Learner Engagement in Online and In-Person Instruction: An Exploration of Question-Asking Behaviors in Academic Library Workshops

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abstract: This study explores participant engagement in online and in-person library workshops by examining question-asking behaviors. Workshops included in the study were part of an academic library graduate workshop series designed for a multi-disciplinary audience of graduate students and faculty. The authors gathered data from 127 participants who asked a total of 357 questions during 20 workshop sessions that were offered in both online and in-person formats. The questions were classified according to the types of questions asked. The results showed that participants are engaged in both in-person and online workshop modalities, and there was no significant difference in the overall number of questions asked or question types. The authors conclude by offering pedagogical recommendations for enhancing behavioral, cognitive, and emotional engagement in both online and in-person settings.

Introduction

Academic libraries play a significant role in the development of advanced learners' information literacy and research skills. The learners discussed in this article are graduate students and faculty who need to learn a new skill or tool for a specific purpose. For example, they could be a graduate student who needs to learn how to manage their sources with a citation manager or a faculty member who

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is incorporating a geographical information element into their research and wants to learn how to use the open-source software QGIS. Traditionally, librarians have relied on in-person workshops to deliver such instruction, a practice that was significantly disrupted by the COVID-19 pandemic. As libraries transitioned to online modalities, a new norm emerged where workshop participants could choose the format that best suited their needs. This shift provided a timely opportunity to critically examine how these dual delivery modes—online and in-person—engage learners, and whether it is worthwhile to continue offering both modalities.

This study explores the potential differences in participant engagement between online and in-person library workshops for graduate students and faculty by analyzing participant question-asking behaviors, one important indicator of learner engagement. Several key factors can influence these advanced learners' approach to workshop engagement. They tend to be self-directed and have specific learning goals. Their participation is motivated by the need to learn a particular skill or tool in a short amount of time, not to obtain a certificate or a title (which is not offered for these workshops). As a result, the type of information covered in these workshops is practical and is often designed as an introduction to the topic, so that after participating in the workshop the participants have the ability to continue learning on their own. Examples of topics covered by these workshops are tools like Zotero, QGIS, Git, Adobe Illustrator, or LaTeX, in addition to skills like researching for a literature review or writing a data management plan.

Creating environments that encourage asking questions is essential to learner-centered teaching, as noted by Helena Pedrosa de Jesus, José J. C. Teixeira-Dias, and Mike Watts, who emphasize that the act of questioning enhances both learning and information retention.[1] Asking questions can stimulate interest and deepen engagement for learners. While existing literature often discusses question-asking behaviors in the context of term-long, credit-bearing courses where students have external motivations and the benefit of established relationships with instructors and peers, less is known about such behaviors in shorter, non-credit workshops like those frequently offered in libraries. To fill this gap, the authors conducted a study over two academic terms, gathering data from 20 workshop sessions across three topic areas (managing citations with Zotero, version control with Git, and visualizing spatial data with QGIS), each offered in both online and in-person formats. The data, which include both the content of the questions and the context of the workshops, were coded using a classification system for identifying question types adapted from the tool developed by Pedrosa de Jesus and collaborators.[2]

Creating environments that encourage asking questions is essential to learner-centered teaching.

The authors developed two primary research questions:

1. Are there differences in the number of questions asked between in-person and online workshop modalities?
2. Are there differences in the type or content of questions asked between in-person and online workshop modalities?

In both cases the authors consider whether the prerequisite knowledge required of the learners and the different instructor practices for each of the workshops influences any potential differences.

The findings from this analysis are presented, highlighting any significant differences in question-asking behaviors between the two modalities. Based on these results, the authors offer pedagogical recommendations and best practices for enhancing learner engagement in both online and in-person instructional settings.

Literature Review

Engaging learners is a core goal for those who teach. Educational researchers have identified three types of student engagement that impact learning: emotional (also known as affective), behavioral, and cognitive engagement.[3] Emotional engagement references the feelings learners bring to the instructional environment. Behavioral engagement explores the actions learners take to demonstrate their learning. Cognitive engagement addresses the mental processes involved in directly learning content, how to scaffold the level of content difficulty, and the motivational aspects required to engage in learning. Cognitive engagement has often received the most emphasis, but instructors are increasingly aware of the impact of emotional engagement on cognitive engagement. As a result, instructors seek to incorporate a variety of strategies within the classroom to foster learner engagement.[4] For example, directed discussion prompts are a common strategy instructors use to encourage student participation as well as to give instructors insight into what students know.[5] In academic library sessions for undergraduates, a proven engagement technique is to encourage students to explore topics that match their authentic interests.[6] In term-long classes, many instructors scaffold active learning strategies that develop critical thinking skills across the term so students can practice their cognitive engagement skills.[7]

Increasingly, instructors must adapt their methods for engaging students to instructional settings with unique constraints such as large-enrollment classes, online classes, and asynchronous classes. One challenge instructors have observed in these settings is related to emotional engagement. Students want to be perceived positively by both their instructor and their peers when asking questions, and so they often prefer to remain anonymous so as to avoid the judgment of their peers and resist activities that require speaking out or raising their hand.[8] M.L. Barr found that providing alternate cognitive engagement tools like clickers in a large-enrollment class still engaged students, even when they were not publicly or verbally responding to questions. As a result, Barr recommends that instructors do not assume students are cognitively disengaged based on a lack of public responsiveness. This sentiment was shared by Alison Hicks and Caroline Sinkinson in their essay critically exploring the possible downsides of active

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learning in library instruction and the reliance on student performance as a measure of learning.[9]

In online learning contexts, instructors have been pedagogically creative as they have sought ways to engage students. Barriers to online student engagement include variable levels of student comfort with technology, especially for older students.[10] When instructors use instructional design best practices, some of the barriers can be overcome. Problem-based activities, group collaboration, and discussion prompts have all been effectively incorporated into online learning environments and are particularly well-suited to engaging adult learners.[11] In synchronous online courses, tools like Piazza and Poll Everywhere have been used by instructors to ask students questions, frame debates, and kick off discussion topics.[12]

Creating an environment in which students can develop question-asking abilities and reframe knowledge on their own is a critical part of learner-centered teaching. Pedrosa de Jesus and collaborators argue that student questions are key to the learning process because generating questions improves learning and information retention.[13] Asking questions also increases student interest and engagement and demonstrates the level of the student's understanding of the content. Because asking questions involves an action on the part of students, question asking can be categorized as a type of behavioral engagement.[14]

Understandably, there are natural differences among students in their willingness to ask questions in classroom settings—some students need more time to process information, others are more reticent, and some ask questions very quickly.[15] These differences should be acknowledged when considering student question-asking behaviors. Understanding that students may have different initial responses to question-asking opportunities, instructors still play a central role in stimulating student engagement by posing questions. One way instructors can encourage question-asking behaviors is by mentoring students as they learn to express their own ideas and questions by actively inviting students to participate in question-asking activities as well as by giving feedback on the questions they ask.[16] Unfortunately, instructors can also have a negative impact on student question asking. If instructors do not effectively answer questions or ignore them, students will ask fewer questions.[17]

Researchers have begun to consider differences in how students ask questions in online learning environments. Chwen Jen Chen and Chee Siong Teh found that students in a synchronous online course in Malaysia preferred using the chat box rather than asking questions verbally, even though that mode was an option, due to shyness, discomfort with speaking English in class, and poor internet connectivity.[18] Similarly, in a large-group preclinical medical student course, differences in question-asking behaviors were evaluated between in-person and synchronous online courses. In the online course, question-asking was only enabled via chat. The researchers found that students asked more questions in the online course than in the in-person course.[19] One important contextual note about this online course is that students knew each other from previous in-person learning environments and so had already established some connections with their peers as a result.

To expand understanding of student question-asking behaviors beyond simply counting the number of questions asked, educational researchers have explored ways to

classify the types of questions asked. Irving Sigel and Ruth Saunders developed an early version of a question-asking taxonomy that distinguished between verbal and non-verbal questions as well as open and closed questions.[20] Arthur Graesser and Natalie Person present a significantly more complex question-asking categorization scheme, the GPH scheme (named for the scheme's authors, Graesser, Person, and Huber), which includes 18 categories.[21] These question-asking categories describe both the length of question asked (short versus long answer), as well as the content of the question, for example interpretation, goal orientation, and so on. In order to avoid characterizing student questions in simple binaries (good versus bad, simple versus complex), Pedrosa de Jesus and collaborators posited that all questions are valuable, and their quality depends on the situation and the learner, rather than the category of the question.[22] These researchers developed a question-asking taxonomy that takes into consideration the context, task, and goal of the instructional setting. Their taxonomy divides questions into confirmation questions, or questions that clarify a concept; and transformation questions, or questions that extend, reorganize, or challenge the information presented.

Question-asking behaviors can be used as an indicator of student engagement, but most of the education literature on question-asking behaviors describes term-long, credit course instructional settings. Hicks and Sinkinson note the dearth of empirical research on information literacy student-centered teaching practices.[23] What literature there is on the efficacy of pedagogical choices in academic library instruction that may enhance student engagement is typically rooted in the delivery of information literacy instruction to undergraduate students with the constraint of teaching in a "one-shot" or guest lecture modality.[24] Alternative instructional settings like continuing education classes or academic library workshops for graduate student and faculty participants may provide unique constraints that impact student question-asking behaviors, but these instruction environments are even less researched than library information literacy sessions for undergraduates. Considering student engagement in other instructional settings is increasingly important as educators look for ways to interest students already in the workforce or who are seeking discrete skill sets such as those offered through micro credentials rather than an entire degree.[25]

Question-asking behaviors can be used as an indicator of student engagement.

Academic libraries frequently offer workshops to audiences like graduate students and faculty as a way to develop targeted information literacy skills, including using citation managers, literature review searching, and data management.[26] To meet the needs of this unique audience, some libraries offer day-long workshops or use a boot camp approach, while others hold shorter workshops throughout the term.[27] Attendance at these workshops is typically voluntary. As a result, motivation to attend and participate can be an issue, and the opportunity to build relationships and trust with students may be limited.[28] In addition, students in these workshop settings may not know one another and do not always have the opportunity to develop a camaraderie or a sense of community.

In some continuing education training circles, online instruction has been used for a long time, and in some cases students in online courses have been found to perform better than students in an in-person cohort.[29] However, in many academic libraries

in-person delivery of workshops for graduate students and faculty audiences was the norm prior to the COVID-19 pandemic, especially in those libraries using a day-long boot camp approach. In this study the authors sought to examine potential differences in participant engagement in online versus in-person library workshops for graduate students and faculty by observing participant question-asking behaviors. The goal is to inform the pedagogical approaches librarians and other continuing education instructors use in both instructional formats, especially as many workshops will continue to be offered online.

Methods

Data Collection

From January to June, 2023, three Oregon State University (OSU) library workshop instructors (the co-authors of this paper) collected participant question-asking information from a total of 20 workshop sessions. These workshops were offered as part of the OSU quarterly series of library workshops for graduate students and faculty. These workshops were free to attend and not required as part of any programmatic curriculum. Participants came from a range of university departments, and all workshops were intended to appeal to a multi-disciplinary audience. Workshops were offered both synchronously online and in person; there were no hybrid workshops. Some of the workshops in this study used a two-part series approach—an introductory session followed by an intermediate session—while others only offered one session. Participants in multi-session workshops were able to attend either one or both parts of the workshop. The length of the sessions ranged from one to three hours, depending on whether participants chose to stay for either part or all of the series (as applicable). Each of the three instructors had previously taught the workshops observed in this study multiple times in both formats, and no additional pedagogical interventions were added to the study design, beyond the systematic comparison of online and in-person participant question-asking behaviors.

The three workshop topics observed were Zotero (Introduction and Intermediate/Advanced), Git (Beginner and Intermediate), and QGIS Basics. The prerequisite knowledge required to understand the content presented in these workshops varied. The Zotero workshops required fewer prerequisite skills, with an expectation of a general knowledge of academic sources, citation styles, and the writing process. The Git workshops (adapted from the Software Carpentry series) were designed for beginners with no previous experience with Git, but participants benefitted from having prerequisite skills including an understanding of how to use the terminal interface, some basic coding skills, knowledge of versioning control, and ideas about projects that could benefit from version control with Git. Participants in the QGIS workshop also benefitted from having more technical and domain-specific prerequisite skills including an understanding of geospatial vocabulary, knowledge of approaches used in geospatial analysis, and facility in using highly detailed and technical software interfaces. See Table 1 for an overview of the workshop characteristics.

Question-asking observations were recorded during each of the workshops four times, with two observations taking place during in-person sessions, and two observations taking place in synchronous online sessions via Zoom. All workshops were observed by another workshop instructor, who used a spreadsheet template to manually record:

Table 1.
Workshop characteristics

Workshop Topic	Workshop levels	Length of workshop	Prerequisite requirements
Git (version control tool)	Beginner and Intermediate	• Beginner - 1.5 hours • Intermediate - 1.25 hours	High - technical knowledge
QGIS Basics (a geospatial data tool)	Basics	• Basics - 2 hours	High - technical and domain-specific knowledge
Zotero (citation management tool)	Introduction and Intermediate	• Introduction - 1 hour • Intermediate - 1 hour	Low - general academic

- the text of the question asked,
- whether the question occurred after the instructor paused and asked for questions or if the question occurred without instructor prompting (later referred to as *prompted* for the former and *organic* for the latter),
- how the question was asked (voice or chat in the case of online sessions), and
- how many times the instructor asked if participants had any questions.

In addition, the total number of participants in each workshop, the total number of questions asked during the session, the modality of the workshop, and the time and date of the workshop were recorded.

Data Coding

To better understand what types of questions were being asked in each of the workshops and whether there were any qualitative differences based on the modality of instruction, the researchers framed the coding using the question classification system described by Pedrosa de Jesus and collaborators.[30] The researchers chose this system because it acknowledges that all questions are valuable, and the quality of questions asked depends on the situation and the learner, rather than the category of the question. Pedrosa de Jesus and collaborators' classification system describes two categories of questions: Confirmation and Transformation questions. The researchers added two more categories based on informal, past observations of participant question-asking behaviors. The first additional category was called Transitional. The Transitional category acknowledges that there are some types of questions that fall in a liminal space between Confirmation and Transformation questions. The researchers also added an "Other" category to recognize the questions that were not topic or learning based but which still signaled a level of participant engagement. See definitions for these three categories in Table 2.

Table 2.
Question classifications with definitions*

Question Category	Definition	Examples
Confirmation	Questions seek to clarify information and detail, attempt to differentiate between fact and speculation, tackle issues of specific details, and ask for examples or definitions. Questions are more mechanical in nature.	• Could you repeat that? • I'm getting an error message, how do I resolve it? • Let me make sure I understand what you just said.
Transitional	Questions express emerging ideas that are not fully formed. Questions may be more conversational in nature and not directly related to a realistic application of the knowledge, or may be starting to explore best practices.	• I'm curious about what happens if I use a different approach with this tool instead. • What if I tried using the tool in a different way? • What if instead of the approach you used, I tried doing it a different way?
Transformation	Questions include some restructuring or reorganization of the learners' current understanding. They tend to propose a hypothesis to see if the new concept will fit the proposed hypothesis, seek extension of knowledge, present an argument, identify missing information, examine ways of thinking, and challenge accepted reasoning.	• I've used a similar (but different) tool or approach, how does this tool or approach compare? • I think I can see how I might apply this in my own work - does that application make sense?
Other	Questions focus on logistics, general information sharing, brief feedback signals, or are more like comments than questions.	• When will the next workshop in this series be held? • Wow! This was so helpful. • I need to leave early, will you be sharing a recording?

*Pedrosa de Jesus, et al., 2003.

Two team members—the instructor of the workshop and the observer of that workshop—coded each of the questions asked within a workshop session using the four question categories. When there was a discrepancy between the categories assigned by the two coders, the coders talked about why they chose a particular category until a consensus was reached.

Data Analysis

Data were analyzed with the statistical analysis platform R, and visualized with RStudio and the ggplot2, RColorBrewer, forcats, tidyverse, and gridExtra plugins. As this was categorical data, the researchers employed the Chi-square test as well as Fisher's exact test to explore differences in modality, workshop content, and instructors.

Results

During the study period, 127 participants attended at least one of 20 workshops observed and asked a total of 357 questions (see Table 3). Note that participants could have attended more than one of the workshops, so the total attendee number likely does not represent unique attendees.

To determine potential differences in participant question-asking behaviors in online vs. in-person library workshops, the researchers analyzed the data from three different perspectives: workshop logistics, workshop content characteristics, and instructor practices.

Table 3.

Summary of total workshop sessions, attendees, and number of questions asked

Workshop	Sessions	Attendees	Questions Asked
Introduction to Zotero	4	40	63
Intermediate Zotero	4	25	32
Git - Beginner	4	25	66
Git - Intermediate	4	9	59
QGIS Basics	4	28	137
TOTAL	20	127	357

Workshop Logistics

The logistics category consists of the modality of the workshop, the time of day the workshop was conducted, the number of attendees, and the date the workshop was observed.

Workshop Modality - Online versus In Person

There were no significant differences in the number of questions asked, when comparing data from online and in-person workshops (p=0.4, see Figure 1). However, the researchers noted a significant difference in the distribution of question types when considered across the online and in-person modalities (see Figure 2). The categories of Confirmation, Transformation, and Transitional encode some form of workshop content-based question, while the Other category represents interactions that did not fit into the first three categories. There were significantly (p<0.001) more Other-category questions asked in the online workshop environment than in person.

Questions in the Other category were primarily concerned with logistics such as whether another session would be offered. In the online learning environment, written or spoken interactions that an attendee might accomplish in person through facial expressions or gestures like nodding in agreement, voicing a quick thanks, or expressing confusion, needed to be more explicitly communicated. While observations included in the

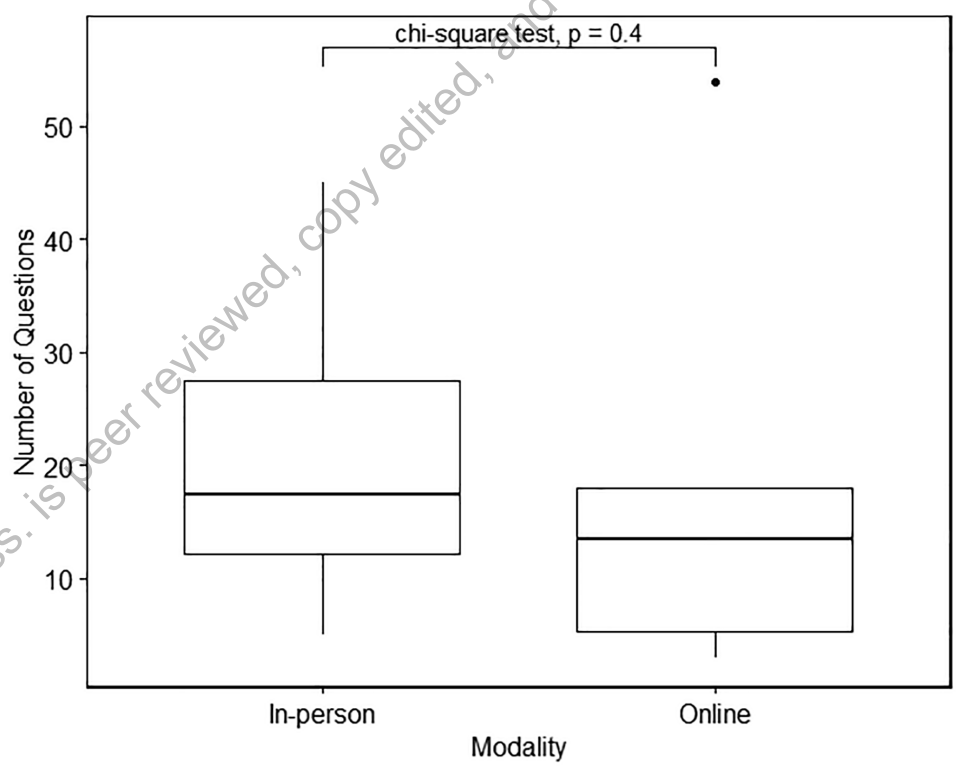

Figure 1. Workshop modality by total questions asked.

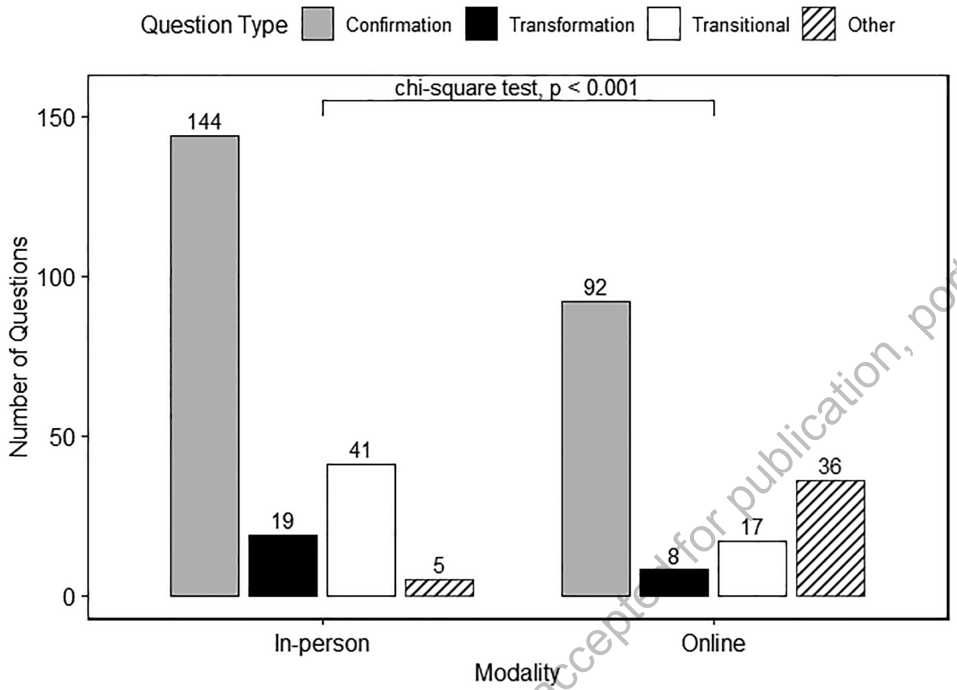

Figure 2. Workshop modality by question type.

Other category may not strictly be considered questions, they do represent an interaction between the attendee and the instructor. Capturing these unspoken or off-hand interactions for in-person workshops was not part of the experimental design, but due to the nature of the online learning environment participants could not express confusion or gratitude without actively voicing those sentiments, or typing them into the chat, and as a result those interactions were recorded. The researchers also observed that online participants tended to have more logistical questions concerning online-specific workflows such as, "Will this workshop be recorded and if so, where can I find the recording?"

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After considering the overall relevance of the Other question category to the primary research objective of this study, the authors decided to remove the Other category from the data for both online and in-person workshops and re-analyze the results. The researchers found no significant difference between workshop modalities with respect

to question type (p=0.5) once the Other category was removed. All of the following results have been calculated without the Other category so as to focus on the more content-specific questions asked.

Time of Day and Term

To determine whether participants were more likely to ask questions at a particular time of the day, the time that the workshop was conducted was compared against the total questions asked for that period. There was not a significant difference between morning or afternoon workshops. The specific workshop date with respect to its timing within the term (OSU uses a 10-week quarter system) against question number or question type also did not show significant differences.

Number of Attendees

To determine if participants were more likely to engage in question-asking behaviors in smaller or larger class-size settings, the researchers evaluated the data for differences in the number of questions and type of questions with respect to the number of attendees per workshop. To simplify analysis, the number of workshop attendees was grouped into four size-based bins: Bin 1 (1–3 attendees), Bin 2 (4–6 attendees), Bin 3 (7–9 attendees), and Bin 4 (10+ attendees). The number of attendees per workshop did not impact the number of questions asked. Conversely, there was a significant difference (p=0.005) between the number of attendees and the question type (see Figure 3). Bins 1 and 2 were significantly different in the distribution of their question types. Specifically, the number of Transitional questions asked in the smallest attendee group (Bin 1) was lower, while the number of Transitional questions asked in the Bin 2 (4–6 attendees) group was higher. There was no difference in the number of question types asked when comparing Bins 3 and 4. No clear reason for this variation arose, but a possible explanation might be that participants felt more comfortable in a somewhat smaller group setting to ask more comprehensive questions, and the Bin 2 groups were still large enough to generate sufficient energy for asking questions based on observing others in the group asking questions.

Finally, to learn whether learners were more likely to ask questions after being explicitly prompted to do so, the researchers analyzed learner-initiated questions, which were coded as "organic," versus instructor-prompted questions, which were coded as "prompted." The researchers did not observe differences in the way questions arose with respect to modality. The numbers of organic versus prompted questions in both online and in-person workshops were similar and did not show a significant difference (see Figure 4).

Workshop Content Characteristics

This category of inquiry explores differences in question-asking behavior that may arise from the content of the workshop materials. First, the researchers explored the number of questions asked. Researchers found that both the Git and Zotero workshops had a similar distribution of questions asked across workshops, while the QGIS workshops had significantly more questions (see Figure 5). This difference is likely due to the higher degree of domain-specific GIS workshop content, as well as the more prescriptive style of the step-by-step tutorial that attendees work through during the workshop.

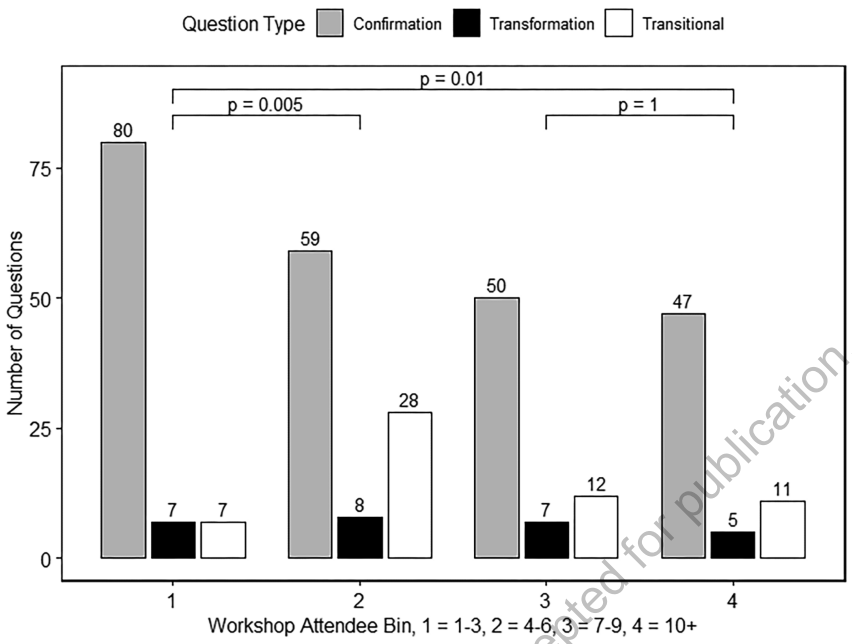

Figure 3. Workshop attendee number by question type.

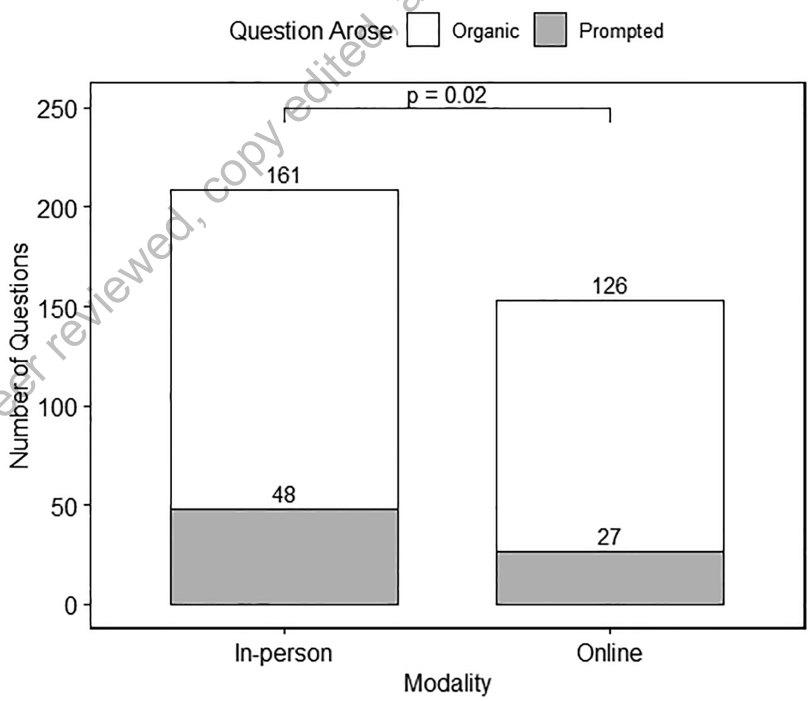

Figure 4. Proportion of prompted by organic questions by workshop modality.

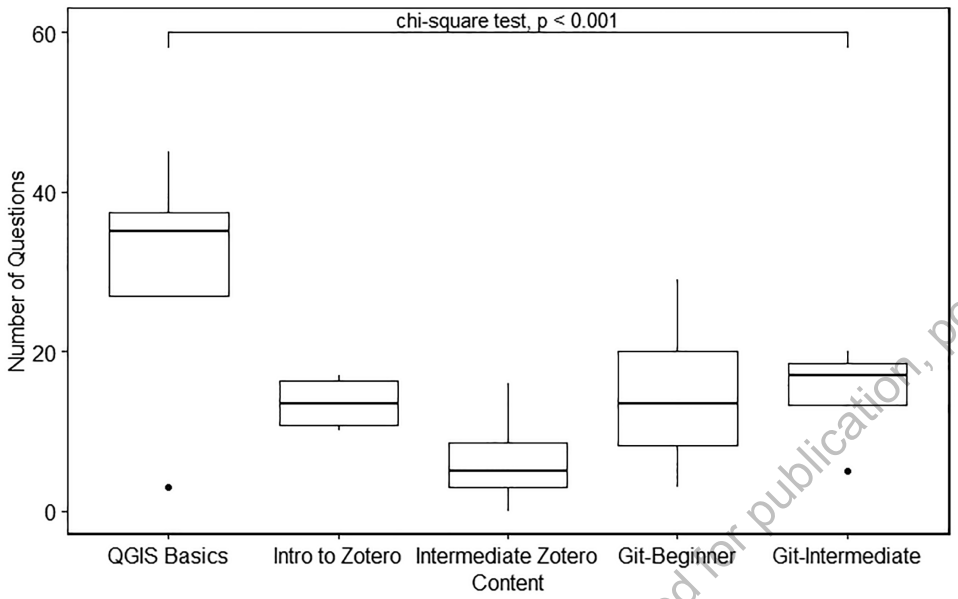

Figure 5. Number of questions by workshop content.

There was a corresponding larger quantity of Confirmation-style questions for the QGIS workshop because of the type of content; the QGIS workshop generated more than twice as many Confirmation questions as the next workshop, which was Intermediate Git (see Figure 6; note that the numbers in each bar on the graph represent the total number of questions asked). There was also a significant difference between the Zotero sessions separately and the Git and QGIS sessions. Because the Git and QGIS workshops have much higher technical knowledge requirements and are based on progression through a step-by-step tutorial, there are many more opportunities for attendees to get off track, thereby prompting more Confirmation questions, whereas the Zotero workshops require participants to have less pre-existing technical knowledge. Perhaps because of this difference, Zotero attendees have more opportunities to engage in Transitional or Transformational question asking, thinking, and application.

Finally, the researchers analyzed whether there was a difference between workshop characteristics in the way that questions arose (prompted vs. organic). The Zotero sessions received significantly more prompted questions than Git or QGIS (see Figure 7). Again, this difference may be due to the lower level of technical knowledge required to engage in the Zotero sessions and greater opportunity for attendees to begin applying new knowledge to their situation. An alternate explanation could be that the question prompting employed by the Zotero instructor is different than that of the Git and QGIS instructors, a possibility that will be explored more in the next section.

Instructor Practices

The last category of analysis explored potential differences in attendee question-asking behavior among the three workshop instructors. The researchers consider instructor

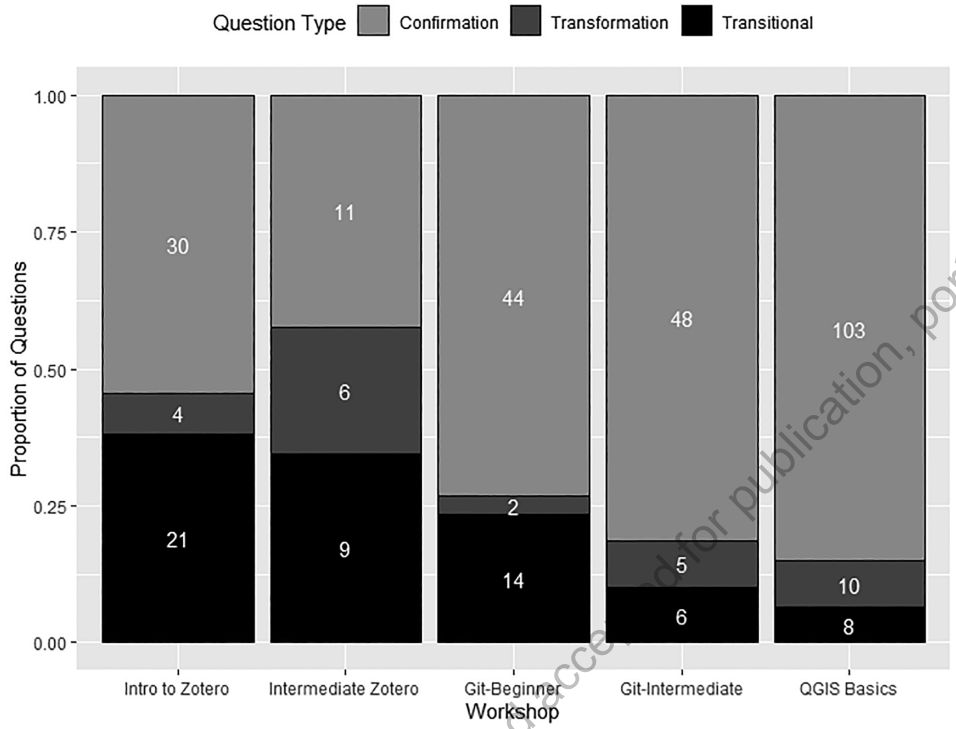

Figure 6. Proportion of question type by workshop.

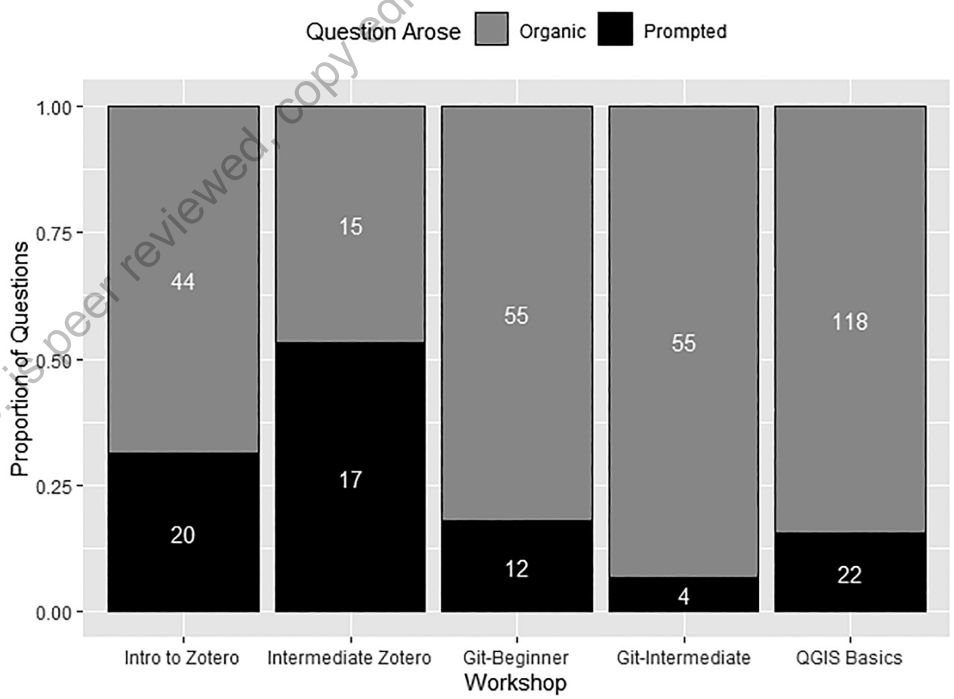

Figure 7. Prompted vs. organic questions by workshop content.

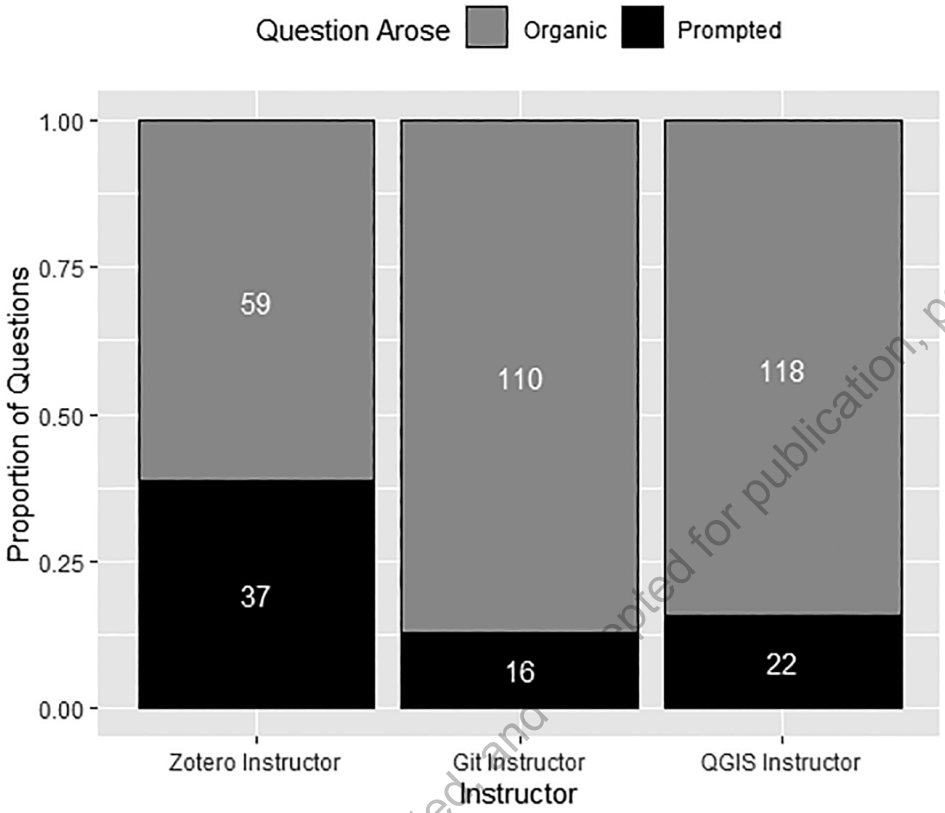

Figure 8. Prompted vs. organic questions by instructor.

practices in two different dimensions: question-prompting behaviors and question type. As was observed in the workshop content characteristics analysis, there was also a significant difference among instructors in the distribution of question-prompting behavior (see Figure 8). The Zotero instructor garnered many more questions based on an instructor prompt as compared to the other two instructors.

The distribution of questions across the question-type categories was also significantly different among instructors, specifically the distribution of Confirmation versus Transitional questions (see Figure 9). The QGIS instructor received the most Confirmation and fewest Transitional question types, while the Zotero instructor's workshops received the most Transitional and fewest Confirmation; the Git instructor's question total was between the other two instructors'. It was outside the scope of this study to have each instructor rotate through teaching responsibilities for each workshop topic, and therefore the authors cannot fully disentangle the influence of content differences from instructor differences.

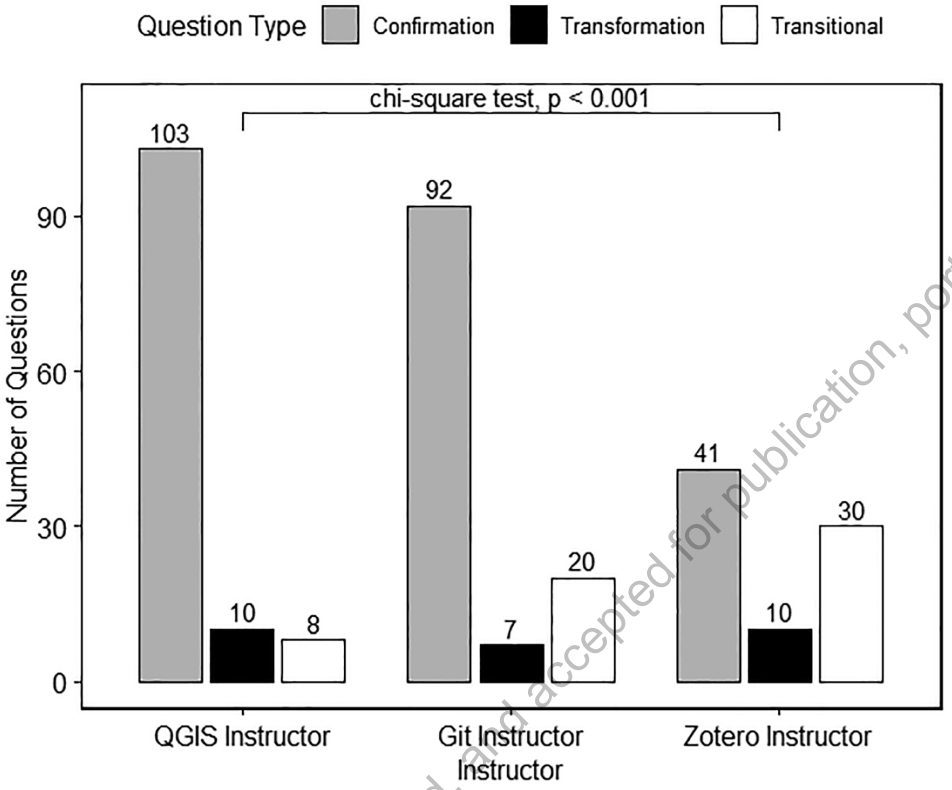

Figure 9. Question type by instructor.

Discussion

Learners demonstrated they are engaged in both in-person and online workshop modalities. The first research question in this study asked if there were differences in the number of questions asked when comparing in-person and online modalities. The results showed no significant difference in the overall question number between modalities. The second research question explored whether there were differences in the types of questions asked when comparing in-person and online modalities. The results again showed no significant difference in question types when comparing the two. This overarching finding indicates there is value in providing learners with a choice between in-person and online workshops, as participants engaged similarly in either modality format.

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Workshop participants have many reasons for needing different instructional modalities. The authors of this study have observed that some participants may not be located in

the geographic region or may be doing field or laboratory work that does not give them the flexibility to travel to the library to participate in a workshop in person. In addition, participants may prefer participating from their own workspace. Other participants may prefer to come to the library for workshops and physically separate from their work. Others may focus their attention differently in person than they can in an online setting.

While not significant, the results indicate some differences in the types of questions learners asked related to variations in prerequisite knowledge among the three workshop topics included in this study. There were also some differences in question types received by each workshop instructor. Overall, participants tended to ask more Confirmation questions. This observation matches findings by Graesser and Person who found students asked questions those researchers classified as "verification" and "instrumental procedure" twice as many times as the next highest question categories.[3] Based on the differences observed in prerequisite knowledge and workshop instructor in this study, the remainder of the discussion will focus on pedagogical recommendations for encouraging question-asking behaviors and eliciting question types that move beyond Confirmation questions. These pedagogical support recommendations are rooted in the three types of engagement described in the literature review.

Behavioral Engagement Supports

Recommendations for establishing a learning environment that supports behavioral engagement focus on timing and content choices. Learners need time to engage with the information presented, practice it, and then ask meaningful questions based on what they are learning. This time is especially necessary for topics that require a higher level of prerequisite knowledge. Providing time for practice and question asking likely means that the amount of content covered should be reduced; however, the authors suggest this tradeoff is worthwhile. With increased time for practice and reflection, learners gain the opportunity to ask confirmation questions to determine if they are on the right track, to ask transitional questions as they begin thinking about hypothetical applications for their knowledge, and to ask transformation questions as they seek to apply what they are learning to their own context or to push back and challenge any of the approaches suggested.

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Differences in how participant questions arose when comparing organic versus prompted questions in this study suggest that instructors can make pedagogical adjustments to how they solicit questions that may result in more responses to direct queries for questions. The Zotero instructor included more specific questions like, "What did you notice about the metadata for the journal article that was collected in the Info section of the Zotero library?" Asking more focused questions in addition to broad prompts, such as, "Does anyone have any questions?" allows learners to focus their attention on a specific content area. Providing a mix of both open-ended and specific question prompts allows students to engage in a range of question-asking behaviors.

Modeling question-asking behaviors, even in a shorter-duration learning experience like a workshop, reinforces that question asking is part of developing a shared learning experience. Researchers have found that one way to encourage student questions is for instructors to ask longer, higher-order questions.[32] Instructors should model question asking by responding to learner questions, especially questions that are more transitional or transformational in nature, with longer answers or with follow-up questions for the learners. Responding in this way demonstrates that the instructor is listening and values the questions learners are sharing.

Cognitive Engagement Supports

Educational researchers have found that many questions asked in the tutoring session context were what they called "common ground" questions, which included questions that established a shared vocabulary and an understanding of the purpose of the instructional content.[33] To quickly establish some common ground within the constraints of the workshop setting, library instructors can send prerequisites, short background information like a glossary, or links to documentation prior to the workshop session. This information could be shared via many different types of platforms. For example, the authors use GitHub, LibGuides, and Canvas. Instructors could also consider sending some question prompts prior to the workshop for participants who need more lead time to process questions. Understandably, because workshops are not a required part of the university curriculum, not all participants will make use of these cognitive supports. However, many workshop instructors have already compiled these resources to distribute after the workshop. Providing participants with access to these resources prior to the workshop is an accessibility adjustment that can be worthwhile for those seeking more learning supports.

Another way instructors can encourage cognitive engagement is by giving enough background information for students to be able to understand the context of the topic, but instructors should avoid filling in all the gaps or over-providing information. Patrícia Almeida found that providing somewhat less information resulted in more student questions.[34] Giving learners space to ask questions can help them gain the core skills needed to engage in problem solving.

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Learners come to workshop settings with a wide variety of previous learning experiences. Instructors should make adaptations to successive workshops based on what they observe about how much prerequisite knowledge learners tend to have. Because the authors offer the same workshops each term, tracking the questions asked over time is one way to determine learners' struggles with the content. In this study the instructors leading the workshops with higher prerequisite requirements have made multiple changes to the amount of content covered and the way it is presented based on observations about the baseline knowledge many learners actually have.

Question asking can serve as a form of metacognitive reflection to aid learners in processing their understanding and in purposefully identifying gaps in their knowl-

edge.[35] However, question asking is certainly not the only way that learners can or should engage in this type of reflective learning. In addition, public demonstrations of reflection and engagement with the material (like question asking), which are often promoted through active learning techniques, do not match all learners' needs and can even be detrimental for learners who have experienced marginalization.[36] As a result, designing instructional experiences with the final area of engagement support in mind–emotional engagement – is crucial.

Emotional Engagement Supports

Creating an instructional environment that is emotionally supportive of question-asking behaviors by being welcoming and clear about the workshop structure is likely the most important form of engagement support. There are multiple ways to create a welcoming environment including greeting students, creating name tags, or asking for introductions. Authors in this study employed a range of these techniques in their workshops. These types of introductions can happen in either in-person or online modalities. In addition, instructors can be clear from the beginning of the workshop that they welcome questions.

To support emotional engagement instructors can also include multiple routes for asking questions. Pedrosa de Jesus and collaborators have documented that providing multiple routes and opportunities for question asking encourages more meaningful questions.[37] In the online environment, instructors can welcome questions via chat or by voice. For in-person workshops, in addition to vocalized questions, instructors can consider having a whiteboard available for questions that arise. Recognizing that some learners need some anonymity to feel comfortable asking questions without the perceived pressure of peer judgment, instructors can collect written questions at particular points throughout the workshop.[38] After the workshop, instructors should provide clear routes for sending questions via email or a learning management system.

To build in multiple opportunities for students to ask questions, establish a pattern of being open to questions. Even if learners do not ask questions at the first opportunity, they will recognize when an instructor is genuinely seeking their questions. Instructors can also consider when questions are asked in the workshop and make an effort to ask for questions while learners are practicing problem-solving activities, instead of only after delivering lecture content.

Finally, instructors should be mindful of how they respond to questions. In this study an unintentional benefit of the study design was that the authors served as informal peer reviewers for each other, ultimately providing a mechanism to reflect on teaching practices. As a result, the authors recommend that instructors invite a peer reviewer to come and specifically observe responses to questions. Based on the feedback, instructors can understand whether they are responding in a way that signals positive or negative reactions to learner questions. Instructors can assess the signals given to students about the value of question asking and look for ways to improve.

Limitations

There are several lines of inquiry the study design did not capture. Participants were not categorized by learner level or position, for example first-year graduate students com-

pared to faculty members. Exploring differences in participant type may have revealed variations in question-asking behaviors based on increased experience in learning settings. These differences may have included measurement of different types of questions based on learning experience.

This study was also not designed to measure nonverbal communication for the in-person modality. Because the increased number of Other questions in the online environment likely served as a proxy for nonverbal behaviors like nodding or waving goodbye, comparing the nonverbal interactions for the in-person modality could have provided a richer picture of overall participant engagement in both settings. Similarly, measurements of emoji use in the online modality could have provided additional signals of engagement. Likewise, participants in the online workshops were not required to use their camera or microphone. While the authors of this study do not encourage this type of requirement for online workshops, having a comparative condition where many participants showed nonverbal communication while on camera could have provided more engagement information. Finally, some of the online workshops were recorded. The announcement that a session was being recorded may have had a dampening effect on some participants' question-asking behaviors.

Conclusion

This study used question asking as a way to measure participant engagement in in-person and synchronous online workshops. The researchers determined that measuring question-asking behaviors provided an understanding of learner engagement and that there was no significant difference in engagement between the in-person and online workshop modalities. Future studies could include interviews with participants to learn more about their question-asking behaviors and determine contributors to increased or dampened engagement. Follow-up studies could also explore alternate ways to measure engagement beyond question asking in these shorter-duration learning experiences.

The findings from this study inform pedagogical approaches librarians can use in the unique instructional format of the workshop setting. The continued improvement in tools for synchronous online learning and learners' adaptations to working in the online learning environment make online workshops a viable instructional modality for librarians. Librarian instructors should make use of both in-person and online modalities for engaging with their learners.

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