An account of the development of a suite of complementary surveys used by the Progress through Calculus and SEMINAL studies of teaching, learning, and success in introductory postsecondary math programs. These surveys have been distributed to students and instructors in pre-calculus and single-variable calculus courses at universities, but can be adapted for many contexts. These projects are funded by the National Science Foundation and run in conjunction with the MAA and APLU. The surveys themselves are included for wider use.

X-PIPS-M Survey Suite

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Progress through Calculus is run in conjunction with the Mathematical Association of America.

SEMINAL is run in conjunction with the Association of Public and Land-grant Universities.

X-PIPS-M SURVEY SUITE

DOCUMENT OVERVIEW

In this document, we present a suite of connected surveys about post-secondary instructional practices, aligning the beliefs, perceptions and experiences of students and their faculty or graduate student instructors. The three surveys presented in this document, the PIPS-M, UGPIPS-M, and SPIPS-M, are based on the Postsecondary Instructional Practices Survey (Walter, Henderson, Beach, & Williams, 2016). In addition to the surveys themselves, this document includes a history of the development of these instruments and the research literature they draw on. These surveys are part of two large NSF-funded studies of university Precalculus to Calculus 2 (P2C2) courses and supporting programs, and have now been distributed at over 25 universities.

We first present an overview of the two projects, *Progress through Calculus* and *SEMINAL* which collectively and collaboratively developed the suite in its current form. This is followed by a detailed discussion of how survey items were identified and adapted from existing literature, or inspired by existing gaps in that literature. We review both differences and similarities between the survey items presented to instructors, graduate (or undergraduate) student instructors, and undergraduate students on each survey. This is followed by a brief discussion of role of these surveys within the two projects, and where to find ongoing analyses of the data obtained via these surveys. The surveys themselves are presented in the appendices for use by others.

PROJECT OVERVIEWS

PROGRESS THROUGH CALCULUS

The *Progress through Calculus* project (PtC) is an NSF-funded research initiative (Grant No. 1430540) run in conjunction with the Mathematical Association of America (MAA). This project is investigating the Precalculus to Calculus 2 (P2C2) course sequence and the surrounding programs at institutions which offer graduate degrees in mathematics in the USA. More details about the project, including updates of ongoing work and reports are available at http://www.maa.org/ptc.

PERSONNEL & AFFILIATIONS.

The PI team includes David Bressoud (Conference Board of the Mathematical Sciences; CBMS; & Macalester College), Chris Rasmussen (San Diego State University; SDSU), Jessica Hagman (Colorado State University; CSU), Sean Larsen (Portland State University; PSU), and Rachel Levy[1] (MAA). Other senior personnel on the project include: Estrella Johnson (Virginia Tech; VT) who has been a faculty research associate from the beginning; Naneh Apkarian (Western Michigan University) who started as a graduate student research associate (GRA) at SDSU and moved to senior personnel in 2018; and Jessica Gehrtz (University of Georgia) who started as a GRA at CSU and moved to senior personnel in 2019. Graduate student research associates of the project currently include: Matthew Voigt (SDSU), Kristen Vroom (PSU), Antonio Martinez (SDSU), Tenchita Alzaga Elizondo (PSU), and Brittney Ellis (PSU). Other contributors include/have included Dana Kirin (PSU), Gaye DiGregorio (CSU), Rachel Keller (VT), Jeff Grabhorn (PSU), and Rebecca Cooper (CSU).

PHASE 1 (CENSUS SURVEY 2015-2016).

The first phase of PtC was a census survey distributed to 330 mathematics departments which offer doctoral or master's level degrees in mathematics. The survey designed for this phase was heavily informed by the results of the previous MAA study, *Characteristics of Successful Programs in College Calculus* (Bressoud, Mesa, &

[1] This PI position is held by the Deputy Executive Director of the MAA. This is currently Rachel Levy; previous members in this role were Linda Braddy and Doug Ensley.

Rasmussen, 2015), and specifically the seven features outlined as common across Calculus 1 at successful doctoral-granting institutions (Bressoud & Rasmussen, 2015; Rasmussen, Ellis, Zazkis, & Bressoud, 2014).

A total of 223 departments responded to the survey for an overall response rate of 68%, which provides great insight into introductory mathematics programs across the country. Apkarian and Kirin (2017) produced a technical report of the results of this survey, including details about response rate and average responses for each survey item. Many analyses are being conducted on this data, and a brief report has been published by the project team which provides an overview of completed analysis and the broad strokes picture of P2C2 programs at universities across the country (Rasmussen et al., 2019).

PHASE 2 (CASE STUDIES 2017-2019).

Of the 223 university departments which responded to the survey, 12 were identified for in-depth case studies. These sites were selected for their variation, in terms of their program features via responses to the census survey, basic institutional characteristics (e.g., size, public or private), and student success measures. Across two academic years (2017-18 and 2018-19), these sites were visited at least twice by project team representatives to gather more nuanced information about the programs in place to support students taking P2C2 courses. Interviews were conducted with P2C2 students and instructors, as well as other department members, graduate students, faculty in other departments, administrators, and staff from a variety of campus support programs. The surveys presented in this document were administered repeatedly as part of these case studies.

SEMINAL

Student Engagement in Mathematics through an Institutional Network for Active Learning (SEMINAL) is a collaborative NSF-funded research project (grant nos. 1624643/1624610/1624628/1624639) conducted in conjunction with the Association of Public and Land Grant Universities (APLU). The goals of this project are to understand and foster systemic change initiatives in university mathematics departments that promote the use of active learning in introductory mathematics courses, particularly the P2C2 courses. As with PtC, the SEMINAL project focuses on institutions and programs which offer graduate degrees in mathematics. More information about SEMINAL can be found at http://www.aplu.org/seminal.

PERSONNEL & AFFILIATIONS.

The collaborative structure of SEMINAL's NSF grant means that there are several PI and co-PI teams at the Association of Public and Land-grant Universities (APLU), University of Nebraska, Lincoln (UNL), San Diego State University (SDSU), and University of Colorado, Boulder (UCB). APLU is represented by PI Howard Gobstein; the PI team from UNL consists of Wendy Smith, Allan Donsig, and Nathan Wakefield; the PI team from SDSU includes Chris Rasmussen, Michael O'Sullivan, and Janet Bowers. Molly Williams (Murray State University) and April Ström (Chandler-Gilbert Community College) are faculty research associates on the SEMINAL senior personnel team. Graduate student research associates on the project currently include Matthew Voigt (SDSU), Antonio Martinez (SDSU), Rachel Funk (UNL), Karina Uhing (UNL), Meggan Hass (UNL), ad Nancy Kress (UCB). Other contributors include Naneh Apkarian (Western Michigan University).

PHASE 1 (RETROSPECTIVE ACCOUNTS 2016-2017).

Six universities were selected from the PtC Census survey that successfully implemented active learning in their P2C2 sequence. Three of the sites are also the sites of the collaborative research team, and the other three were external to the research team. The external sites, in addition to having active learning in P2C2 courses, were selected to add diversity the overall data set, in contrast to the internal sites. Phase 1 focused on retrospective case studies, seeking to understand how mathematics departments got to their current status, where incorporating active learning is the norm for P2C2 courses. The case studies draw on a combination of qualitative and quantitative data, including: self-studies, classroom observations, interviews of stakeholders from students to provosts, and surveys of instructors and students.

PHASE 2 (SUPPORTING CHANGE 2018-2020).

With the lessons learned from Phase 1 – understanding the contextual features, cultures, and change stories of six institutions – the SEMINAL team had built in funds for nine incentivized case studies of mathematics departments that would try to change their cultures, so that active learning would become the norm in P2C2 courses. The SEMINAL team developed a call for proposals, and conducted NSF-style reviews of the 47 proposals received to select nine Phase 2 sites. Considerations of diversity – in student demographics, size, geography, types of universities, and planned change strategies – were part of the final selection process. Institutional change literature suggests that sharing effective change strategies with a site is not sufficient to induce and support desired changes. Thus, the SEMINAL team also built in a structure of Networked Improvement Communities (NIC; Bryk, Gomez, Grunow, & LeMahieu, 2015; Martin & Gobstein, 2015) so that the nine Phase 2 sites could learn from each other and form a community of practice to support one another's change efforts. The research team is also supporting the Phase 2 sites' change efforts, through sharing the change stories of the Phase 1 sites, and through serving as the hub for the NIC. The research team is developing case studies to describe the Phase 2 sites' change efforts.

INSTRUCTOR SURVEY: PIPS-M

REFERENCE MATERIAL

The primary reference instrument for the instructor surveys is the *Postsecondary Instructional Practices Survey* (PIPS) developed for use in STEM departments more broadly (Walter, Henderson, Beach, & Williams, 2016). The original PIPS consisted of a few course context items and a set of 24 statements with a Likert-type response. Participants are asked to report, using a 5-point scale of "not at all descriptive" to "very descriptive," how descriptive those statements are of their instructional practices.

The 24 items that make up Walter et al.'s (2016) instrument were selected and adapted from a set of over a hundred items pulled from the literature and available assessments, and these items were categorized into four components: instructor-student interactions, student-content interactions, student-student interactions, and assessment. This original PIPS was designed for instructors of high enrollment lower-divisions courses, which is compatible with both projects' focus on the P2C2 course sequence at universities.

The PIPS was developed at four universities, where it was distributed to 891 postsecondary instructors in a variety of fields. Factor analyses on this data corpus was largely consistent with the *a priori* categorization, except for a split of "assessment" into "formative assessment" and "summative assessment." Their results indicated that the PIPS was able to detect differences in instructional practice across departments and institutions. As the PtC goals include describing variation in teaching practice across P2C2 programs at different institutions, we elected to use the PIPS instrument as a major feature of our investigative suite.

Walter et al. (2016) report both the fit of both a two-factor and a five-factor model for explaining variance in instructor responses. The two factors split into "student-centered" and "teacher-centered" instructional practices, and the two are not mutually exclusive. The five-factor model is not quite nested within the two-factors, and includes formative assessment, summative assessment, student-student interactions, content delivery, and student-content engagement. Ongoing work across STEM higher education research continues to improve the model, and investigate variations across STEM fields and local contexts.

While we began with the PIPS as a starting point, we made several modifications to both the main Likert-item and the surrounding contextual pieces. From here forward, we refer to this as the PIPS-M (PIPS-Mathematics). The instrument is presented in an Appendix A, and numbered for ease of reference. Participants did not see numbering when they took the survey.

PIPS-M OVERVIEW

Participants were first presented with an overview of the project and the goals of the survey, addressing requirements for informed consent guided by institutional review boards at the respective universities administering the survey. If an instructor consented to participate, they were asked to select the courses they were *currently* teaching, from a list of courses being targeted by the PtC and/or SEMINAL projects (Appendix A, Introduction). The first part of the survey consisted of eight items (Appendix A, Course-Specific Loop) which were repeated as a block for each course a participant indicated they were teaching. Once these loops were completed, participants were asked a series of demographic questions related to their personal and professional identities and experiences (Appendix A, Demographics & Context).

COURSE-SPECIFIC LOOP

For each course, participants were asked to report on several aspects of the course's structure and situation. Some of these are associated with the original PIPS as well as other instruments.

We asked participants to report the number of contact hours, per week, that students in their course have with the instructor (Question 1; Q1). We broke this down by lecture, discussion/recitation, office hours, and other. This item gives us information about how much time instructors spend with their students, which is

particularly relevant given that "lack of time" is a frequently cited reason for not using more student-centered approaches. While time is often reported as a barrier to active learning, increased time has not been shown to drive change (Johnson, E., Keller, R., & Fukawa-Connelly, T., 2018; Shadle, Marker, & Earl, 2017). We are therefore able to assess whether or not "more time" is related to reports of particular instructional strategies.

Questions 2 and 3 ask about who makes decisions in relation to course content and instructional approach for the course. Course coordination, the use of uniform course elements and regular instructor meetings, is a common phenomenon in university mathematics departments (Rasmussen & Ellis, 2015). We need to know the extent to which responses to the instructional practice items reflect the instructors' own decision-making or reflect following department standards. The three options offered to participants were "I make most decisions," which indicate that this person has autonomy; "I'm part of a team that makes most decisions," which reflects committee-style course coordination; and "someone else makes most decisions," which would indicate that a participant is part of a coordinated course in which their choices are not always their own. We elected to add this item in order to investigate potential deviations from patterns like those found in other literature.

The first item that targets instructional practice is Question 4, which asked instructors to make a blunt categorization of the proportion of time in their class that students spend *listening to the instructor lecture or solve problems*, *participating in whole-class discussions*, *working on tasks in small groups*, and *working on tasks individually*. The survey system required that these proportions add up to 100%. The categories we selected are similar to those on the original PIPS, except for the addition of "whole-class discussion" which is a key aspect of some student-centered instructional strategies (Rasmussen, Marrongelle, Kwon, & Hodge, 2017).

Question 5 forms the core of the course-specific question loop for instructors, and consists of 41 Likert-type scale items about instructional practice. These items asked instructors to report whether or not particular teaching practices were descriptive of their approach to teaching a particular course. Critically, these items were designed to ask primarily about what happens in class in a fairly objective way, without transmitting value judgements nor asking about subjective constructs like active learning. Surveys constructed in this way are largely trustworthy in measuring what is happening in a class (Hayward et al., 2018). More detail about the construction of this question follows in the next section.

After reporting on their teaching practice bluntly (Q4) and in detail (Q5), in Question 6 participants were asked if other instructors teach in a similar way, with the options *Yes, No, Too varied to choose,* and *I don't know*. This item is intended both to alert us to instructors' awareness of their colleagues' approaches to instruction in the same course, and (when awareness is there) to let us know whether or not instructors feel their practices are part of the norm. In Question 7 we ask whether or not they are happy with the way the course is being taught, and Question 8 provides space for them to explain their response. These items are particularly relevant in university P2C2 courses because of the frequency with which course aspects are formally coordinated. Thus, an instructor who might want to use active learning might be prevented; one who does not might be forced to use particular techniques. These hypothetical scenarios have the potential to impact the interpretation of survey results related to predicting instructional style from contextual characteristics. We asked these items to gauge participants' perception of the extent to which they and their colleagues share teaching norms, and their satisfaction level with what those norms are. Dissatisfaction with the status quo can be a driver for change (Reinholz & Apkarian, 2018; Shadle et al., 2017).

Finally, in Question 9 instructors were given space for any comments related to the instruction of that particular course. This space allows participants to explain or clarify any responses where they felt some confusion about which answer to select, or to alert us to aspects of teaching that matter to their context but did not appear in our survey constructs. This is primarily for understanding nuance, not an item for targeted analysis across instructors.

ADAPTATIONS TO THE PIPS LIKERT.

Question 5 in the course loop of the PIPS-M is the large Likert-item adapted from the PIPS. We used the 24 statements of the original PIPS, with some modifications, and added an additional 17, for a total of 41

statements. Our amendments to the original PIPS items reflect our prior experience working with instructors who teach introductory mathematics courses, in particular from the *Characteristics of Successful Programs of College Calculus* (CSPCC) project (Bressoud et al., 2015) which involved interviews with students and department members, as well as our interest in the use of instructional practices which support goals of equity and diversity in the classroom.

In Appendix A (Course-Specific Loop) the statements in Question 5 labeled *a-n* and *p-y* are from the original PIPS. Item *o* was added to parallel the four categories in Question 4 about the proportion of class-time spent with students working individually, and also reflects what we know about the structure of mathematics courses. Items *b, i, k, l, n, p, q, t, v, w, x* saw wording changes intended to make the items more specific to language used by mathematics instructors. These included changing "my test" to "the test," and "content" to "mathematics" to account for the likelihood of common exams that the instructor might not solely author, and to make the survey more specific to the context. The original items and those on the PIPS-M are presented in Appendix D.

Sixteen new items, labeled *z-oo* in Appendix A (Course-Specific Loop), were written for this survey. Eight of these items [*cc, gg, hh, ii, jj, kk, ll, mm*] targeted aspects of active learning and/or mathematical knowledge for teaching (Jang, Guan, & Hsieh, 2009; Zelkowski, Gleason, Cox, & Bismarck, 2013). The CSPCC project highlighted distinctions between *good* and *ambitious* teaching that affected students in distinct ways, and as a successor project it was important to address these constructs as well (Larsen, Glover, & Melhuish, 2015; Mesa & White, 2015). The other eight new items [*z, aa, bb, dd, ee, ff, nn, oo*] were written with the intention of measuring instructional practices that support an inclusive experience for students. As inclusive teaching work has been done more extensively in the K-12 levels than higher education, we drew from that body of literature and adjusted language to fit the university setting (Equity Initiatives Unit, 2010; Tanner, 2013).

DEMOGRAPHICS

In addition to questions about the course, we asked instructors for information about their identity and experiences. This served two primary functions. One was to get a sense for how instructor demographics compared to that of their students, so the extent to which students in these courses were likely to see themselves represented in their instructors. The second was to investigate the extent to which individual characteristics are related to the instructional practices being used – at least in cases where instructors make the majority of the decisions related to course content and instructional approach.

The first of the demographics questions relate to aspects of individuals' experience that might impact their approach to instruction but are not too personal. These include length of time affiliated with the university, length of time/experience with instruction of P2C2 courses, and research area (if applicable).

Questions 4, 5, and 7 of the demographics section are commonly queried aspects of demographics regardless of study: gender, race/ethnicity, and age. There is substantive research indicating that student and instructor gender matters in understanding instructional practices and lived experiences. For example, women have been shown to be more likely to switch out of STEM majors (Ellis, Fosdick, & Rasmussen, 2016), but having a woman instructor might impact this phenomena as women are more likely to use innovative teaching practices (Henderson, Dancy, & Niewadomska-Bugaj, 2012) and can mitigate stereotype threat (Lockwood, 2006; Marx & Ko, 2012; Marx & Roman, 2002). The literature is less plentiful on the role of race and ethnicity in postsecondary STEM contexts, but demographic patterns in undergraduate STEM degrees awarded (IES NCES, 2018) suggest a need to investigate that role as well as the role of intersectional identities. Instructors' age suggests something about the temporal contexts in which they were in high school, took calculus, started teaching, and had opportunities for professional development for teaching, as well as a supporting measure of how long they've been teaching.

Asking demographic questions can be a fraught undertaking, and we explored best practices in asking these items in ways that are responsible and useful. We used a range of gender options rather than using biological sex to acknowledge their distinction and the range of identities that might impact one's experiences and

interpretation of those experiences (e.g., Fernandez et al., 2016). In particular, allowing participants to select multiple options from the list of gender options affords more individuality and personalization of responses.

Three adjustments were made to the standardized race question commonly used by government-sponsored agencies and present in publicly available data. One was to include the Hispanic/Latinx category as one of the many groups, and to allow for selection of multiple options in order to parse the information as needed. The second distinction was to separate out the option "Middle Eastern and/or North African" from the "White" category, to reflect the differential experiences of people with that heritage. Finally, we separated out "Asian" into four categories which differentiate between Central Asian, East Asian, South Asian, and Southeast Asian. The categories themselves were drawn from the Asian Pacific Institute on Gender-Based Violence (2017) and the NIH's definition (2015). Our decision to separate out these groups was informed by recent conversations that highlight differential experiences for people who are traditionally lumped together in this category (NCAAPIRE, 2008). While these sets of options go beyond those used by the US census survey (U.S. Census Bureau) and data collected through IPEDS (IES NCES, 2018), the structure of our questions does still allow for comparison to publicly available data sets through selective aggregation.

Question 6 asks for sexual orientation or sexual identity, something that is not as commonly queried in demographic surveys – and is still unused in the US Census. However there is growing evidence that sexual minority students are less likely to take STEM courses (Gottfried, Estrada, & Sublett, 2015) in high school and are more likely to switch to a non-STEM major in their undergraduate (Hughes, 2018). Additionally, STEM faculty within the sexual minority report a department climate that puts pressures to not disclose one's sexual orientation to others (Bilimoria & Stewart, 2009). Our decision to include sexual orientation is also in alignment with the American Psychological Association's *Resolution on Data about Sexual Orientation and Gender Identity* (2016).

The final multiple choice item in the demographics section, Question 8, asks about special populations that instructors might belong to and which might have some impact on their approach to instruction or higher education in general. These questions address their previous experiences with higher education, the extent to which they might relate to their students, and attributes which might affect their ability to use particular teaching strategies.

STUDENT INSTRUCTOR SURVEY: UGPIPS-M

At many universities, graduate students teach in the P2C2 sequence. At some sites, Graduate Student Instructors (GSIs) teach their own courses as instructors of record; at others, Graduate Teaching Assistants/Associates (GTAs) lead supplementary breakout sessions commonly referred to as lab, discussion, or recitation sections. Of course, some universities employ graduate students as both GSIs and GTAs, and perhaps there are some where this is not done, or not done in the P2C2 sequence. Some of the sites participating in the PtC and SEMINAL case studies also use undergraduate students as supporting instructors, who we refer to as Undergraduate Teaching Assistants (UTAs). Hence, we developed a version of the instructor survey particularly for undergraduate and graduate student instructors, referred to as the UGPIPS-M. This survey instrument is presented in full in Appendix B.

UGPIPS-M OVERVIEW

The UGPIPS-M is very similar to the PIPS-M, but amended to be more appropriate and relevant for student instructors. The survey begins with some basic questions about the participant so that the survey adapts appropriately. This is followed, as in the PIPS-M, by a bank of items which repeat for each different course they are involved with. This bank of items focuses on the course context, participants' role in relation to the course, and their teaching practices. The final section of the survey asked participants about certain individual characteristics and demographic items.

COURSE-SPECIFIC LOOP

The course-context block of the UGPIPS-M starts with questions about the participants' official role in relation to a particular course, to ascertain if they are an instructor of record in charge of the primary course meetings or a supporting instructor. The wording of the contact hours question was changed to reflect our interest in what the student instructors are doing and their experience working with students, while in the PIPS-M we are primarily concerned with the expectations and how often enrolled students have access to their primary instructor. The item about others' instructional practices is phrased to specify "others in your role," to distinguish between various roles that student instructors may take on in the P2C2 course. The rest of the questions in the course loop are the same as those in the PIPS-M.

DEMOGRAPHICS & CONTEXT

The demographic items are largely the same as those in the PIPS-M. The first item in this section distinguishes between time spent at the university as an undergraduate vs. graduate student, while the PIPS-M simply asks "in any capacity." Question 2, about degree aims, was specifically designed for student instructors as their intended degree aim may be a key aspect of these participants' local context. The third and fourth questions in this section were displayed only to those participants who indicated that they are graduate students: Question 3 asks about career trajectories in fairly general terms, which is also specific to the UGPIPS-M, and Question 4 asks about research area, in the same way that the PIPS-M does. The rest of the items in this section are the same as those on the PIPS-M.

STUDENT SURVEY: SPIPS-M

Students' experiences at a university impact their ability and interest in continuing their studies in mathematics, STEM, and postsecondary education more generally (Kogan & Laursen, 2014; Seymour & Hewitt, 1997). Both SEMINAL and PtC understand this and sought to design a survey instrument for students which gathered a student perspective on in-class practices (lecture and discussion/recitation), their experiences of those practices, their attitude toward mathematics, their intentions to continue their studies, and demographics. Our intention is to better understand the impact of P2C2 course experiences on students' success in STEM, and the extent to which demographic characteristics predict differences in experience. We refer to this student version of the survey as the SPIPS-M. This survey instrument is presented in Appendix C.

SPIPS-M OVERVIEW

The SPIPS-M consists of several blocks. The introductory block provided an informed consent process, eligibility for participation, and the course students were enrolled in (as well as any co-enrollments). The main block of the survey focused on their classroom experiences: what happened in class, whether they felt certain activities were helpful for their learning, change in attitudes toward themselves as learners and doers of mathematics, and their perceptions of the classroom climate. The final block consisted of demographic questions, class standing, major, etc.

INTRODUCTION BLOCK

In the introduction block, students were asked first to select the exact section of the course in which they were enrolled. This was populated with options drawn from the course registrar, and was constructed using drop-down lists so that students first selected the course itself (e.g., Math 101: Calculus 1), then their instructor from a list of instructors teaching that course that term, then the time their section is scheduled, and (if applicable) the associated discussion/recitation section. Thus, we can link student responses to those of other students in their discussion/recitation or primary section, as well as with their instructors' responses, without accessing their personal information. The other questions in this section checked for eligibility and whether or not students were enrolled in supplemental courses at the same time – which was used later to show/hide particular items.

CLASSROOM EXPERIENCE BLOCK

The items in the SPIPS-M classroom experience block share some similarities with the class loop questions on the PIPS-M and the UGPIPS-M, but are shown exactly for one course. Some items on this survey are adapted to gain students' perspectives on what happens in class, which can be directly compared to the responses of their instructors (if the instructors completed the PIPS-M). Other items are more specifically designed to gain access to aspects of students' experiences which are not always obvious to observers or instructors. Throughout this section, the course title and/or instructors' names from the introductory items are piped through to help keep participants' focus on particular experiences.

GENERAL ITEMS.

This block begins with two open-ended items asking students to indicate what (e.g., class activities, projects, campus resources, clubs, people) has been particularly helpful or unhelpful to them as students in this course. These items come first, so that students are not biased by the survey's focus or wording when responding.

Question 3 in this block asks students to report on how often they have missed course meetings (including recitation sections, if applicable). This item is intended in part to help us understand the frequency with which students miss class generally, and in part to help us think about the representativeness of a particular students' responses.

Questions 4-7 ask about the proportion of class time spent in various activities, mirroring the item on both the PIPS-M and the UGPIPS-M. It is repeated, as applicable, for the regular course meetings, the recitation section meetings, Supplemental Instruction sessions, and co-enrolled courses. As in the other surveys, this is intended to be a blunt assessment of general class activities.

INSTRUCTIONAL PRACTICE ITEMS.

As with the PIPS-M and UGPIPS-M, the core of the SPIPS-M is a set of items, primarily in Likert-style scale format, which ask about students' perceptions of and experiences with instructional practices in their mathematics classrooms. Our interest in students' experiences meant that the items in this section needed to be broken up in distinct ways, and students were also asked about their own activities and their perception of the utility of their and their instructors' activities.

In the following paragraphs, we describe which items from original PIPS and our adaptations for the PIPS-M and UGPIPS-M were presented to students as well. As might be expected, these items could not be presented exactly in their original form. Some items could not be used at all, as students are unaware of some of their instructors' decision-making processes and intentions. Others relate to aspects on which students may be able to comment, but needed to be reframed to present the students' perspective. For example, "I guide students through major topics as they listen" was reframed as "I listen as the instructor guides me through major topics." A table with all versions of the items is presented in Appendix D.

The first of the instructional practice sets on the SPIPS-M, Question 8, asks about some general activities related to the course that are not specific to the regular course or recitation section. Four of these (Q8 items *a, b, d, e*) are student versions of the original PIPS items, and correspond to items *t, u, v,* and *w* on the PIPS-M and UGPIPS-M versions. The additional items ask about students' activities outside of the classroom, including their use of technology, tutoring centers or services, and interactions with their instructor(s) and peers outside of the classroom. Students who indicate that they use technology in relation to the course were presented with Question 9, which asks them to specify the kinds of technology they use. Those who indicate that they avail themselves of tutoring opportunities were shown Question 10 and asked about the format of that tutoring.

Next, students were presented with Question 11, which included the other 22 items adapted from the (UG)PIPS-M Likert-style item sets. These are separated out because we believed that students might respond differently to these items when considering their regular class meetings or recitation section meetings. Identical items were presented to students for their recitation section (Q14) or a co-enrolled course (Q15) as applicable.

Questions 12 and 13 get at students' perception of the helpfulness of various instructional practices and course elements. Question 12 consists of a subset of the statements given in Q11 (12 statements total). Students were asked how helpful the 12 statements were for their learning only if they indicated that the particular practices were something that occurred in class in Q11. We were very conscious of the length of the survey when selecting items to pull through from Q11 to Q12. Thus, we only selected a subset of the items, particularly those which we felt might be useful for researchers and practitioners to know. Question 13 also asked about helpfulness, but in relation to four course elements that are common across most courses and are not represented in the PIPS items. Questions 12 and 13 are not intended to assess what aspects of courses *are* helpful for students' learning, but rather their perception of what is helpful or not.

CLIMATE AND ATTITUDES.

The final aspect of the classroom experience block of the SPIPS-M investigates students' perception of the class environment, their mindset, and the impact of this course on their attitudes toward mathematics and learning. Part of the reasoning behind using these items is a recognition that students' experiences of their course and their attitudes toward the subject and themselves have an impact on their ultimate decision to pursue and complete a STEM degree (Ellis et al., 2016; Seymour & Hewitt, 1997). Furthermore, there is reason to believe that particular instructional strategies impact students' feelings of belonging which we are able to test using

these surveys (Kogan & Laursen, 2014; Larsen et al., 2015; Mesa & White, 2015). Finally, we value inclusive learning environments both generally and because of the lack of diversity among STEM graduates (NSF, 2013).

Questions 17 and 18 ask about students' feelings of inclusion in their course, as compared to other students in the same class. They are identical, but Q17 asks about regular course meetings and Q18 asks about recitation sections (when applicable). These items were adapted from the *what is happening in class* (WIHIC) instrument equity scale (Dorman, 2003; Fraser, 1998). To assess overall perceptions of the climate within this course, we asked students Question 19, which asked them to describe the climate along three constructs, using a semantic differential scale. That is, students were asked to choose from a 5-point anchored scale.

More general attitudes were assessed in Questions 20 and 21. Question 20 is an item related to growth mindset (Dweck, Chiu, & Hong, 1995). We reworded the item to specifically target feelings related to mathematics ability in light of the prevalence of mathematics anxiety and a tendency, in this country, to separate mathematics ability from other statements about intelligence (Hottinger, 2016). Question 21 is drawn from the original CSPCC study, but adapted to reflect the fact that the SPIPS-M is distributed once per term as opposed to the pre-post format used in the CSPCC. By asking students to report on their attitudes at the beginning of the term and "now" at the same time (roughly 70% of the way through the term) we avoid some of the bias potentially brought on by having a "bad day," as well as bias introduced when participation in two separate surveys is required. We are more interested in students' reported *change* than their absolute attitudes, as this is likely a more comparable construct across students, and this format is well suited to that task.

DEMOGRAPHICS & CONTEXT

The demographic and individual context items on the SPIPS-M are more extensive than those utilized on the PIPS-M and UGPIPS-M, in order to capture information particularly about student characteristics that would not necessarily apply to instructors.

As with the other surveys, we query students about their gender, race/ethnicity categories, sexual orientation, and age using the same language as the other instruments. We also ask the same question about special populations, but the options are slightly different. For one, the term "instructor" was replaced with "student." We omitted first-generation higher education (since they are undergraduate students), and added *commuter student*, *transfer student*, and *student athlete*. Several of these populations are associated with extracurricular burdens and/or time commitments, and in this vein we also asked students to report how many hours a week they work at a job during the term. Students were asked whether or not they used the Free Application for Federal Student Aid (FAFSA) to apply for financial aid, which many students do regardless of socioeconomic status. If they did use the FAFSA, they were asked whether or not they received a free grant, like the Pell. This is more indicative of socioeconomic status, which is known to impact students' experiences of higher education (Hurtado et al., 2007; Wilson & Kittleson, 2013).

We are also curious about students' context and reasons for taking their P2C2 course. Part of this is addressed through the questions about the number of years they have been at the university and their class standing. Another part of this is addressed through the question of whether or not they intend to pursue a STEM degree (broadly) and what particular major they have declared or intend to declare. Ideally, these items will help us to distinguish between students taking this course as part of a major or as part of general education requirements, factors which might affect their experience of the course.

The final three multiple choice items relate to assessment of the course and P2C2 program. We ask whether their previous mathematics courses prepared them for this one, what grade they think they will get in the course, and what (if any) mathematics course they intend to take next. These items help us investigate whether or not a student is continuing on with mathematics, and the relationship between that and their expected grade.

The survey concludes with open-ended items asking students if there are other aspects of their identity which have impacted their experiences in mathematics at the university, and more generally anything else they want us to know about those experiences.

SURVEY USAGE ACROSS PROJECTS

Both the PtC and SEMINAL projects have used surveys of students and instructors to inform their investigations. In this section we review the timing and scope of the use of this set of surveys. Analyses of these surveys are ongoing at the time of preparing this document, but some preliminary findings have been presented at various research conferences including the annual Conference for Research in Undergraduate Mathematics Education, the Joint Mathematical Meetings, the Annual Meeting of the American Educational Research Association, and more. A current list of publications and reports for PtC can be found at http://bit.ly/PtC_Reporting, and for SEMINAL at http://www.aplu.org/projects-and-initiatives/stem-education/seminal/seminal-resources/.

PILOTING AND REVISIONS

The X-PIPS-M suite was first used as part of an extensive pilot process by the PtC project, which saw the surveys distributed to students and instructors at three universities. These were complemented by on-campus site visits and interviews with students, instructors, and other people with some connection to the P2C2 programs at those sites. Investigation of survey responses, particularly write-in responses, and triangulation with other elements of the site visits led to revisions of the items. Amendments were made to item wording to avoid common misunderstandings identified in pilot. Items were added to expand the scope of the surveys, in particular to capture information that we missed in the first round of surveys but discovered through our site visits. These pilots also served to establish that the surveys were best administered in the second half of the term.

DISTRIBUTION THROUGH PROJECTS

For both PtC and SEMINAL, the X-PIPS-M survey suite was distributed to participants roughly 70% of the way through the term. This timing was selected to (1) avoid the rush and stress which often comes with the end of a term, as people prepare for final examinations and (2) occur late enough for students and instructors alike to have a solidified sense of what is happening in the course. Overall, the X-PIPS-M has been used at 26 campuses across the country as part of these two projects at the time this document was written. Using strategies aligned with institutional research guidelines and policies, and consistent with the Family Educational Rights and Privacy Act (FERPA), unique identifiers attached to participants participating in the research study which allow for the linking of responses across time, in the event that an individual participated more than once during the study of a particular site (e.g., while taking/teaching Calculus 1 in the Fall and while taking/teaching Calculus 2 in the Spring). This allows not only for snapshots of instructional and educational experiences during the study, but the analysis of longitudinal trajectories during a students' course of study or an institution's initiatives to adjust instructional practice.

PROGRESS THROUGH CALCULUS

The X-PIPS-M was used as a key piece of Phase 2 of the PtC project in the case studies of P2C2 programs at 12 universities. These case studies took place during the 2017-18 and 2018-19 academic years. The PIPS-M, UGPIPS-M, and SPIPS-M were used in these case studies during Fall 2017, Spring/Winter 2018, and Fall 2018. The surveys were distributed to students and instructors in all mainstream precalculus and single-variable calculus courses for each of those terms.

SEMINAL

The X-PIPS-M was used in both Phase 1 and Phase 2 of the SEMINAL project. In Phase 1, the PIPS-M and SPIPS-M were used in the case studies of six universities which took place during Spring 2017. In Phase 2, the surveys are being used as part of case studies of change at nine partner sites between Fall 2018 and Spring 2020. The number of terms of X-PIPS-M usage, and the exact courses they are used in, varies depending on the nature of the change initiatives at each site.

COMPARING INSTRUCTIONAL PRACTICE RESPONSES

One of the design choices in the creation of the X-PIPS-M survey suite for PtC and SEMINAL was to repeat items based on the original PIPS instrument across all the surveys. This decision offers us the opportunity to compare responses from different perspectives. In Appendix D, we present a side-by-side comparison of the original PIPS items, those used on the PIPS-M and UGPIPS-M, and those used on the SPIPS-M. Data collection for the PtC project is finishing in the 2018-19 academic year, while the SEMINAL project will continue collecting data through 2020. Forthcoming analyses will address questions such as the extent to which students and instructors report classroom activities consistently and how factor analyses of the X-PIPS-M statements compare or differ from the original PIPS analyses across STEM departments. The large data sets we are developing should serve as compelling narratives about P2C2 programs in the United States.

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APPENDIX A – INSTRUCTOR SURVEY ITEMS (PIPS-M)

Items are numbered in the appendix for reference in this document. Participants did not see the item numbers or letters. This survey was built and distributed via Qualtrics (Qualtrics, 2018). The text **your institution** *was replaced by the institution's name in the survey participants viewed.*

INTRODUCTION

Which of the following courses are you teaching *this term*? Mark all that apply.

[*Site-specific options of each of the targeted courses*]

None of the above.

COURSE-SPECIFIC LOOP

This loop is repeated for each of the courses an instructor selects in the introductory item, with that course's name piped in to certain items. For demonstration purposes, we reference **Math 101: Calculus 1**.

1. Weekly contact hours students have with you for **Math 101: Calculus 1** per section.

a.	Lecture	_____
b.	Discussion/recitation	_____
c.	Office hours	_____
d.	Other	_____

2. How are most decisions about ***course content*** (e.g., syllabi, exams, homework, pacing, grading) made for **Math 101: Calculus 1**? Clarify if you wish.

a.	I make most decisions.	□	_____
b.	I'm part of a team that makes most decisions.	□	_____
c.	Someone else makes most decisions.	□	_____

3. How are most decisions about ***instructional approach*** (e.g., use of clickers, group work, active learning) made for **Math 101: Calculus 1**? Clarify if you wish.

a.	I make most decisions.	□	_____
b.	I'm part of a team that makes most decisions.	□	_____
c.	Someone else makes most decisions.	□	_____

4. What percent of regular class time in **Math 101: Calculus 1**, over the whole term, did your students spend... [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

5. Please indicate the degree to which the following statements are descriptive of your teaching in **Math 101: Calculus 1**.

Response options: (1) Not at all descriptive; (2) Minimally descriptive; (3) Somewhat descriptive; (4) Mostly descriptive; (5) Very descriptive

a.	I guide students through major topics as they listen	□□□□□
b.	I provide activities that connect course content to my students' lives and future work	□□□□□
c.	My syllabus contains the specific topics that will be covered in every class session	□□□□□
d.	I provide students with immediate feedback on their work during class (e.g., student response systems; short quizzes)	□□□□□
e.	I structure my course with the assumption that most of the students have little useful knowledge of the topics	□□□□□
f.	I use student assessment results to guide the direction of my instruction during the semester	□□□□□
g.	I ask students to respond to questions during class time	□□□□□
h.	I use student questions and comments to determine the focus and direction of classroom lessons	□□□□□
i.	In my class a variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems	□□□□□
j.	I structure class so that students explore or discuss their understanding of concepts before direct instruction	□□□□□
k.	My class sessions are structured to give students a clear/structured set of notes	□□□□□
l.	I structure class so that students talk with one another about course topics	□□□□□
m.	I structure class so that students constructively criticize one another's ideas	□□□□□
n.	I structure class so that students discuss their mathematical difficulties with other students	□□□□□
o.	I structure class so that students work on problems individually during class.	□□□□□
p.	I structure class so that students work together in pairs or small groups	□□□□□
q.	I structure class so that more than one approach to solving a problem is discussed	□□□□□
r.	I provide time for students to reflect about the processes they use to solve problems	□□□□□
s.	I give students frequent assignments worth a small portion of their grade	□□□□□
t.	I expect students to make connections between related ideas or concepts when completing assignments	□□□□□
u.	I provide feedback on student assignments without assigning a formal grade	□□□□□
v.	Test questions focus on important facts and definitions from the course	□□□□□
w.	Test questions require students to apply course concepts to unfamiliar situations	□□□□□
x.	Test questions contain well-defined problems with one correct solution	□□□□□
y.	I use a grading curve as needed to adjust student scores	□□□□□
z.	A wide range of students respond to my questions in class	□□□□□
aa.	I know most of my students by name	□□□□□
bb.	When calling on students in class, I use randomized response strategies (e.g., picking names from a hat)	□□□□□
cc.	I structure class to encourage peer-to-peer support among students (e.g., ask peer before you ask me, having group roles, developing a group solution to share, etc.)	□□□□□
dd.	There is a sense of community among the students in my class	□□□□□
ee.	I require students to work in predetermined or randomized groups	□□□□□
ff.	I use strategies that have been shown to support students from underrepresented groups	□□□□□
gg.	I consider students' thinking/understanding when planning lessons	□□□□□
hh.	I use a variety of approaches (e.g., questioning, discussion, formal/informal assessments) to gauge where my students are in their understanding of concepts	□□□□□
ii.	I understand students' previous conceptions, skills, knowledge, and interests related to a particular topic	□□□□□
jj.	I explain concepts in this class in a variety of ways	□□□□□
kk.	I adjust my teaching based upon what students currently do or do not understand	□□□□□
ll.	I give feedback on homework, exams, quizzes, etc.	□□□□□
mm.	I structure class so that students share their ideas (or their group's ideas) during whole class discussions	□□□□□
nn.	I use strategies to encourage participation from a wide range of students	□□□□□
oo.	A wide range of students participate in class	□□□□□

6. Generally speaking, do other **Math 101: Calculus 1** instructors use a teaching style similar to yours?

a.	Yes	□
b.	No	□
c.	Too varied to choose	□
d.	I don't know	□

7. How do you feel about the instructional approach(es) being used to teach **Math 101: Calculus 1** at **your institution**?

a.	Very unhappy	□
b.	Somewhat unhappy	□
c.	Neutral	□
d.	Somewhat happy	□
e.	Happy	□

8. Please use the following space to explain or clarify your previous response.

_____

_____

_____

9. Is there anything else you would like us to know about how **Math 101: Calculus 1** is taught at **your institution**?

_____

_____

_____

DEMOGRAPHIC & INDIVIDUAL CONTEXT ITEMS

1. How many years have you been at **your institution**, in any capacity?

   _____

2. For how many years have you taught precalculus/calculus courses, at **your institution** or elsewhere?

   a. As instructor of record/primary instructor _____
   b. As a teaching assistant (TA) _____

3. What is your primary area of research, if you have one?

   _____

4. (Select all that apply) Do you consider yourself to be:

   a. Man □
   b. Transgender □
   c. Woman □
   d. Not listed (please specify) □ _____
   e. Prefer not to disclose □

5. (Select all that apply) Do you consider yourself to be:

   a. Alaska Native of Native American □
   b. Black or African American □
   c. Central Asian □
   d. East Asian □
   e. Hispanic or Latinx □
   f. Middle Eastern or North African □
   g. Native Hawaiian or Pacific Islander □
   h. Southeast Asian □
   i. South Asian □
   j. White □
   k. Not listed (please specify) □ _____
   l. Prefer not to disclose □

6. (Select all that apply) Do you consider yourself to be:

   a. Asexual □
   b. Bisexual □
   c. Gay □
   d. Straight (heterosexual) □
   e. Lesbian □
   f. Queer □
   g. Not listed (please specify) □ _____
   h. Prefer not to disclose □

7. What is your age, in years?

   _____

8. (Select all that apply) Do you consider yourself to be:

a.	International instructor	□
b.	First-generation college student (i.e., neither parent nor guardian completed a Bachelor's degree)	□
c.	First-generation higher education (i.e., first in your family to pursue an advanced degree such as PhD)	□
d.	Person with a disability	□
e.	English language learner (i.e., the primary language spoken in your childhood home was not English)	□
f.	Parent or care-giver	□
g.	Prefer not to disclose	□

9. Are there any aspects of your identity (or who you are) that have impacted your experience at **your institution**? Please explain.

_____
_____
_____

10. Is there anything else you would like us to know about you or your experiences at **your institution**?

_____
_____
_____

APPENDIX B – STUDENT INSTRUCTOR SURVEY ITEMS (UGPIPS-M)

This survey was distributed to students (undergraduate as well as graduate students) who are part of the instructional team for one or more P2C2 courses. This included both instructors of record and teaching assistants who lead discussion and/or recitation sections. Items are numbered in the appendix for reference in this document. Participants did not see the item numbers or letters. This survey was built and distributed via Qualtrics (2018).

INTRODUCTION

1. Are you currently an undergraduate or graduate student at **your institution**?

a.	Undergraduate student	□
b.	Graduate student	□
c.	Other (please explain)	□

2. For how many terms have you held the following roles at this institution?

a.	Tutor	_____
b.	Recitation/discussion/lab section leader or instructional assistant	_____
c.	Instructor of record / primary instructor	_____
d.	Research assistant	_____
e.	Other (please describe, include any other teaching experiences)	_____

3. Which of the following courses are you involved with this term, as primary instructor of record or as a recitation/discussion/lab section leader?
   [*Site-specific options of each of the targeted courses*]
   None of the above.

COURSE-SPECIFIC LOOP

1. What is your official role with regards to **Math 101: Calculus 1**?

a.	Instructor of record / primary instructor	□
b.	Recitation/discussion/lab section leader or instructional assistant	□
c.	Other (please explain)	□ _____

2. How many hours a week, for **Math 101: Calculus 1**, do you spend:

a.	Teaching a lecture section	_____
b.	Leading a recitation/discussion/lab section	_____
c.	Holding office hours	_____
d.	Other	_____

3. How are most decisions about ***course content*** (e.g., syllabi, exams, homework, pacing, grading) made for **Math 101: Calculus 1**? Clarify if you wish.

a.	I make most decisions.	□	_____
b.	I'm part of a team that makes most decisions.	□	_____
c.	Someone else makes most decisions.	□	_____

4. How are most decisions about ***instructional approach*** (e.g., use of clickers, group work, active learning) made for **Math 101: Calculus 1**? Clarify if you wish.

a.	I make most decisions.	□	_____
b.	I'm part of a team that makes most decisions.	□	_____
c.	Someone else makes most decisions.	□	_____

5. When you are teaching **Math 101: Calculus 1**, what percent of that time do students spend... [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

6. Please indicate the degree to which the following statements are descriptive of your teaching in **Math 101: Calculus 1**.

Response options: (1) Not at all descriptive; (2) Minimally descriptive; (3) Somewhat descriptive; (4) Mostly descriptive; (5) Very descriptive

a.	I guide students through major topics as they listen	□□□□□
b.	I provide activities that connect course content to my students' lives and future work	□□□□□
c.	My syllabus contains the specific topics that will be covered in every class session	□□□□□
d.	I provide students with immediate feedback on their work during class (e.g., student response systems; short quizzes)	□□□□□
e.	I structure my course with the assumption that most of the students have little useful knowledge of the topics	□□□□□
f.	I use student assessment results to guide the direction of my instruction during the semester	□□□□□
g.	I ask students to respond to questions during class time	□□□□□
h.	I use student questions and comments to determine the focus and direction of classroom lessons	□□□□□
i.	In my class a variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems	□□□□□
j.	I structure class so that students explore or discuss their understanding of concepts before direct instruction	□□□□□
k.	My class sessions are structured to give students a clear/structured set of notes	□□□□□
l.	I structure class so that students talk with one another about course topics	□□□□□
m.	I structure class so that students constructively criticize one another's ideas	□□□□□
n.	I structure class so that students discuss their mathematical difficulties with other students	□□□□□
o.	I structure class so that students work on problems individually during class.	□□□□□
p.	I structure class so that students work together in pairs or small groups	□□□□□
q.	I structure class so that more than one approach to solving a problem is discussed	□□□□□
r.	I provide time for students to reflect about the processes they use to solve problems	□□□□□
s.	I give students frequent assignments worth a small portion of their grade	□□□□□

t.	I expect students to make connections between related ideas or concepts when completing assignments	□□□□□
u.	I provide feedback on student assignments without assigning a formal grade	□□□□□
v.	Test questions focus on important facts and definitions from the course	□□□□□
w.	Test questions require students to apply course concepts to unfamiliar situations	□□□□□
x.	Test questions contain well-defined problems with one correct solution	□□□□□
y.	I use a grading curve as needed to adjust student scores	□□□□□
z.	A wide range of students respond to my questions in class	□□□□□
aa.	I know most of my students by name	□□□□□
bb.	When calling on students in class, I use randomized response strategies (e.g., picking names from a hat)	□□□□□
cc.	I structure class to encourage peer-to-peer support among students (e.g., ask peer before you ask me, having group roles, developing a group solution to share, etc.)	□□□□□
dd.	There is a sense of community among the students in my class	□□□□□
ee.	I require students to work in predetermined or randomized groups	□□□□□
ff.	I use strategies that have been shown to support students from underrepresented groups	□□□□□
gg.	I consider students' thinking/understanding when planning lessons	□□□□□
hh.	I use a variety of approaches (e.g., questioning, discussion, formal/informal assessments) to gauge where my students are in their understanding of concepts	□□□□□
ii.	I understand students' previous conceptions, skills, knowledge, and interests related to a particular topic	□□□□□
jj.	I explain concepts in this class in a variety of ways	□□□□□
kk.	I adjust my teaching based upon what students currently do or do not understand	□□□□□
ll.	I give feedback on homework, exams, quizzes, etc.	□□□□□
mm.	I structure class so that students share their ideas (or their group's ideas) during whole class discussions	□□□□□
nn.	I use strategies to encourage participation from a wide range of students	□□□□□
oo.	A wide range of students participate in class	□□□□□

7. Generally speaking, do other people in your role for **Math 101: Calculus 1** use a teaching style similar to yours?

a.	Yes	□
b.	No	□
c.	Too varied to choose	□
d.	I don't know	□

8. How do you feel about the instructional approach(es) being used to teach **Math 101: Calculus 1** at **your institution**?

a.	Very unhappy	□
b.	Somewhat unhappy	□
c.	Neutral	□
d.	Somewhat happy	□
e.	Happy	□

9. Please use the following space to explain or clarify your previous response.

_____

_____

_____

10. Is there anything else you would like us to know about how **Math 101: Calculus 1** is taught at **your institution**?

_____
_____
_____

DEMOGRAPHIC & INDIVIDUAL CONTEXT ITEMS

1. For how many years have you been at **your institution**?

a.	As a graduate student	_____
b.	As an undergraduate student	_____
c.	Other	_____

2. What degree(s) or certifications do you intend to obtain from **your institution**?

a.	B.A./B.S. in…	□ _____
b.	Teaching certification/credential	□
c.	M.A./M.S. in mathematics	□
d.	M.A./M.S. in mathematics education	□
e.	Ph.D. in mathematics	□
f.	Ph.D. in mathematics education	□
g.	Ed.D.	□
h.	Other (please explain)	□ _____

3. What is your intended career trajectory?

a.	Academic position at a 4-year college or university: teaching focused	□
b.	Academic position at a 4-year college or university: research focused	□
c.	Academic position at a 2-year college	□
d.	Non-academic position (industry, government, etc.)	□
e.	Other (please explain)	□ _____

4. What is your primary area of research, if you have one?

_____

5. (Select all that apply) Do you consider yourself to be:

a.	Man	□
b.	Transgender	□
c.	Woman	□
d.	Not listed (please specify)	□ _____
e.	Prefer not to disclose	□

6. (Select all that apply) Do you consider yourself to be:

a.	Alaska Native of Native American	□
b.	Black or African American	□
c.	Central Asian	□
d.	East Asian	□
e.	Hispanic or Latinx	□
f.	Middle Eastern or North African	□
g.	Native Hawaiian or Pacific Islander	□
h.	Southeast Asian	□
i.	South Asian	□
j.	White	□
k.	Not listed (please specify)	□ _____
l.	Prefer not to disclose	□

7. (Select all that apply) Do you consider yourself to be:

a.	Asexual	□
b.	Bisexual	□
c.	Gay	□
d.	Straight (heterosexual)	□
e.	Lesbian	□
f.	Queer	□
g.	Not listed (please specify)	□ _____
h.	Prefer not to disclose	□

8. What is your age, in years?

_____

9. (Select all that apply) Do you consider yourself to be:

a.	International instructor	□
b.	First-generation college student (i.e., neither parent nor guardian completed a Bachelor's degree)	□
c.	First-generation higher education (i.e., first in your family to pursue an advanced degree such as PhD)	□
d.	Person with a disability	□
e.	English language learner (i.e., the primary language spoken in your childhood home was not English)	□
f.	Parent or care-giver	□
g.	Prefer not to disclose	□

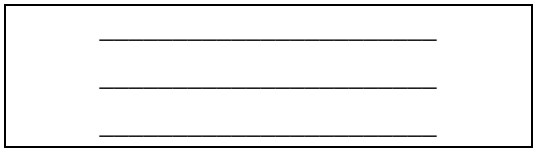
10. Are there any aspects of your identity (or who you are) that have impacted your experience at **your institution**? Please explain.

_____

_____

_____

11. Is there anything else you would like us to know about you or your experiences at **your institution**?



APPENDIX C – STUDENT SURVEY ITEMS (SPIPS-M)

*At the beginning of the survey, students select which course section they are enrolled in, including the course itself, the instructor, and scheduled meeting time. If applicable, they also select which recitation section they are enrolled in, including the time and instructor. At select sites, supplemental instruction was offered as was the possibility to co-enroll in another course – this information was also collected in the introductory section. For the remainder of the survey, students saw the name of their course (i.e., **Math 101: Calculus**) and, when appropriate, the name of their instructor(s). Items are numbered in the appendix for reference in this document. Participants did not see the item numbers or letters. This survey was built and distributed via Qualtrics (Qualtrics, 2018).*

CLASSROOM EXPERIENCE

1. What things (class activities, projects, campus resources, clubs, people) have you found to be particularly helpful to you as a student in **Math 101: Calculus 1**?

   _____
   _____
   _____

2. What things (class activities, projects, campus resources, clubs, people) have you found to be particularly unhelpful to you as a student in **Math 101: Calculus 1**?

   _____
   _____
   _____

3. Roughly how often have you missed class meetings for **Math 101: Calculus 1**?

		Class	[Recitation]
a.	(Almost) never	□	□
b.	Occasionally	□	□
c.	Frequently	□	□
d.	I've missed more than half the classes	□	□

4. What percent of regular class time, over the whole term, did you spend… [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

5. [If applicable] What percent of recitation/lab time, over the whole term, did you spend… [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

6. [If applicable] What percent of Supplemental Instruction time, over the whole term, did you spend… [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

7. [If applicable (co-enrolled)] What percent of time in ${q://QID80/ChoiceGroup/SelectedChoices}, over the whole term, did you spend… [must total 100]

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

8. Indicate the degree to which the following statements describe your experience in **Math 101: Calculus 1**.

Scale options: (1) Very descriptive; (2) Mostly descriptive; (3) Somewhat descriptive; (4) Minimally descriptive; (5) Does not occur

a.	The test questions focus on important facts and definitions from the course	□ □ □ □ □
b.	The test questions require me to apply course concepts to unfamiliar situations	□ □ □ □ □
c.	I use technology or online resources in relation to this course	□ □ □ □ □
d.	I make connections between related ideas or concepts when completing assignments	□ □ □ □ □
e.	I receive feedback on my assignments without being assigned a formal grade	□ □ □ □ □
f.	I see my instructor(s) outside of class for help	□ □ □ □ □
g.	I work with peers outside of class on math problems	□ □ □ □ □
h.	I attend tutoring sessions outside of class time	□ □ □ □ □

9. Which technologies and/or online resources do you use? Mark all that apply.

a.	Graphing calculator	□
b.	Clickers or other polling devices	□
c.	Computer algebra software (e.g., Maple, Mathematica, Matlab)	□
d.	Online search engines (e.g., Google)	□
e.	Online textbooks	□
f.	Online tutorials (e.g., Khan Academy, YouTube videos)	□
g.	Online computational or graphing tools (e.g., WolframAlpha, Geogebra, Desmos)	□
h.	Online homework (e.g., WebAssign, MyMathLab, Webwork)	□
i.	Online forums (e.g., Chegg, StackExchange, Slader)	□
j.	Learning management systems (e.g., Blackboard, Canvas, Piazza)	□
k.	Other (please explain):	□ _____

10. Where do you go for tutoring?

a.	Tutoring center at [institution] (please specify):	□ _____
b.	Office hours	□
c.	Friend(s)	□
d.	Private tutor	□
e.	Extra course sessions (e.g., supplemental instruction, extra lab)	□
f.	Review sessions	□
g.	Other (please explain):	□ _____

11. Indicate the degree to which the following statements describe your experience in regular course meetings of **Math 101: Calculus 1** with ${q://QID3/ChoiceGroup/SelectedAnswers/2}.

Response options: (1) Not at all descriptive; (2) Minimally descriptive; (3) Somewhat descriptive; (4) Mostly descriptive; (5) Very descriptive

a.	I listen as the instructor guides me through major topics	□ □ □ □ □
b.	The class activities connect course content to my life and future work	□ □ □ □ □
c.	I receive immediate feedback on my work during class (e.g., student response systems such as clickers or voting systems; short quizzes)	□ □ □ □ □
d.	I am asked to respond to questions during class time	□ □ □ □ □
e.	In my class a variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems	□ □ □ □ □
f.	I talk with other students about course topics during class	□ □ □ □ □
g.	I constructively criticize other student's ideas during class	□ □ □ □ □
h.	I discuss the difficulties I have with math with other students during class	□ □ □ □ □
i.	I work on problems individually during class time	□ □ □ □ □
j.	I work with other students in small groups during class	□ □ □ □ □
k.	Multiple approaches to solving a problem are discussed in class	□ □ □ □ □
l.	I have enough time during class to reflect about the processes I use to solve problems	□ □ □ □ □
m.	A wide range of students respond to the instructor's questions in class	□ □ □ □ □
n.	The instructor knows my name	□ □ □ □ □
o.	Class is structured to encourage peer-to-peer support among students (e.g., ask peer before you ask instructor, having group roles, developing a group solution to share)	□ □ □ □ □
p.	There is a sense of community among the students in my class	□ □ □ □ □
q.	The instructor adjusts teaching based upon what the class understands and does not understand	□ □ □ □ □
r.	The instructor explains concepts in this class in a variety of ways	□ □ □ □ □
s.	I receive feedback from my instructor on homework, exams, quizzes, etc.	□ □ □ □ □
t.	I share my ideas (or my group's ideas) during whole class discussions	□ □ □ □ □
u.	A wide range of students participate in class	□ □ □ □ □
v.	My instructor uses strategies to encourage participation from a wide range of students	□ □ □ □ □

12. For each of the following activities, please indicate how much each helps your learning in **Math 101: Calculus 1**.

Response options: (1) Very helpful; (2) Somewhat helpful; (3) Not helpful; (4) Not applicable

a.	I listen as the instructor guides me through major topics	□ □ □
b.	The class activities connect course content to my life and future work	□ □ □
c.	I receive immediate feedback on my work during class (e.g., student response systems such as clickers or voting systems; short quizzes)	□ □ □
d.	I am asked to respond to questions during class time	□ □ □
e.	I talk with other students about course topics during class	□ □ □
f.	I constructively criticize other student's ideas during class	□ □ □
g.	I work on problems individually during class time	□ □ □
h.	I work with other students in small groups during class	□ □ □
i.	The instructor knows my name	□ □ □
j.	Class is structured to encourage peer-to-peer support among students (e.g., ask peer before you ask instructor, having group roles, developing a group solution to share)	□ □ □
k.	I receive feedback from my instructor on homework, exams, quizzes, etc.	□ □ □
l.	My instructor uses strategies to encourage participation from a wide range of students	□ □ □

13. To what extent are the following course elements helpful to your learning in **Math 101: Calculus 1**?

Response options: (1) Very helpful; (2) Somewhat helpful; (3) Not helpful; (4) Not applicable

a.	Online homework	□ □ □ □
b.	Written homework	□ □ □ □
c.	Exams	□ □ □ □
d.	Worksheets or handouts in class	□ □ □ □

14. [If applicable] Indicate the degree to which the following statements describe your experience in recitation/lab sections ${q://QID3/ChoiceGroup/SelectedAnswers/4} of **Math 101: Calculus 1**.

See items in Q11.

15. [If co-enrolled] Indicate the degree to which the following statements describe your experience in ${q://QID80/ChoiceGroup/SelectedChoices}.

See items in Q11.

16. Consider your regular course meetings ${q://QID3/ChoiceGroup/SelectedAnswers/3} and primary instructor ${q://QID3/ChoiceGroup/SelectedAnswers/2} of **Math 101: Calculus 1**. As compared to other students in class…

Response options: (1) A lot less than other students; (2) Somewhat less than other students; (3) The same as other students; (4) Somewhat more than other students; (5) A lot more than other students

a.	How much opportunity do you get to answer questions in class?	□ □ □ □
b.	How much attention does the instructor give to your questions?	□ □ □ □
c.	How much help do you get from the instructor?	□ □ □ □
d.	How much encouragement do you receive from the instructor?	□ □ □ □
e.	How much opportunity do you get to contribute to class discussions?	□ □ □ □
f.	How much praise does your work receive?	□ □ □ □

17. Consider your recitation/lab section and recitation/lab instructor ${q://QID3/ChoiceGroup/SelectedAnswers/4}. As compared to other students in class…

Response options: (1) A lot less than other students; (2) Somewhat less than other students; (3) The same as other students; (4) Somewhat more than other students; (5) A lot more than other students

a.	How much opportunity do you get to answer questions in class?	□ □ □ □
b.	How much attention does the instructor give to your questions?	□ □ □ □
c.	How much help do you get from the instructor?	□ □ □ □
d.	How much encouragement do you receive from the instructor?	□ □ □ □
e.	How much opportunity do you get to contribute to class discussions?	□ □ □ □
f.	How much praise does your work receive?	□ □ □ □

18. How would you describe the overall climate within **Math 101: Calculus 1**?

a.	Excluding and hostile	□ □ □ □ □	Including and friendly
b.	Intellectually boring	□ □ □ □ □	Intellectually engaging
c.	Academically easy	□ □ □ □ □	Academically rigorous

19. I believe that my math ability can be improved through dedication and hard work.

a.	Strongly agree	□
b.	Agree	□
c.	Slightly agree	□
d.	Slightly disagree	□
e.	Disagree	□
f.	Strongly disagree	□

20. Please indicate your level of agreement for the following statements from the beginning of the course and now.

Response options: Strongly agree; Agree; Slightly agree; Slightly disagree; Disagree; Strongly disagree

	Beginning	Now
a. I am interested in mathematics.	□ □ □ □ □ □	□ □ □ □ □ □
b. I enjoy doing mathematics.	□ □ □ □ □ □	□ □ □ □ □ □
c. I am confident in my mathematical abilities.	□ □ □ □ □ □	□ □ □ □ □ □
d. I am able to learn mathematics.	□ □ □ □ □ □	□ □ □ □ □ □

DEMOGRAPHICS & INDIVIDUAL CONTEXT

1. (Select all that apply) Do you consider yourself to be:

a.	Man	□
b.	Transgender	□
c.	Woman	□
d.	Not listed (please specify)	□ _____
e.	Prefer not to disclose	□

2. (Select all that apply) Do you consider yourself to be:

a.	Alaska Native of Native American	□
b.	Black or African American	□
c.	Central Asian	□
d.	East Asian	□
e.	Hispanic or Latinx	□
f.	Middle Eastern or North African	□
g.	Native Hawaiian or Pacific Islander	□
h.	Southeast Asian	□
i.	South Asian	□
j.	White	□
k.	Not listed (please specify)	□ _____
l.	Prefer not to disclose	□

3. (Select all that apply) Do you consider yourself to be:

a.	Asexual	□
b.	Bisexual	□
c.	Gay	□
d.	Straight (heterosexual)	□
e.	Lesbian	□
f.	Queer	□
g.	Not listed (please specify)	□ _____
h.	Prefer not to disclose	□

4. (Select all that apply) Do you consider yourself to be:

a.	International student	□
b.	First-generation college student (i.e., neither parent nor guardian completed a Bachelor's degree)	□
c.	Commuter student	□
d.	Transfer student	
e.	Student with a disability	□
f.	Student athlete	
g.	Current or former English language learner (i.e., the primary language spoken in your childhood home was not English)	□
h.	Parent, guardian, or care-giver	□
i.	Prefer not to disclose	□

5. Did you use FAFSA to apply for financial aid?

a.	Yes	□
b.	No	□
c.	Prefer not to disclose	□

6. Did you receive a free grant (e.g., Pell Grant)?

a.	Yes	□
b.	No	□
c.	I don't know	□
d.	Prefer not to disclose	□

7. Approximately how many hours per week did you work at a job this term?

a.	0	□
b.	1-5	□
c.	6-10	□
d.	11-15	□
e.	16-20	□
f.	21-30	□
g.	More than 30	□
h.	Prefer not to disclose	□

8. What is your age, in years?

_____

9. How many years have you been at **your institution**?

a.	0-1	□
b.	1-2	□
c.	2-3	□
d.	3-4	□
e.	More than 4	□
f.	Prefer not to disclose	□

10. What is your class standing?

a.	First-year	□
b.	Sophomore	□
c.	Junior	□
d.	Senior	□
e.	Other (please specify)	□ _____
f.	Prefer not to disclose	□

11. Have you declared, or do you intend to declare, a STEM (science, technology, engineering, or mathematics) major?

a.	Yes	□
b.	No	□
c.	Unsure	□
d.	Prefer not to disclose	□

12. Which major have you declared, or do you intend to declare?

_____

13. Do you think your previous math courses adequately prepared you for **Math 101: Calculus 1**?

a.	Yes	□
b.	No (please explain):	□ _____

14. What grade do you expect to get in **Math 101: Calculus 1** this term?

a.	A, A+, or A-	□
b.	B, B+, or B-	□
c.	C, C+, or C-	□
d.	D	□
e.	F	□
f.	Other (please clarify)	□ _____

15. As of now, what math course (if any) do you plan to enroll in next?

a.	[Site specific course offerings]	□
	…	…
b.	Other (please clarify)	□ _____
c.	I do not plan to enroll in another math course	□

16. Are there any aspects of your identity (or who you are) that have impacted your experience in mathematics at **your institution**? Please explain.

_____
_____
_____

17. Is there anything else you would like us to know about you or your experience in mathematics at **your institution**?

_____
_____
_____

APPENDIX D – COMPARISON OF INSTRUCTIONAL PRACTICE LIKERT-SCALE ITEMS

This table shows the statements as phrased in their original form from the PIPS (Walter et al., 2016), the PIPS-M and UGPIPS-M, and the SPIPS-M. An asterisk (*) after a SPIPS-M item indicates that it was presented in a separate item block from the others.

	Original PIPS Statement	PIPS-M & UGPIPS-M Statement	SPIPS-M Statement
a.	I guide students through major topics as they listen and take notes	I guide students through major topics as they listen	I listen as the instructor guides me through major topics
b.	I design activities that connect course content to my students' lives and future work	I provide activities that connect course content to my students' lives and future work	The class activities connect course content to my life and future work
c.	My syllabus contains the specific topics that will be covered in every class session	My syllabus contains the specific topics that will be covered in every class session	
d.	I provide students with immediate feedback on their work during class (e.g., student response systems; short quizzes)	I provide students with immediate feedback on their work during class (e.g., student response systems; short quizzes)	I receive immediate feedback on my work during class (e.g., student response systems such as clickers or voting systems; short quizzes)
e.	I structure my course with the assumption that most of the students have little useful knowledge of the topics	I structure my course with the assumption that most of the students have little useful knowledge of the topics	
f.	I use student assessment results to guide the direction of my instruction during the semester	I use student assessment results to guide the direction of my instruction during the semester	
g.	I frequently ask students to respond to questions during class time	I ask students to respond to questions during class time	I am asked to respond to questions during class time
h.	I use student questions and comments to determine the focus and direction of classroom discussion	I use student questions and comments to determine the focus and direction of classroom lessons	
i.	I have students use a variety of means (models, drawings, graphs, simulations, etc.) to represent phenomena	In my class a variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems	In my class a variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems
j.	I structure class so that students explore or discuss their understanding of new concepts before direct instruction	I structure class so that students explore or discuss their understanding of concepts before direct instruction	
k.	My class sessions are structured to give students a good set of notes	My class sessions are structured to give students a clear/structured set of notes	
l.	I structure class so that students regularly talk with one another about course topics	I structure class so that students talk with one another about course topics	I talk with other students about course topics during class
m.	I structure class so that students constructively criticize one another's ideas	I structure class so that students constructively criticize one another's ideas	I constructively criticize other student's ideas during class
n.	I structure class so that students discuss the difficulties they have with this subject with other students	I structure class so that students discuss their mathematical difficulties with other students	I discuss the difficulties I have with math with other students during class
o.		I structure class so that students work on problems individually during class.	I work on problems individually during class time

p.	I require students to work together in small groups	I structure class so that students work together in pairs or small groups	I work with other students in small groups during class
q.	I structure problems so that students consider multiple approaches to finding a solution	I structure class so that more than one approach to solving a problem is discussed	Multiple approaches to solving a problem are discussed in class
r.	I provide time for students to reflect about the processes they use to solve problems	I provide time for students to reflect about the processes they use to solve problems	I have enough time during class to reflect about the processes I use to solve problems
s.	I give students frequent assignments worth a small portion of their grade	I give students frequent assignments worth a small portion of their grade	
t.	I require students to make connections between related ideas or concepts when completing assignments	I expect students to make connections between related ideas or concepts when completing assignments	I make connections between related ideas or concepts when completing assignments*
u.	I provide feedback on student assignments without assigning a formal grade	I provide feedback on student assignments without assigning a formal grade	I receive feedback on my assignments without being assigned a formal grade*
v.	My test questions focus on important facts and definitions from the course	Test questions focus on important facts and definitions from the course	The test questions focus on important facts and definitions from the course*
w.	My test questions require students to apply course concepts to unfamiliar situations	Test questions require students to apply course concepts to unfamiliar situations	The test questions require me to apply course concepts to unfamiliar situations*
x.	My test questions contain well-defined problems with one correct solution	Test questions contain well-defined problems with one correct solution	
y.	I adjust student scores (e.g., curve) when necessary to reflect a proper distribution of grades	I use a grading curve as needed to adjust student scores	
z.		A wide range of students respond to my questions in class	A wide range of students respond to the instructor's questions in class
aa.		I know most of my students by name	The instructor knows my name
bb.		When calling on students in class, I use randomized response strategies (e.g., picking names from a hat)	
cc.		I structure class to encourage peer-to-peer support among students (e.g., ask peer before you ask me, having group roles, developing a group solution to share, etc.)	Class is structured to encourage peer-to-peer support among students (e.g., ask peer before you ask instructor, having group roles, developing a group solution to share)
dd.		There is a sense of community among the students in my class	There is a sense of community among the students in my class
ee.		I require students to work in predetermined or randomized groups	
ff.		I use strategies that have been shown to support students from underrepresented groups	
gg.		I consider students' thinking/understanding when planning lessons	
hh.		I use a variety of approaches (e.g., questioning, discussion, formal/informal assessments) to gauge	

		where my students are in their understanding of concepts	
ii.		I understand students' previous conceptions, skills, knowledge, and interests related to a particular topic	
jj.		I explain concepts in this class in a variety of ways	The instructor explains concepts in this class in a variety of ways
kk.		I adjust my teaching based upon what students currently do or do not understand	The instructor adjusts teaching based upon what the class understands and does not understand
ll.		I give feedback on homework, exams, quizzes, etc.	I receive feedback from my instructor on homework, exams, quizzes, etc.
mm		I structure class so that students share their ideas (or their group's ideas) during whole class discussions	I share my ideas (or my group's ideas) during whole class discussions
nn.		I use strategies to encourage participation from a wide range of students	My instructor uses strategies to encourage participation from a wide range of students
oo.		A wide range of students participate in class	A wide range of students participate in class

SUPPLEMENT: OBSERVATION PROTOCOLS

ROLE OF OBSERVATIONS

As part of the case study site visits of both PtC and SEMINAL, the research teams observed P2C2 mathematics classrooms. However, the two teams took distinct approaches to collecting data during these observations. SEMINAL used the Mathematics Class Observation Practices Protocol ($MCOP^2$) as the basis for their instrument, while PtC developed an instrument aligned with the other X-PIPS-M instruments.

The $MCOP^2$ instrument (Gleason, Livers, & Zelkowski, 2015) was designed for use in K-16 classrooms, to assess the alignment of those classes with practices set out by various national organizations. This instrument measures two distinct factors: student engagement and teacher facilitation, which have been validated as having high Cronbah alpha scores (Gleason, Livers, & Zelkowski, 2017). A score of 0-3 is assigned for each of 16 items based on descriptions of each practice. The SEMINAL research team trained on pre-recorded classroom data until all users were familiar and consistent in their scoring of each item. The original $MCOP^2$ was used along with a few additional items related to practices supporting equity in the classroom.

For PtC, a new instrument was generated, called the postsecondary instructional practices observation protocol for mathematics, or the PIP-OP-M. This instrument, presented in Appendix E, was used to structure observers' field notes while in the classroom. The data created from these observations will support triangulation with survey responses, but the nature of single-class observations suggests that the scores from the PIP-OP-M should not be used to evaluate particular instructors or courses. This is true of any observation protocol being used in this way.

At the time of writing, no systematic evaluation of the observation data for SEMINAL or PtC has been conducted, though the field notes accompanying both the PIP-OP-M and $MCOP^2$ have been referenced to better understand student and instructor responses, as well as statements made in interviews about the nature of these courses. In general, researchers on both projects have noted variation in student, instructor, and researcher understandings of what it means to engage in various student-centered practices in the classroom, which is hardly surprising (e.g., Apkarian, Kirin, Vroom, & Gehrtz, in review). Further work on the nature of classroom activities within both PtC and SEMINAL will serve to further unpack that variation and potentially identify strategies to increase compatibility of terminology.

OBSERVATION PROTOCOL (PIP-OP-M)

The PIP-OP-M has both a paper and an online version in Qualtrics (2018). Notes about scoring criteria accompanied both versions, and observers were directed to take detailed notes supporting their scoring to support discussion and triangulation with surveys and other observers' scores.

Name of observer:	_____	Date:	_____
Institution:	_____	Class/recitation observed:	_____
Instructor name:	_____	Course start and end time:	_____
Duration of observation:	_____	Number of students in class:	_____

What is the classroom like? Mark all that apply:

Fixed chairs/desks in rows	□	Plenty of board space	□
Movable individual desks	□	Not enough board space	□
Movable tables/chairs	□	Space for instructors to circulate	□
		No space for instructors to circulate	□

Other comments about the room:

Course time division:

Approximately what proportion of class time did students spend… (must total 100):

a.	Listening to the instructor lecture or solve problems	_____
b.	Participating in whole-class discussions	_____
c.	Working on tasks in small groups	_____
d.	Working on tasks individually	_____

Additional comments:

Comment on the use of technology in the classroom (what, who how):

Comment on whose voices or ideas are being heard in the classroom? Privileged? Please also comment on the general demographic makeup of the students in this class (as best you can assume).

Comment on the use of pedagogical strategies in the classroom, particularly those that are known to support students from underrepresented groups and/or promote an equitable experience. *Examples: randomized response strategies; using students' heritage language; using students' real life experiences to connect school learning to students' lives; materials reflect the racial/cultural/ethnic backgrounds of students in the classroom; intentional grouping strategies; defined roles (notetaker, etc.) in groupwork; talking to students about their personal lives*.

Additional comments (including the general topics being discussed/presented in class):

How descriptive are each of the following of the course being observed? Support your score in the notes.

(1) Not at all descriptive; (2) Somewhat descriptive; (3) Very descriptive

	Item	Score	Notes
	Class Structure		
a.	Class was structured so that students explored or discussed their understanding of concepts before direct instruction	□□□	
b.	Class was structured to give students a clear/structured set of notes	□□□	
c.	Class was structured so that students talked with one another about course topics (include freq. in notes)	□□□	
d.	Class was structured so that students constructively criticized one another's ideas	□□□	
e.	Class was structured so that students discussed their mathematical difficulties with other students	□□□	
f.	Class was structured so that students could work together in pairs or small groups	□□□	
	Instructor Activities		
g.	Instructor guided students through major topics as they listened	□□□	
h.	Instructor provided activities that connect course content to students' lives and future work	□□□	
i.	Instructor asked students to respond to questions during class time	□□□	
j.	Instructor used student questions and comments to determine the focus and direction of the lesson	□□□	
	Mathematical Content		
k.	A variety of means (models, drawings, graphs, symbols, simulations, tables, etc.) are used to represent course topics and/or solve problems	□□□	
l.	More than one approach to solving a problem is discussed in class	□□□	
m.	In-class activities expected students to make connections between related ideas or concepts	□□□	
	Instructor and Student Interactions		
n.	Instructor used strategies to encourage participation from a wide range of students (please explain)	□□□	
o.	A wide range of students verbally responded to questions in class (please explain)	□□□	
p.	Instructor uses students' names in class	□□□	
q.	Instructor structured class to encourage peer-to-peer support among students (e.g., ask a peer before me; group roles; develop group solutions to share; etc.)	□□□	