pre-workshop survey. These ratings and trends are fairly consistent with those from previous IBL workshops.

Overall, these patterns indicate that participants learned a lot about IBL during the workshop. They felt they gained skill in using IBL by attending and they continued to gain skills as they implemented IBL in their own classrooms. Participants entered the workshop reporting high levels of motivation to use IBL, and these levels remained high on all three surveys. Participants also entered feeling IBL was an effective teaching method. Their beliefs in its effectiveness increased after the workshop, but by follow-up, it was no longer significantly different than pre-workshop levels. These patterns make sense for participants in their first year of implementing a new teaching method; while they are gaining skills, they are probably also finding it challenging. Ongoing support may be helpful for participants to work through difficulties and continue using IBL.

Feedback on the Workshop

Most useful aspect of workshop for implementing IBL (9 respondents, 11 coded topics)

- Video sessions (4)
- Planning time (3)
- Examples of how to do IBL, learning specific strategies (2)

Use of materials participants developed at the workshop (9 respondents, 11 coded topics)

- Used materials to teach IBL course (3)
- Used selected activities (3)
- Plan to use in the future (2)
- Did not use the materials (2)

Other helpful resources (7 respondents, 8 coded topics)

- JIBLM/ other course notes (3)
- No additional resources (3)
- NCTM website (1)
- IBL colleagues (1)

Resources desired (7 respondents, 7 coded topics)

- Contact/ networking with other IBLers (2)
- Time/funding to develop courses (2)
- More active & specific group listserv (i.e. 'can't remember who specialized in what classes' (2)

Given the small numbers of responses on open-ended feedback from this workshop, it is difficult to make generalizations. However, patterns in the most frequent responses were quite similar to past workshops and suggest that like previous workshops, participants felt that this Portland workshop had been useful in helping them implement IBL in their own classrooms. Like the Kenyon workshop, the video sessions and content planning sessions were identified most frequently as the most helpful aspects.

Participants took advantage of some other resources offered throughout the IBL community, including shared course notes. Participants valued the network of other IBLers they already had, but also wanted to meet and work with even more IBL practitioners. Unlike other workshops, some participants from this Portland workshop did report that they wanted the group listserv to be more helpful. This workshop's listserv suffered from lower participation than other workshops, which is discussed in the next section.

Implementation of IBL

Personal gains for instructors (9 respondents, 10 coded topics)

- Helped me be a better teacher/understand student thinking (7)
- Better relationships with students (2)
- More enjoyable way to teach (1)

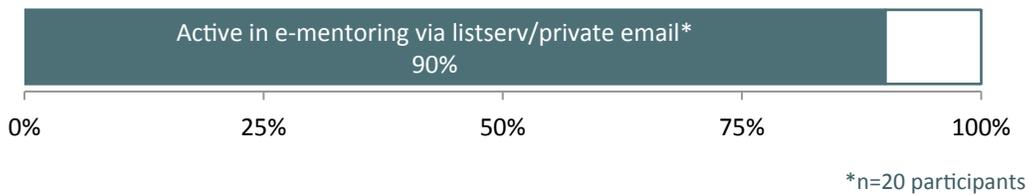
Problems experienced (9 respondents, 12 coded topics)

- Student resistance (3)
- Implementing IBL is challenging (e.g. managing bad presentations & pacing) (3)
- Coverage/exposure to certain topics (2)
- IBL takes more time to plan and implement (2)

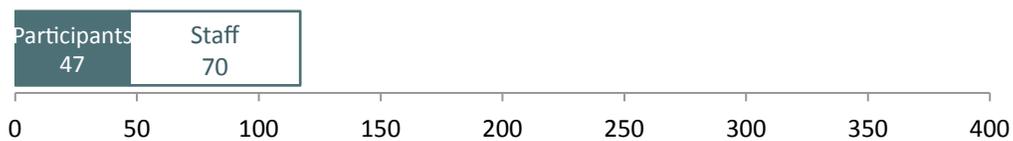
Overall, many instructors felt they were better teachers through using IBL. The main problems they experienced were the same as those concerns that respondents shared on pre-workshop and post-workshop surveys: coverage, the difficulty of implementing IBL, and student resistance. These continue to be challenges for instructors, but on the whole, did not stop them from using IBL methods. Ongoing support should continue to provide advice and resources to help participants manage these challenges and improve their skills as IBL instructors.

Ongoing Support

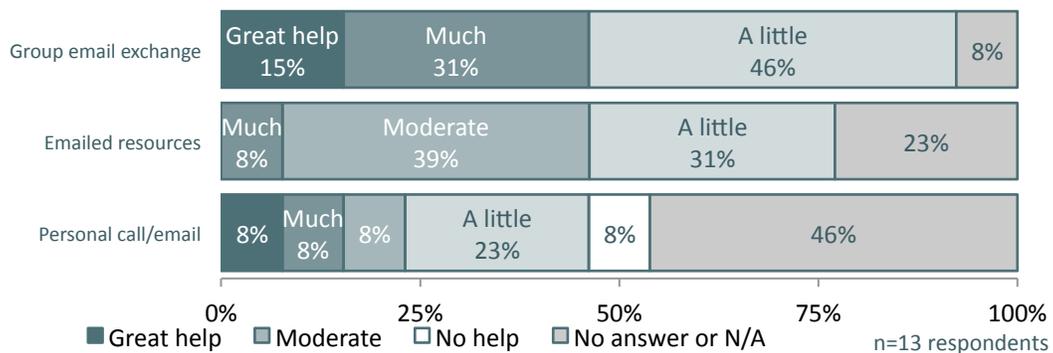
Workshop Resources

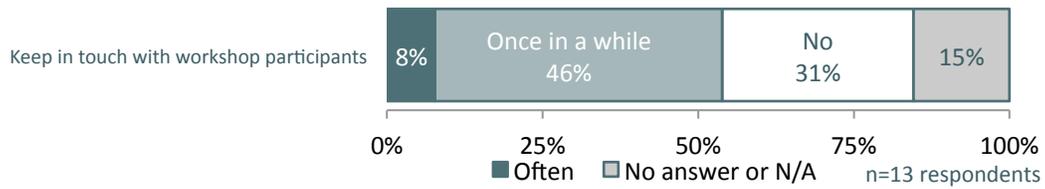


Group listserv messages in one year following workshop

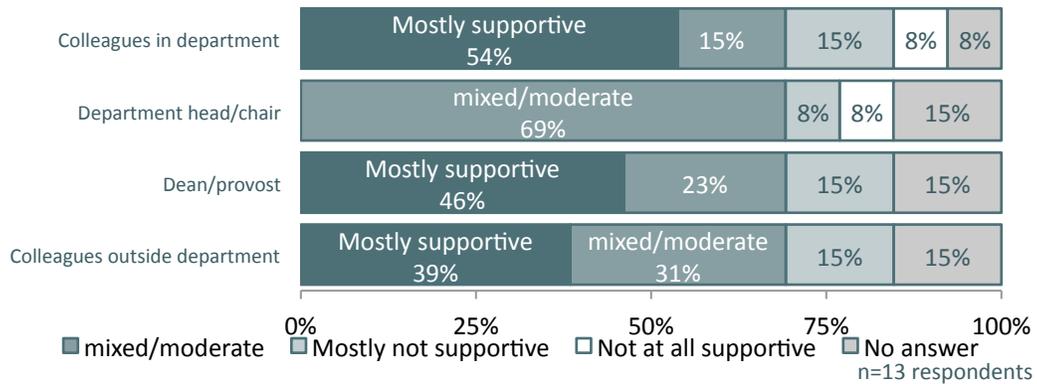


Helpfulness of e-mentoring activities





Institutional Support

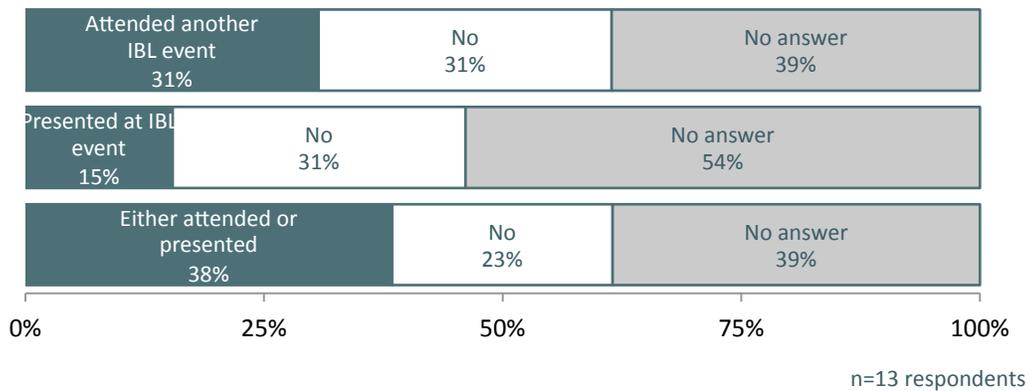


Descriptions of departmental/institutional IBL support (6 respondents, 7 coded topics)

- Encouragement - supports philosophy of IBL (2)
- Freedom to 'do what I want' (2)
- No support (2) or skepticism (1)

Other IBL Supports

IBL events



Attended

- IBL sessions at JMM 2015 (3)
- IBL session at MAA meeting (2)
- IBL booth at MathFest 2014 (2)
- IBL poster at MathFest 2014 (2)
- Legacy of R.L. Moore/IBL Conference (1)
- Other (0)

Presented

- IBL sessions at JMM 2015 (1)
- IBL session at MAA meeting (1)
- IBL poster at MathFest 2014 (1)
- IBL booth at MathFest 2014 (0)
- Legacy of R.L. Moore/IBL Conference (0)
- Other (0)

Use of IBL supports



Received

- Read workshop listserv (11)
- Contributed to listserv (7)
- Used notes from JIBLM (3)
- Received AIBL minigrant (1)

Plan to in the future

- Will use notes from JIBLM (7)
- Will read workshop listserv (8)
- Will attend Legacy of R.L. Moore/IBL Conference (6)
- Will attend IBL session at JMM (8)
- Will contribute to listserv (5)
- Will apply for AIBL minigrant (5)
- Will attend IBL session at MAA (6)
- Will submit notes to JIBLM (3)
- Will attend IBL session at MathFest (7)
- Will use AIBL mentor program (2)

Like the prior workshops, it appears that participants used a variety of available resources. More participants used easily accessible, electronic resources such as the listserv and JIBLM and fewer did more intensive activities like attending conferences.

Overall, participants from this workshop were less active in ongoing mentoring activities than prior workshops. For the workshop at Kenyon, there was an average of 4.9 messages sent per participant. For this workshop, the average was only 2.4 messages per participant. Moreover, if staff & participants had the same rates of activity on this listserv as they did for the Kenyon workshop, the predicted numbers adjusted for the size of the workshop would be 63 staff messages (vs. 70 actual) and 98 participant message (vs. 47 actual). So, by comparison, staff were about 10% more active trying to start discussions with the Portland group than they were with the Kenyon group, but Portland participants were only about half as active as what could have been expected. While this may reflect differences in the participants who attended this workshop, it may also be because of the smaller size of this workshop. With fewer participants, there are fewer potential respondents to any given message, which may make it harder to sustain discussions. Possibly because of the lower activity, participants from this workshop also reported that the group listserv was less helpful than participants from prior workshops have reported. It remains an open question what the ideal group size for a workshop like this is. There should be enough participants to foster collaboration and a supportive network for ongoing mentoring activities, but not so large that participants do not receive adequate individual attention.

Conclusion

Results from the follow-up surveys help to learn about the impact of the workshop on participants' teaching practices. At least 60% of all workshop participants reported using at least some IBL methods in the year following the workshop. This proportion from survey self-report is slightly lower than found by analyzing messages sent through the group listserv (70% of all participants). The implementation rates are slightly lower than those reported by participants at the prior workshops, which have been 75% or higher.

Participants from the Portland workshop have spread IBL methods to over 850 students in over 30 courses in just the first year following the workshop. These numbers are on par for the small workshop size. Many participants (85%) used IBL in classes that had 35 students or fewer and 39% were upper-level courses. There were many participants (31%) who reported using IBL in classes for pre-service teachers. Participants reported that using IBL had many positive effects on their students, especially development of critical thinking and problem-solving abilities.

While previous workshops have shown that follow-up support is important for participants, results were weaker for this group. Again, almost all respondents (85%) reported using some form of support, and the workshop listserv was the most commonly used form of support. However, the workshop was less active than with previous workshop cohorts, and participants reported it as being less helpful than did previous workshop cohorts. This is likely due to the small size of this workshop, which seems to have made collaboration on the listserv more difficult.

Like all previous workshop evaluation reports, student resistance and content coverage remain as challenges for participants implementing IBL. Given the focus on these topics at the workshop and the high rate of IBL implementation, it appears that participants felt prepared to manage these concerns.

The results from the Portland workshop are very consistent with prior workshops in many ways, but differ in some key ways - specifically, slightly lower reported IBL implementation and weaker results from ongoing mentoring. The similarities indicate that the workshop model can still be successfully implemented with smaller groups, but the differences suggest that the outcomes may not be as positive. So, while attaching the Portland workshop to MathFest afforded a cost-effective opportunity to offer the SPIGOT IBL workshop model to a small number of participants who may not have attended a stand-alone workshop, in the future, stronger outcomes may be achieved with bigger workshops for around 35-40 participants, as long as sufficient funds are available.

References

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