© Journal of Higher Education Outreach and Engagement, Volume 24, Number 2, p. 37, (2020)
 eISSN 2164-8212

The University Classroom Observation Program: Connecting Middle and High School Teachers with University Instructors

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Abstract

In the University Classroom Observation Program (UCOP), middle and high school teachers spend time on campus observing science, technology, engineering, and mathematics (STEM) classes and engaging in discussions with colleagues and college instructors. The program provides a unique and reciprocal professional learning opportunity. Middle and high school teachers learn to use an observation protocol to collect data in STEM classrooms. These data serve as feedback for individual college instructors; help provide an aggregate snapshot of teaching throughout the university; and contribute to faculty professional learning opportunities, new teaching and learning initiatives, and the larger discipline-based education research (DBER) literature. UCOP offers middle and high school teachers discussion and networking opportunities to reflect on their own teaching and on ways to better prepare their students for college. Here we describe the program, articulate the benefits for stakeholders, reflect on lessons learned, and discuss important considerations for the development of similar programs.

Keywords: community engagement, professional learning, peer observation, instructional practices, reflective teaching

The inspiration for designing a community engagement program in which middle and high school teachers collect data and reflect on college science, technology, engineering, and mathematics (STEM) instruction came from national calls, such as those from the American Association for the Advancement of Science (2011) and the President's Council of Advisors on Science and Technology (2012), to reform how undergraduate classes are taught. These calls have largely focused on the implementation of evidence-based teaching strategies, such as active learning. Active learning strategies (e.g., asking students to discuss concept questions with peers) increase both retention and learning gains for undergraduate students, including those from underrepresented groups (Eddy & Hogan, 2014; Freeman et al., 2014; Freeman et al., 2007). A recent study also found that increasing the duration of group work in undergraduate biology classes, particularly with the use of worksheets, can lead to increases in student learning (Weir et al., 2019).

Aligned with these broader goals, the Maine Center for Research in STEM Education (RiSE Center) at the University of Maine created the Maine Physical Sciences Partnership, or PSP (with funding from the National Science Foundation, Grant #DRL-0962805). The RiSE Center's PSP (known today as the Maine STEM Partnership) was originally designed and continues to strengthen science education by facilitating community partnerships with K-12 schools and school districts, teachers, university faculty, and other organizational partners to improve STEM education and teacher preparation through research-supported practices. We wanted to extend the opportunities for professional learning to additional stakeholders teaching STEM courses at the university level and to find ways for educators at all levels to discuss evidence-based teaching strategies with one another.

As institutions work to transform instruction, it is helpful to document current instructional practices so that results can be used to plan future transformation strategies and professional development (National Academies of Sciences, Engineering, and Medicine, 2018). There are a variety of ways to document instructional practices, including surveying college instructors about what they are doing in their classrooms (Borrego et al., 2010; Henderson & Dancy, 2009; Macdonald et al., 2005; Wieman & Gilbert, 2014; Zieffler et al., 2012). However, college instructors tend to overestimate the amount of active learning that occurs in the classroom (Williams et al., 2015), so it can be difficult to use this information to gain insight into actual practices and plan for appropriate professional development.

Another strategy is for observers to visit classrooms and record what is happening. A growing number of observation protocols have been used to document instructional practices in undergraduate STEM classrooms, including the Reformed Teaching Observation Protocol (RTOP; Sawada et al., 2002), the Teaching Dimensions Observation Protocol (TDOP; Hora et al., 2013), the Classroom Observation Protocol for Undergraduate STEM (COPUS; Smith et al., 2013), the Practical Observation Rubric To Assess Active Learning (PORTAAL; Eddy et al., 2015), and the Measurement Instrument for Scientific Teaching (MIST; Durham et al., 2017). Classroom observers often come from within an institution (Cleveland et al., 2017; Pelletreau et al., 2018; Stains et al., 2018); typically such an individual is a colleague or a member of the campus center for teaching and learning. However, because instructors are often observed under high-stakes circumstances, such as consideration for tenure and promotion or in response to negative evaluations or feedback from students, it can be difficult to convince instructors to open their classrooms to observers.

To help avoid the sense that observations are high-stakes activities, we created the University Classroom Observation Program (UCOP) at the RiSE Center within the University of Maine (UMaine). UCOP is a unique professional learning opportunity that engages both teachers and college instructors. As part of this program, middle and high school teachers were trained to collect observation data in STEM classrooms on campus, using the Classroom Observation Protocol for Undergraduate STEM (COPUS; Smith et al., 2013). COPUS characterizes the behaviors of both instructors and students throughout the class, without any value judgment from the observer. Using this protocol, observers mark at least one of 13 behaviors for students and at least one of 12 behaviors for instructors during each 2-minute interval of the class. For example, observers may indicate that the students are listening to the instructor, working in groups, asking questions, and so on. At the same time, the observer may indicate that the instructor is lecturing, showing a video, asking a question, answering a question, and so on. The COPUS was adapted from the Teaching Dimensions Observation Protocol, or TDOP (Hora, 2015; Hora et al., 2013).

In addition to COPUS observation data, the college instructors also submitted questions they have about their teaching (e.g., Am I paying attention to all parts of the room?), and the middle and high school teachers provided feedback. Since 2014, 84 middle and high school STEM teachers have completed 620 course observations of 191 college instructors in 26 UMaine STEM departments.

To our knowledge, UCOP is one of the first community engagement programs in which middle and high school teachers observe and provide feedback to college instructors. Overall the goals of the program include

- developing a clearer understanding of the current state of teaching and learning in undergraduate STEM courses by observing and documenting what occurs in the classroom;
- using observation data to better design college faculty professional development opportunities around evidence-based teaching strategies; and
- providing discussion and networking opportunities for middle and high school teachers to reflect on their own teaching and ways they are preparing students for college.

UCOP weaves together the guiding principles of community engagement as defined by the Carnegie Classification for Community Engagement, including partnership and reciprocity as well as exchange of knowledge (Campus Compact, 2013). Here we describe UCOP, share the benefits for stakeholders (including the university, college instructors, middle and high school teachers, and education researchers), reflect on lessons we have learned from running such a program, and discuss important considerations for other institutions interested in designing a similar program.

The University Classroom Observation Program: An Overview From the Teacher and Instructor Perspectives

UCOP typically occurred during the spring semesters when there are two weeks, one in February and one in April, when UMaine is in session but middle and high school teachers are on week-long breaks. By scheduling the program at this time, we were able to avoid taking middle and high school teachers out of their classrooms.

Ahead of the spring semester, UCOP staff searched the UMaine course database for STEM courses that would work well for the observation schedule (i.e., meet two or three times a week at a time between 8 a.m. and 5 p.m.). A draft agenda was created and college instructors were sent an email requesting permission for two local middle/high school teachers to observe their class on a particular day and time. The college instructors were also sent an informed consent form asking if the observation data collected by the middle and high school teachers could be used for research purposes (University of Maine, IRB protocol no. 2010-04-03 and 2013-02-06). Just prior to the start of the UCOP in both February and April, college instructors received an email reminder of the date and time when teachers would be observing in their class as well as a link to a short questionnaire that asked them to list their name, department, and course number. The college instructors could also use the questionnaire to request specific feedback from the middle and high school teachers who would be visiting their class (examples in Figure 1). Approximately 35% of the college instructors requested this feedback.

At the beginning of the spring semester, STEM middle and high school teachers from across the state were sent an email describing UCOP and linking to the application. The email was posted on a statewide education electronic mailing list and sent to teachers who previously participated in UMaine professional developmental events. We also emailed approximately 200 teachers by going through school district webpages and sending the email to teachers listed in STEM departments. The application included open response questions that asked

1) I am getting a lot of different students participating but they are mostly from the center section. Are there ways to get the "wings" to volunteer more answers?

I think that students around us in the wings had answers and they were willing to share with the TAs. They have the information and are willing to share in a smaller setting. One suggestion coul dbe to have them sit in a different seat the next class and see if that changes the participation level.

2) Is the course staff getting around to everyone? There are pockets in the middle we physically cannot reach, but are we covering the more accessible ground?

We were very impressed with this. Most students were well served by the TAs.

3) Are students largely engaged in the material?

Absolutely, the topical and timely articles and short films are great as an engagement tool and for content. The students seemed to really respond to the real-world examples and the connections to these diseases and carrier probability.

Figure 1. Sample College Instructor Feedback Requests
Note. Examples of college instructor feedback requests (shown in bold) and middle/high school teacher responses.

1. **L**-Listening; **Ind**-Individual work; **CG**-Clicker Q discussn; **WG**-Worksheet group work; **OG**-Other group work; **AnQ**-Answer Q; **SQ**-Student Q; **WC**-Whole class discussion; **Prd**-Predicting; **SP**-Student presentation; **TC**-Test/quiz; **W**-Waiting; **O**-Other
2. **Lec**-Lecturing; **RtW**-Writing; **FlUp**-Follow up; **PQ**-Pose Q; **CQ**-Clicker Q; **AnQ**-Answer Q; **MG**-Moving/Guiding; **101**-One-on-one; **D/V**-Demo+; **Adm**-Admin; **W**-Waiting; **O**-Other

For each 2 minute interval, check columns to show what is happening in each category (or draw vertical line to indicate continuation of activity). Check multiple columns where appropriate.

COPUS

	1. Students doing												2. Instructor doing												Comments: Examples-explain difficult coding choices, flag key points for feedback for the instructor, identify good analogies, etc.
min	L	Ind	CG	WG	OG	AnQ	SQ	WC	Prd	T/Q	W	O	Lec	RtW	Flup	PQ	CQ	AnQ*	MG	101	D/V	Adm	W*	O*	
0-2																									
2-4																									
4-6																									
6-8																									
8-10																									

Figure 2. Sample COPUS Data Collection Sheet
Note. A sample of the Classroom Observation Protocol for Undergraduate STEM (COPUS) data collection sheet. Observers place a check mark in the box if a behavior occurs during a 2-minute time block. Multiple codes may be marked in the same 2-minute block.

teachers about their motivation to be part of the observation team for UCOP and for details about their instructional style (including, for example, a description of a favorite lesson). We also asked for the name of their school, how many years they had been teaching middle and/or high school, and what subjects they teach. Finally, we asked for their commitment to come to all of the February and April dates (three days in February and three and a half days in April). The average acceptance rate was 41.3%. We chose teachers based on their application responses and worked to select a group who taught a variety of STEM subjects at a variety of grade levels (middle and high school), came from schools throughout the state, and had varied levels of teaching experience.

On the first day of the program, middle and high school teachers introduced themselves and learned more about the goals of the program. We told the middle and high school teachers that their expertise and efforts were critical for collecting data, making improvements to the institution, and contributing to the larger field of discipline-based education research (DBER). Our emphasis on teachers' contribution to research is based on one of Barker's (2004) emerging practices in the scholarship of engagement, which includes participatory research. According to Barker, "participatory research stresses the active role citizens can play in the production of academic knowledge" (p. 130), and we wanted to ensure that the teachers involved in UCOP recognized the important role they play in the research.

Middle and high school teachers were then trained to use COPUS (details in Smith et al., 2013). There were several reasons why COPUS was used for this program: (1) It simply records what is happening in the class so middle and high school teachers do not need to make a value judgment about the teaching quality of college instructors, (2) behaviors are aligned with evidence-based teaching strategies (Lund et al., 2015), and (3) observers can be trained to reliably use the instrument in approximately two hours (Smith et al., 2013). A sample of the COPUS data collection sheet is shown in Figure 2. More resources for COPUS training can be found at http://www.cwsei.ubc.ca/resources/files/COPUS_Training_Protocol.pdf.

Training to use COPUS involved giving teachers a description of the 25 codes they would be marking during the observation and then discussing what each code looks like in a college classroom. For example, one of the student codes is CG: "Discussing clicker questions in groups of two or more students." Clickers are personal response devices that allow students to answer a multiple-choice question that instructors pose in class. Typically, a peer instruction method is used in which students vote on a question individually, discuss the question with those sitting near them, and vote again (Mazur, 1997). Monitoring students' answer choices allows instructors to gain immediate feedback from students about understanding and to structure classroom discussions. Clickers are used widely across university campuses and are one of many evidence-based teaching strategies for improving student engagement even in large-enrollment courses. Although clickers may not be as common in middle and high school settings, they are becoming more standard in university settings, and so we discuss as a group what a clicker is, how it is typically used in a college classroom, and when peer discussion is likely to occur.

The teachers were then shown three approximately 10-minute videos of instructors teaching (e.g., https://youtu.be/wont2v_LZ1E) with different types of active learning, and the teachers practiced coding using COPUS. We found it works best to play 2 minutes of a video while the middle and high school teachers each fill out the COPUS data sheet, pause the video, and then discuss the 2-minute time block as a group. At the end of each 2-minute time block, we called on different middle and high school teachers to tell the group what they selected and discussed whether or not the group agreed with the choices. After the group discussion, we projected a slide that showed what the UCOP staff members selected for the 2-minute time interval so observers could double-check their codes with a visual reference and to help everyone understand the correct codes. Then we moved on to the next 2-minute segment. For the third video, we played the whole segment (usually 8–10 minutes) for teachers to observe with COPUS without stopping every 2 minutes, as it provides the teachers a more realistic experience of what they will be doing in live classes. Then we compared the whole coded segment and discussed the codes as a group.

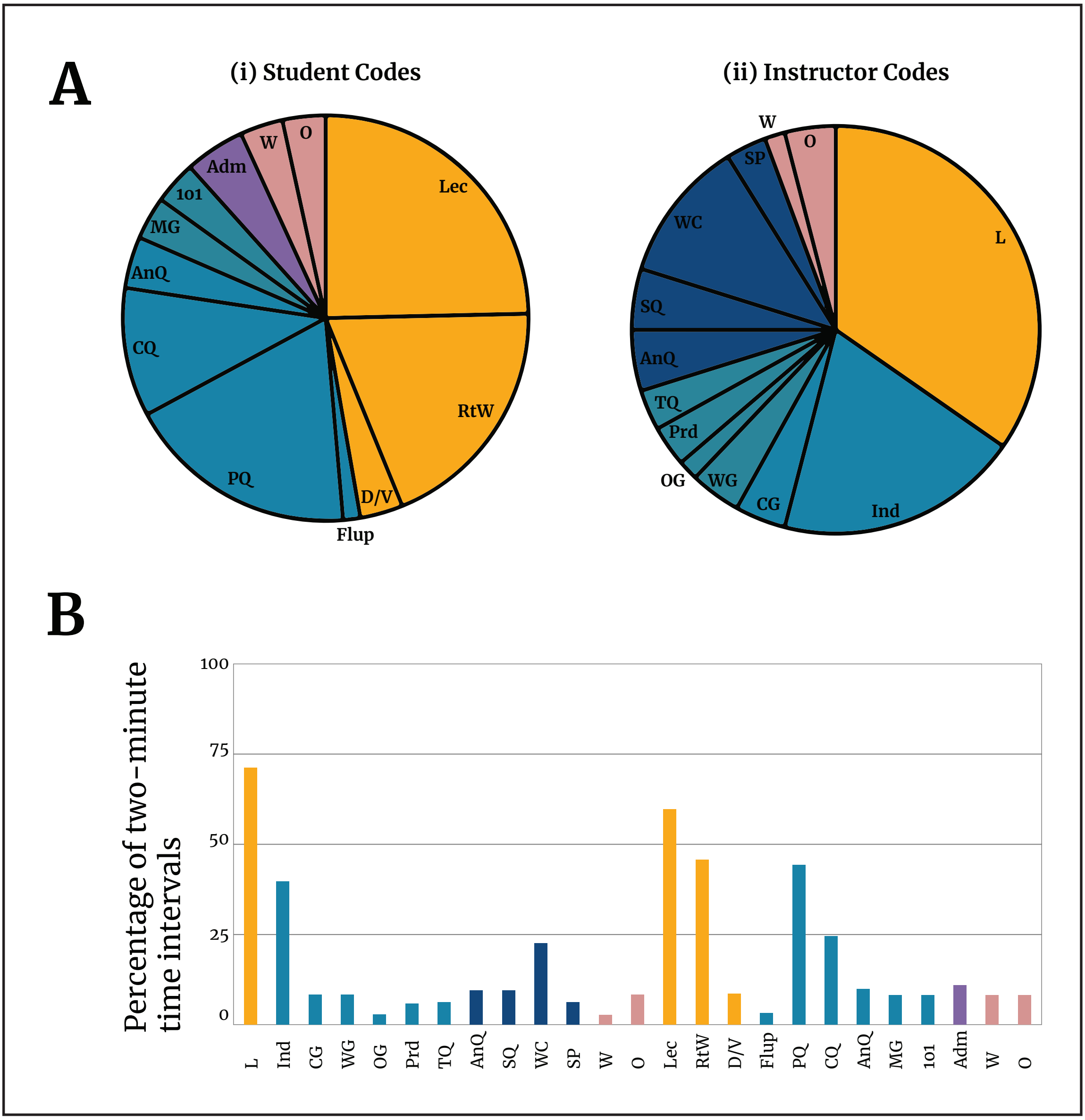

Figure 3. Graphic Results Based on COPUS Data Collection Sheet
Note. Sample results of a single Classroom Observation Protocol for Undergraduate STEM (COPUS) observation showing the (a) abundance of (i) student and (ii) instructor COPUS codes and (b) frequency of all COPUS codes as a percentage of 2-minute time intervals in which the behavior was observed during the duration of the class. The abbreviations are described in Figure 2. Colors in both (a) and (b) correspond to broader categories of codes as described in Smith et al. (2014).

Next, we talked about expectations for the classroom observations. These expectations included encouraging teachers to introduce themselves to the instructor, recognizing that instructors may be nervous about being observed, not asking undergraduate students to share their opinions of the instructor or class, and not reprimanding students for being off-task during class. We also stressed that the middle and high school teachers would be seeing a wide variety of classroom practices.

Teachers then observed a live class in pairs. During each class observation, middle and high school teachers sat with a partner and each individually completed the COPUS form for the duration of the class. The middle and high school teachers used a shared stopwatch, started at the same time, and proceeded in sync to a new row on the COPUS form every 2 minutes. When the observation was over, the middle and high school teachers turned in their data collection sheets and the data were entered into an Excel spreadsheet that automatically generates graphs showing the frequency and abundance of each code (example graphs shown in Figure 3. Sample data collection sheet and more comprehensive spreadsheet output may be requested by emailing author ELV. Abundance or percentage of each code was calculated by adding the total number of times each code was marked and dividing by the total number of codes. Frequency or percentage of time was calculated by counting the number of 2-minute time intervals in which each code was marked and dividing that by the total number of time intervals. Additional details about these calculations can be found in Lewin et al. (2016).

UCOP staff members calculated the Cohen's kappa interrater reliability scores between the two middle and high school teacher observers. Observations with an interrater reliability score of greater than 0.65 were used for research purposes (Landis & Koch, 1977); we found that about 98% of the observations reached this threshold.

After the first live observation, the middle and high school teachers convened to discuss what they had seen and ask questions about any confusing COPUS codes. Teachers often also wanted to discuss how the observation went, what stood out to them, what could be improved, and how what they saw was similar to or different from their own middle or high school classes.

After each observation, the middle and high school teachers filled out an online survey, the Instructional Practices Survey, developed for UCOP. The Instructional Practices Survey may be requested by emailing author ELV. The Instructional Practices Survey provdes teachers with an opportunity to discuss the instructional practices observed and make suggestions for improvement. The survey included questions about teaching practices observed, such as, "Were students given the opportunity to discuss course material with their peers during this class period?" If the answer was yes, teachers responded to a variety of questions regarding the quality of the peer discussion. If the answer was no, teachers responded to questions about whether the course would be improved by using peer discussion and, if so, how. The survey included questions the college instructors submitted before the start of UCOP, and middle and high school teachers were able to provide specific feedback. Teachers were encouraged to discuss and reflect with their partner as they completed this survey. In addition, each teacher separately completed the Individual Observer Survey to reflect on their own teaching practices. This survey asked questions such as, "What additional skills, if any, would your students need to acquire to successfully learn in this course?" The Individual Observer Survey may be requested by emailing author ELV.

In addition to the first day, which included training and at least one live observation, the middle and high school teachers observed for two more days during their February break, with each teacher observing four to seven different courses each day. We changed observation partners each day so that teachers interacted with multiple members of the group. At the end of every day, UCOP staff led a wrap-up discussion to talk about the teachers' experiences that day as well as other issues relevant to teaching and learning. Middle and high school teachers often requested discussions around topics such as the frequency of particular instructional techniques such as clicker questions, strategies to use and skills to teach to better prepare their students for college, and the most effective teaching strategies that were observed and why they worked.

Middle and high school teachers returned for three and a half more days during their April break. The week started with a refresher COPUS training during which teachers reviewed the codes and practiced coding another video. Every effort was made to observe the same courses in February and April; for example, if the class Introduction to Biology (BIO100) was observed in February, it was also observed in April. However, teachers often observed different courses in February and April (i.e., the two teachers who observed BIO100 in February were different from the two teachers who observed BIO100 in April) to expose them to a larger diversity of instructors and teaching practices.

On the last half day of the program in April, college instructors and middle and high school teachers were invited to discuss teaching and learning in small groups. The middle and high school teachers developed a list of topics to discuss with college instructors. College instructors were invited to participate for any length of time in a 3-hour open-house discussion with the teachers and select which small groups to join based on their interest. Topics included use of technology, classroom norms and culture, common ground among educators, assessment, student transition to college, student engagement, and broadening participation in STEM disciplines. After the small group discussion, the entire group met together, providing both middle and high school teachers and college instructors the opportunity to ask one another questions. By the end of the program, each middle and high school teacher had performed approximately 18 observations with a partner. With 10 teacher pairs (20 teachers), a total of roughly 180 observations were completed each year of the program.

After the April observations, the college instructors were sent an email asking if they would like to meet with a member of the UCOP staff to discuss their COPUS data and feedback from middle and high school teachers on the questions they asked. Approximately 73% requested a meeting, and they went through their individual codes and summary graphs, which were similar to material shown in Figure 3. College instructors often wanted to know how their teaching practices compared to those of their colleagues. To respond to this request, college instructors were also given aggregate data from all of the observations showing the relative percentage of different codes (examples of aggregate data are shown in Smith et al., 2014). A member of the UCOP staff read through the middle and high school teacher feedback before sharing it with the college instructors to make sure the feedback had a constructive tone.

Benefits of UCOP to Many Stakeholders

The benefits of UCOP are experienced by a wide range of stakeholders involved with the project, including universities, college instructors, and middle and high school teachers. The program is one of community engagement (incorporating reciprocity to all stakeholders) and not simply a one-way outreach initiative—either from middle and high school teachers to college instructors or from college instructors to middle and high school teachers (Sandmann, 2008). We found that the unique role of UCOP is that it benefits all involved.

Benefits to Universities

UCOP provides several benefits to the university, including generating a large amount of information about instructional practices in a short amount of time. At UMaine, the observation data have been used to design more targeted professional development opportunities for college instructors. For instance, when it was determined that the size of the class was not strongly correlated with the amount of time spent lecturing (Akiha et al., 2018), workshops were offered that focused on ways for both small- and large-enrollment classes to include more student-centered activities. In addition, it was found that only a subset of college instructors who were using clickers were providing students with the opportunity to talk to each other (Lewin et al., 2016), so workshops were designed around ways to encourage peer discussion. Using a data-driven approach to design educational development increased the number of college instructors who participated. Before COPUS data, about 10 college instructors would typically attend such professional development opportunities, but after aligning topics to faculty needs, attendance at these workshops often numbered 50 or more.

Benefits to College Instructors

College instructors also benefited from being involved with UCOP, as it provided them with an opportunity to engage in low-stakes observation by teaching professionals. Although many observations conducted

"As part of the University of Maine Classroom Observation Program, middle and high school teachers observed my genetics course from 2013-2017. The teachers used an observation protocal that documents different instructional behaviours the instructor and students engage in during the class period. The pie charts show the instructional behaviors I used in a single class period of my class, and reveal that students are asked to come to my class with their "minds on" ready to answer clicker questions, work in small groups, and practice solving problems."

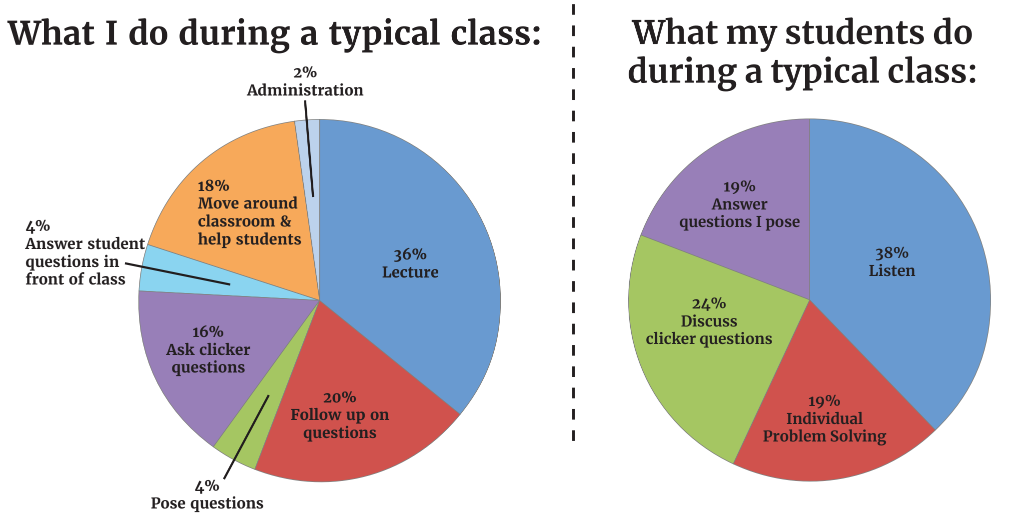

Figure 4. COPUS Data in Tenure and Promotion Portfolio. Example showing how a college instructor used Classroom Observation Protocol for Undergraduate STEM (COPUS) data as a part of a tenure and promotion portfolio.

at the university level are associated with high-stakes evaluation during tenure and promotion, UCOP gives college instructors the chance to simply learn from feedback, to engage in discussion with teachers, and to reflect on their teaching. Many college instructors involved with UCOP have used their individual COPUS results as a part of their tenure and promotion portfolio to provide evidence for their teaching philosophy and practices. An example of how the information was presented is shown in Figure 4.

Benefits to Middle and High School Teachers

Surveys of middle and high school teachers at the end of the program indicated that they also experience several benefits. A summary of the benefits they listed and example quotes are shown in Table 1. Also, UCOP provided a key community-building opportunity in a state as rural as Maine, which according to the U.S. Census Bureau is the most rural state, with nearly 62% of the population living in rural areas (Fields et al., 2016). Some of the middle and high school teachers who participated in our program have few, if any, STEM colleagues in their home school district—often there is only one science or math teacher in a given school. UCOP provided an opportunity for all teachers to expand their professional network.

Recommendations and Lessons Learned

We have found some key components that are critical for the success of UCOP.

Create a Competitive Application Process for Middle and High School Teachers

Our program received more applications than we could accept, which allowed us to select teachers based on a variety of factors, including reasons for wanting to participate, STEM discipline and grade level taught, number of years teaching, geographic location in the state, and socioeconomic status of various communities (based on Maine Department of Education data indicating percentage of students receiving free and reduced-price lunch).

Table 1. Benefits to Middle and High School Teachers, Including Quotes From Teacher Evaluations of the Program
Benefits to Middle and High School Teachers
Observe instruction in university STEM courses to help prepare students for college. • "Teachers get the opportunity to observe the different teaching styles of professors and reflect on the skills they need to explicitly teach students to be college ready. We even got direct feedback from professors on what they felt students needed to be prepared." • "[UCOP] informed my understanding of the expectations required of students headed to a University from the perspective of the professor." • "Opportunity to understand where my students are headed and how I can better prepare them."
Reflect on issues of teaching and learning while observing college classes. • "I was able to get a better understanding of how I teach through observing and reflecting." • "The strategies that I have learned from UCOP have allowed me to facilitate a much more productive classroom climate and conversation." • "Observing others also gives you an opportunity to see strategies in use, not just read about them. Ultimately, discussing what you saw with someone else allows you to view the lesson from more than one perspective."
Experience ways of evaluating classroom practices. • "I will encourage my administrators to adopt a similar observation protocol for the administrator/teacher and teacher/teacher observations we are now conducting in my school district." • "The COPUS protocol showed me one way of gathering quantifiable data on teaching practices" and "I think of how my [COPUS] pie chart would look! Are my kids listening all the time or are they engaged and doing multiple things during class time?" • "The COPUS tool has allowed me to look at my own practice with a greater focus on student vs teacher directed work. I have already begun reevaluating how I am teaching and guiding my students."
Feel valued for their professional expertise. • "UCOP is an invaluable experience that made me feel valued as a professional educator." • "It was so refreshing to be viewed as a professional who has something to offer other instructors. I felt like my input mattered."
Contribute to research that focuses on institutional improvement. • "It is always great to work with colleagues who are as invested in improving STEM education as I am. It is also so exciting to be part of such a great research program." • "I like knowing (or at least thinking) that this program overall will lead to more engaging, student-centered instruction at the University."

Establish a Professional and Welcoming Atmosphere for the Teachers

Throughout UCOP we stressed that the expertise of the middle and high school teachers was critical for the success of the program and our research questions. In addition, the teachers were awarded 52 continuing education unit contact hours for their participation, earned a stipend of $1,300 ($25/hour for 52 hours) for attending all six and a half days, and had the opportunity to have someone from the university observe their middle or high school class. Funding for the program and the teacher stipends was provided through grants from the National Science Foundation (Grants DUE-1347577 and DRL-0962805).

Set Clear Expectations and Protocols for Observers

Providing expectations for observing college instructors helped to prevent uncomfortable situations. One lesson we learned early on is to remind middle and high school teachers that faculty have anxiety about being observed. We also reminded teachers that college instructors are not typically trained in teaching or pedagogy, which helped teachers be more compassionate regarding observations. We asked teachers to observe a class with the utmost respect for the instructor—such as introducing themselves to the instructor ahead of time, being quiet and attentive during class, and avoiding an often strong desire to reprimand students who may be talking or off-task during class.

Involve Teachers in the Research Process

If you are collecting observation data for institutional improvement or research, it is helpful to share your research questions with the middle and high school teachers and get them involved with the process. Teachers often commented that one benefit of the program is being able to contribute to questions about institutional improvement (see Table 1). All teachers who participated in collecting data have been acknowledged by name in presentations and manuscripts (see, for example, Smith et al., 2014).

Provide Feedback to College Instructors After the Program

College instructors often do not set aside time to discuss their teaching with peers, so meeting with faculty one-on-one to share observation data provided an opportunity for feedback about their teaching and to connect them with teaching resources (e.g., upcoming workshops, resources from teaching centers).

Use the Data to Improve Professional Development for College Instructors

It can be difficult to determine what professional development opportunities to offer college instructors. By using a data-driven approach, limited resources can be focused on topics where college instructors need the most help (such as how to encourage peer discussion during clicker questions). The UMaine Center for Innovation in Teaching and Learning has also been using aggregate COPUS results to plan programming for campuswide events.

Offer Middle and High School Teachers the Opportunity to Provide Feedback

We gave middle and high school teachers online evaluation surveys in both February and April. Performing evaluation at these two time points allowed us to make changes in April based on feedback from February. For example, after the February week, a teacher suggested that it would be beneficial for teachers to be able to select the classes they wanted to observe, and we were able to implement such a system in April. The April survey allowed us to get feedback about the value of the UCOP professional learning opportunity and suggestions for future programming.

Outcomes From UCOP and Future Work

We have used the results of UCOP to write research papers. For example, we used UCOP data to help validate the COPUS instrument (Smith et al., 2013); write about instructional practices in STEM classes throughout a university (Smith et al., 2014); document different ways in which clickers are used (Lewin et al., 2016); contribute to a large-scale analysis of instructional practices across North America (Stains et al., 2018); and compare instructional practices in middle school, high school, and college environments (Akiha et al., 2018). Being able to use UCOP data to publish a number of studies has helped increase the visibility of COPUS, which is being used to document instructional practices as part of the Tufts University's HHMI-funded Listening Project; Mobile Summer Institutes on Scientific Teaching, Transforming Education, Stimulating Teaching and Learning Excellence (TRESTLE); and the Automated Analysis of Constructed Response (AACR) projects. In addition to STEM-related projects, COPUS is used by university centers for teaching and learning as a service provided for all faculty (not just STEM faculty) who are interested in acquiring COPUS observation data from their class. Examples include University of California Irvine's Teaching and Learning Research Center (https://dtei.uci.edu/tlrc-using-copus-as-a-research-tool/) and the University of Southern Indiana's Center for Excellence in Teaching and Learning (https://www.usi.edu/cetl/teaching-and-learning/copus-observations/).

UCOP data have also been used to launch new grant-funded initiatives. For example, we used COPUS data collected during UCOP and combined it with COPUS data collected at the middle and high school level (Akiha et al., 2018). We found that although middle and high school classrooms were characterized primarily by active learning teaching practices, those at the introductory and advanced university level predominantly used lecturing. We used these data as justification for creating new faculty learning communities (FLCs), which are networks of eight to 10 faculty members who work together over several months to discuss and reflect on particular educational issues (Cox, 2004, 2016). Our FLC project, which is supported by the National Science Foundation (DUE 1712074), is focused on understanding the instructional shift students perceive and experience in the transition from high school to the first year of college, providing a support network for college instructors who want to try active learning in the classroom, and developing instructional resources that college instructors can use to ease this transition period for students.

Conclusion

UCOP is a novel professional learning program that (1) supports middle and high school teachers' engagement with each other and with college instructors, (2) utilizes the teaching expertise of middle and high school teachers, (3) provides data that can be used to design new educational development opportunities and contribute to the research literature, and (4) launches new data-driven projects. This community engagement program answers several national calls to document current instructional practices and provides the information needed to implement nationally aligned initiatives that are tailored to a local environment. UCOP also provides an opportunity to open college campuses to middle and high school teachers, and honor their interest and expertise in transforming STEM education at a variety of educational levels.

Institutional Review Board Information

All college instructors and secondary teachers who agreed to be observed were given a human subjects consent form. The Institutional Review Board at the University of Maine granted approval to evaluate observation data of classrooms and survey instructors about the observation results (exempt status, protocol no. 2010-04-03 and 2013-02-06).

Acknowledgments

We would like to thank the Maine Center for Research in STEM Education (RiSE Center) at the University of Maine for being a home to UCOP as well as the RiSE Center's founding director, Dr. Susan McKay. We are grateful for the involvement of the University of Maine's Provost Jeffrey Hecker and Associate Provost Jeffrey St. John. We would like to thank the UMaine instructors who opened their classrooms for observation. We also want to thank and acknowledge the middle and high school teachers and other personnel associated with UCOP:

K. Akiha, K. Bailey, E. Baker, T. Barboza, T. Bates, M. Benoit, S. Boyle, V. Brackett, J. Briggs, S. Brown, M. Buchwalder, C. Carney, J. Combs, E. Connors, C. DeMarco,

T. Deschaine, D. Doughty, G. Douston, L. Driscoll, S. Dunton, A. Everleth, A. Ford, B. Fortier, W. Freudenberger, K. Glidden, M. Haas, D. Hall, L. Hanley, E. Hartill, S. Hastings, K. Hayes, E. Haynes, S. Hilt, A. Hoffert, M. Holmes, R. Jelley, T. Jergenson, C. Johnson, D. Johnson, D. Jones, R. Kumpa, L. LaCombe-Burby, N. Larlee, N. LeBarnes, M. Lewis, V. Madore, J. Mann, J. Mannette, N. Martin, L. Matthews, J. McKechnie, S. McQuarrie, A. Mercado, J. Morrill, R. Nickerson, N. Novak, L. Oliver, J. Page, S. Parrott-Wolfe, P. Pelletier, J. Perry, I. Porter, J. Poulin, S. Reed, K. Scantlebury, M. Shelton, D. Small, G. Smith, J. Smith, B. Smyth-Handley, D. Sorenson, J. Stevens, R. Stevens, N. Stevick, E. Trenckmann, J. Tyson, M. Wachtl, P. Walsh, W. Walsh, M. Warren, S. Wedge, M. White, T. White, K. Whitney, C. Williams, and M. Witick.

This material is based upon work supported by the National Science Foundation under Grant Numbers DUE-1347577 and DRL-0962805.

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