



# Instructor Perspectives on Prerequisite Courses in Computing

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## ABSTRACT

Recent research in computing has shown that student performance on prerequisite course content varies widely, even when students continue to progress further through the computing curriculum. Our work investigates instructors' perspectives on the purpose of prerequisite courses and whether that purpose is being fulfilled. In order to identify the range of instructor views, we interviewed twenty-one computer science instructors, at two institutions, that teach a variety of courses in their respective departments. We conducted a phenomenographic analysis on the interview transcripts, which revealed a wide variety of views on prerequisite courses. The responses shed light on various issues with prerequisite course knowledge, as well as issues around responsibility and conflicting pressures on instructors. These issues arise at the department level, as well as with individual course offerings.

## CCS CONCEPTS

• **Social and professional topics** → **Computing Education.**

## KEYWORDS

prerequisites, knowledge retention, curriculum

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## 1 INTRODUCTION

Prerequisites are a necessary feature to any curriculum where concepts build from course to course and where there are desired assumptions about students' incoming knowledge and skills. In computing, researchers have begun to study the impact of prerequisites on student outcomes [12, 13, 23]. These studies showed that student performance on prerequisite course content varied widely

in later courses, with a notable portion of students demonstrating poor performance [23]. A later study found that many students do not resolve gaps in knowledge around early course material even as they progress through later computer science courses [25].

Indeed, proficiency with prerequisite course content may matter for student success as it is correlated with exam scores in later courses [12, 23]. Given that proficiency is tied to later course success, it is all the more concerning that recent work has found that Black, Latinx, Native American and Pacific Islander (BLNPI), and transfer students may be disproportionately impacted [13].

Given that mastering prior course content is tied to student success and may be an issue impacting the diversity of the field, this work seeks to gain a better understanding of the problem. Specifically, prior work both inside and outside computing has not examined the perspectives of a key stakeholder who controls the curriculum and establishes course prerequisites in the first place: the instructor. As such, this work asks the questions: 1) what are instructor views about the purpose of prerequisite courses and 2) whether they believe this purpose is presently being fulfilled? Answers to these questions could inform remediation of the problem.

In this study, we interviewed twenty-one instructors from our two institutions and conducted a phenomenographic analysis on the interviews to understand the range of instructor perspectives. We find that instructors report prerequisites serving varying purposes. These purposes include ensuring students enter later courses with a certain level of proficiency, helping to avoid repeated teaching of concepts, and helping students by providing an efficient path through the curriculum. Instructors also vary in their beliefs about whether prerequisites are currently fulfilling their purpose with significant differences in views about who is responsible (among students, instructors, and the institution) for ensuring students are learning what is expected. In addition, there are varying ideas for why prerequisites may not be fulfilling their purpose, such as academic integrity issues, grade inflation, the COVID-19 pandemic, pressure to graduate students within a certain number of years, and student evaluations impacting instructor motives.

In view of these findings, we discuss how instructors' perspectives relate to issues surrounding who is responsible for prerequisite courses fulfilling their purpose, as well as the many conflicting pressures on instructors and relevant theories of learning.



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**Table 1: Participation was solicited for instructors typically teaching following courses.**

Course	CS Area	Level	Sample Course Topics	N Instructors
CS1/OOP	Programming	Lower	variables, loops, functions/methods, testing	5
CS2/Data Structures	Programming	Lower	stacks, queues, binary search trees	3
Computer Organization	Systems Programming	Lower	assembly language, number representations	3
Advanced Discrete Math	Theory	Lower	counting principles, algorithmic analysis,	1
Advanced Data Structures	Programming	Upper	graphs, hash tables, performance analysis	2
Algorithms	Programming/Theory	Upper	greedy algorithms, divide and conquer	4
Theory of Computation	Theory	Upper	formal languages, finite automata	1
Software Engineering	Applications	Upper	process, design patterns, software testing	2

## 2 PREVIOUS WORK

As a fundamental part of most curriculum designs, formally required prerequisite courses have been well-studied outside of computing and have begun to be studied inside computing. Many prior studies have used a quantitative approach to measure the effectiveness of prerequisites, examining the correlation between students' performance in a course and their performance in its prerequisite courses [2, 4, 9, 12, 15, 17, 22, 23, 26]. Other studies have included additional measures in the correlations, trying to determine which factors have the most impact, such as gender [2, 15, 26], race [15, 26] and high school GPA [1, 8, 14, 22, 28]. The opportunity remains to explore prerequisites beyond correlation, considering the reasons for and effects of prerequisite courses as observed by instructors.

Computing is a particularly useful field in which to study prerequisites for several reasons. First, there are well-established curriculum guidelines from the Joint Task Force on Computing Curricula Association [10] that provide knowledge areas that are helpful for identifying prerequisite chains. Second, computing tends to have long prerequisite course chains. These chains may cause misunderstandings from an early course to have amplified effects throughout the long chain. In addition, there is pressure to re-examine and shorten the prerequisite chains to reduce time-to-degree, and to potentially improve the accessibility of computing.

With more recent work in computing suggesting that students often do not have sufficient prerequisite course proficiency as they make their way through the computing curriculum [12, 13, 23], our work aims to better understand the perspective of instructors.

The work most similar to our own is a multi-methods study that investigated the effects of making a lecture prerequisite optional for a microbiology lab course by Sato et al. [21]. While not the focus of this work, the authors describe students' perspectives as they more broadly relate to prerequisite courses, providing some insight into how students view the purpose of prerequisite courses.

In computing, Walker described the most common purposes of a prerequisite course as 1) content - allowing another course to build on its foundation; 2) maturity - allowing a course to build on previous experiences and maturity outside of the specific content; 3) filtering - filtering out students who are not committed and limiting enrollment in courses; 4) requirement enforcement - using prerequisites to show students a path through the curriculum, irrespective of required course content; and 5) historical - a long time ago a course was determined to be a prerequisite [27]. However, this may not include the larger instructor perspective. In Section 5.1, we will compare the purposes identified by Walker

and touch on the student perspective from Sato et al. with those identified in this paper [21, 27].

## 3 STUDY DESIGN

The motivation of our study was to better understand the range of perspectives held by CS instructors about prerequisites.

### 3.1 Research Questions

Our research questions are as follows:

RQ-1: What are instructor views on the purpose of prerequisite courses?

RQ-2: What are instructor views on whether the purpose of prerequisite courses is being fulfilled?

### 3.2 Course Context

We interviewed 21 instructors who teach a wide range of undergraduate courses at our institutions: a public research-intensive institution and a Hispanic-serving public undergraduate institution. The courses can be seen in Table 1. To obtain the full range of instructor perspectives, we chose to interview instructors who teach a wide range of computing courses (e.g., theory, systems, applications and both lower- and upper-division courses). The majority of the instructors interviewed teach multiple courses, but we recruited each instructor with a specific course in mind.

### 3.3 Sample Selection

Before conducting any interviews, we first compiled a list of instructors across both of our institutions who either recently taught or were currently teaching the computer science courses in which we were interested. We reached out to each instructor by email to ask them to participate in our study. This was done with the approval of our human subjects protocol. The interviews lasted one hour, and instructors were given a \$50 gift card in compensation for their time. In total, we recruited 26 instructors and 21 participated in our study. Fifteen of the instructors were from the research-intensive institution and six were from the Hispanic-serving institution.

### 3.4 Interview Method

In order to make sure our research questions were addressed and that we were able to get complete responses from the instructors, we chose to use semi-structured interviews. The interviews were conducted over Zoom and recorded. After the interviews were completed, they were transcribed and anonymized.

The interviews were semi-structured where the interviewer would ask prepared questions and additional follow up questions

when necessary. The follow up questions generally revolved around asking the interviewee to provide further detail to their response of a previous question. At each interview two members of the research team were present. The primary interviewer was the same for all interviews. The secondary team member would introduce themselves at the beginning of the interview, explain their role and then observe the interview with their camera turned off. They would ensure the interviewer did not miss any questions and ask follow-up questions after all prepared questions were answered.

Before conducting our interviews, we developed an initial set of interview questions that was reviewed by the research team. We reused a general question on prerequisites from the work of Sato et al.. This question, broken into two parts, can be found in Section 4. These interview questions were then piloted with three instructors who were not going to be selected for our analysis. After each of these interviews, we asked for feedback from the interviewees and updated the questions as needed.

During the interviews, we asked the participants about their views on prerequisite courses in general and within the context of a course they teach. We did not provide a definition of prerequisite courses to allow us to gain insight into how instructors think about prerequisites courses and what they believe the term encompasses. Depending on the individual instructor, the definition may or may not have included prerequisite courses outside of computing.

### 3.5 Data Collection and Cleaning

All interviews were conducted through Zoom using its video- and audio-recording features. When an instructor was scheduled for an interview, they were given an online consent form to confirm they were willing to have their video and audio recorded per our approved human subjects protocol. In the event a stakeholder was not willing to have their video recorded, they were asked to turn off their camera for the duration of the interview. Once the interviews were completed, the recordings were transcribed for analysis and the original recordings were deleted.

### 3.6 Details of Analysis

Phenomenography is a method used in qualitative research that focuses on understanding the variation in how people experience a phenomena [11]. We chose to use phenomenography as it allowed us to understand the range of perspectives of instructors on prerequisites. This means our results encompass the breadth of perspectives and are not meant to provide a direct comparison between individual responses. The analysis was performed by the first three authors of this paper. The steps of analysis were derived by Carbone et al. [5, 24].

**Step 0: Reading the Interviews.** The authors examined each of the transcripts, reading them multiple times to gain an understanding of scope of the interviews and the instructor perspectives.

**Step 1: Individually Labeling.** Each author extracted excerpts associated with each research question from the transcripts and created and applied their own labels.

**Step 2: Extracting Categories of Variation.** The labeled excerpts were discussed and categorized to organize the variation in instructor's perspectives. These categorizations were then mapped back onto the instructors from whom the excerpts were taken.

**Step 3: Constructing Categories of Description.** The extracted categories of variation (from Step 2) were then used to create a hierarchical structure of categories and subcategories. This was done through discussion of the authors. Any disagreements were discussed until there was a consensus.

## 4 RESULTS

In this section we will discuss the results of our phenomenographic analysis in terms of the hierarchical structure of categories of description and subcategories identified per research question. The categories are presented in bold and italic, followed by subcategories in bold. We provide quotes where relevant, with an anonymous instructor identifier included (I1-I21). These responses encompass the range of views of instructors and therefore it is important to point out that not all instructors share all of these viewpoints.

### 4.1 RQ1: Purpose of Prerequisite Courses

We present hierarchical categories for instructor's beliefs on the purpose of prerequisite courses. While this analysis was informed by the complete instructor interview, it focused on responses to the question "In general, what do you think the purpose of prerequisite courses is?" This is the same question asked by Sato et al. [21].

#### 4.1.1 Student Preparation.

**Baseline and/or Solid Foundation.** Instructors believe the role of prerequisite courses is to provide students with knowledge and skills to build upon. The exact wording of answers varied in terminology, however the wording matters as it offers insight into the perspectives of the instructors. When defining the purpose in relation to course content, instructors used the phrases: "mastered," "have seen," "have the necessary skill and knowledge." In relation to how well the students should be prepared instructors used the phrases: "succeed at the highest level," "minimize struggle," "success," "ensure preparation," and "competency." The minimal requirement of having "seen" a topic can be understood as a useful precursor to increasing mastery of it later.

**Preventing Moving Forward without Required Knowledge.** Instead of preparing students for the following course, other instructors framed the purpose as a way of preventing students from moving forward without the required knowledge.

*"It's also a place where we need to stop them if we know they're going to be unsuccessful"* - I11

#### 4.1.2 Instructor Preparation.

**Assumptions of Student Knowledge.** Instructors can assume some level of knowledge of students entering the course.

*"So that the instructor in the course for which it's a prerequisite can assume certain knowledge of his or her students."* - I20

**Not Reteaching Material.** Some instructors specifically mentioned that the purpose of prerequisites is to allow them to cover the current course material without having to review previous material, although many instructors mentioned they do still review previous material at the beginning of the term.

*"so that you don't have to review material or teach material from the start of every course."* - I1

**4.1.3 Implicit Requirements.** These were frequently listed when instructors were asked about their own courses.

**Maturity.** Instructors believe prerequisites allow them to assume some level of maturity when students enter a course and specifically skill maturity as it related to computing. Instructors specifically mention the term “maturity” in their descriptions as it related to mathematical maturity and ability to reason about larger problems. *“It’s not just learning some stuff, not just learning knowledge, but it’s really learning the knowledge, assimilating it, understanding a step in their maturing, all of those things make it so that they can be successful in these other courses.”* - I19

**Critical Thinking and Reasoning Skills.** Instructors believe that prerequisites need to prepare students to think critically and reason about computer science related problems. Students should be able to apply their knowledge to program effectively and understand the trade-offs of what they are creating.

**Soft Skills.** Instructors mentioned students learn to communicate and work in groups in prerequisites.

#### 4.1.4 Guidance through the Curriculum.

**Guiding Student Choice.** Instructors said prerequisites give students the knowledge necessary to help them select courses when they are given multiple options, such as electives. The prerequisite courses also provide them with a breadth of knowledge to help determine what they are interested in pursuing as a career.

*“To try and give them enough material and a broad enough scope so that they can better select their electives.”* - I2

**Administrative Guidance through the Curriculum.** Instructors stated that prerequisites provide administrative guidance for the department, instructors and students.

*“Prerequisites also help from an administrative perspective, on how the student can progress from one step to another, in a formal way. That gives guidelines, which anybody can follow.”* - I8

**Historical Requirements.** One instructor mentioned historical requirements which is best described in the quote itself. *“I think what doesn’t always work well is that there are courses that were introduced a while ago and have migrated from their original intention or changed as technology progressed. The prerequisites that made sense when they were adopted, or it could be the course, that course is the same, but the prerequisite has changed a lot.”* - I1

## 4.2 RQ2: Is the Purpose being Fulfilled?

The quotes in this section are all responses to the question “Is this purpose being fulfilled?” a question as a follow-up to “In general, what do you think the purpose of prerequisite courses is?” Our high-level categories of description are “Yes,” “Sometimes,” and “No.” and are explained in order below. This follow-up question is from [21].

**4.2.1 Yes, prerequisites are fulfilling their purpose.** This category reflects responses that prerequisite courses are fulfilling their purpose as much as possible. Responses categorized as yes started off as follows: “Probably, as well as it can be,” “I think so”, and “Oh... Yeah. I tend to be an optimist about that kind of thing.” In most cases where instructors responded saying yes, this did not mean they felt students entered courses with the required knowledge and skill, but rather that the problem was not caused by the prerequisite courses. *“Do students know every single thing they’re supposed to know from the prerequisite course? No, of course not. But do they*

*know something? Yeah, definitely. Otherwise, I’d be starting over... every single time I taught any class.”* - I15

**Interest/Motivation.** Instructors believe students do not always have the necessary interest or motivation to learn the content.

*“I feel yes, it has been fulfilled, but no matter what you do, there will be some students who had no interest in the prerequisite, so they just try to get it over with.”* - I18

**Asking for help.** Students are unwilling to admit that they don’t understand and do not reach out for help.

*“And there will be still some students who just don’t want to admit that they are not understanding the problem and they don’t want me to help them so I can recognize them, but no matter how hard I work to try to reach out to those students, if they don’t want me to help them, I can’t.”* - I18

**Students Lack Confidence in Themselves.** Instructors believe that the students do not lack knowledge, but self-confidence.

*“A lot of times, it’s just confidence, believing that they have the problem-solving skills or knowledge to break a problem down and think of it all more in a mathematical way.”* - I19

**Transfer Students.** Transfer students came up as a population of students that is not prepared for courses<sup>1</sup>.

#### 4.2.2 Prerequisites are sometimes fulfilling their purpose.

The majority of instructors did not answer this question solely with a Yes/No answer and rather specified where they think issues may and may not lie. They started off their answers with wording such as “For the courses that I teach...”, “In large part yes...”, and “I would say it depends on the class and it also depends on who teaches it...” The same categories of description were mentioned as in the previous section, as well as additional categories shown below.

**Variability of Course offerings.** Due to variability across prerequisite course offerings, some instructors feel they need to repeat material and therefore end up covering less material in their own courses, furthering the issues through the prerequisite chains. A couple of possible reasons instructors described for this issue were that some instructors may do a bad job of teaching the material or simply did not teach all of the material.

*“I would say it depends on the class and it also depends on who teach it, because I don’t think we have a very uniform requirement of what a class should cover.”* - I20

**Courses Outside of the Department.** While transfer students struggling has already been mentioned, here the idea of Advanced Placement (AP) credit<sup>2</sup> was introduced, and the idea that allowing students to take equivalent courses outside of the department may allow students to progress through the computing curriculum without the necessary knowledge.

**Design of the Course.** Instructors mentioned the importance, and sometimes lack, of aligning courses in prerequisite chains.

**Grade Inflation.** Grade inflation allows students to progress in the curriculum without the required knowledge. This was described inside and outside of the context of the COVID-19 pandemic. The

<sup>1</sup>Transfer students are students who start their undergraduate degree after completing a 2-year college program that fulfills General Education requirements and normally a few computing courses.

<sup>2</sup>AP credit is college credit that can be earned by students in high school who take AP courses and pass an exam on the course material.

pandemic worsened this issue as students could take courses with a "pass/no-pass" grade that would normally require a letter grade. *"In general, I think most of the prerequisites should be covered if a student did well in the previous class. But because of grade inflation, I think there may be issues where a student was able to pass a certain class with a very low grade, but they got the credit, and they will struggle in the next class."* - I5

**4.2.3 Prerequisites are not fulfilling their purpose.** The categories of description are most detailed for this section as the instructors who said prerequisite courses were not fulfilling their purpose tended to give longer explanations. These responses covered some previous categories, as well as introducing more nuanced issues.

**Individual Student Abilities and Motivations.** Instructors provide additional context for this category. One instructor specifies the impact of impostor phenomenon [20] and how when a student feels like an impostor *"...the student will often build on a shoddy foundation, because they're not willing to reveal their lack of understanding of a base idea that they should have learned maybe, potentially, months or years ago."* - I12

**Retention of Knowledge Cannot be Assumed.** Instructors believe retention of knowledge can no longer be assumed to the extent that used to be possible. One instructor suggests this is due to students being assessed too much so that the focus shifts from understanding to getting a grade.

*"And the other thing is that I feel that we focus more on getting the right answer rather than teaching them how to get to a point where they're able to...expand on what they're looking for."* - I21

**Teaching to a Diverse Population.** Instructors believe it is hard to teach material in a way that is salient enough for a more diverse population of students.

*"Somehow the material may not be absorbed or learned in a sticky enough way, in a retained way. I think there's many factors that go into that, having to do with the difficulty of teaching a diverse student population who come into the institution with a diverse set of backgrounds and preparations and then shepherding that diverse cohort through the curriculum with adequate success and progress through the degree program, right?"* - I9

**Pressure on Instructors.** Instructors mentioned different pressures they have experienced. The pressures mentioned included the pressure to pass students and help them complete their degree, not having enough time to teach everything in a term, and social pressures to be well-liked and maintain good evaluations.

*"Students simply have to move on, in other words. And I think instructors, for whatever reason, are sometimes motivated to help students move on."* - I9

## 5 DISCUSSION

Section 4.1 enumerates several categories and sub-categories of purposes for prerequisites, highlighting their richness and potential complexity as seen from the instructor perspective. This richness and complexity plays out further with regards to the fulfillment of those purposes. This section discusses these issues.

### 5.1 Comparison to Walker's Purposes

Walker's description of the most common purposes of a prerequisite course are provided in Section 2 [27]. We first note that

filtering was not mentioned by the instructors we interviewed. Certainly, the concept of a "weeder course" is well known. However, being that current priorities in computing education are focused on recruitment and retention, instructors could hold the view that filtering is not a legitimate purpose. Interestingly, a few students (positively) mentioned filtering in the work by Sato et al., for example a prerequisite reducing competition for senior students to get in a subsequent course [21].

Requirement enforcement, as defined by Walker, was not mentioned by instructors. We take this to be a reflection of the instructor perspective: such a prerequisite would be in name only—a program requirement masquerading as a course prerequisite—a bureaucratic maneuver of sorts.

Walker did not list administrative guidance (Section 4.1.4), a major category for our instructors. This is a role prerequisites play in terms of helping students plan their path through a curriculum. Instructors describe it as allowing students to manage their time-to-degree and taking the right prerequisites for later desired electives (e.g., as they relate to their desired career path). Sato et al. shows that students also appreciate this role of prerequisites [21].

Finally, we note an important difference in the way prerequisite purposes are framed. Walker does not list instructor preparation as a purpose, but later mentions it as a consequence, saying "a prerequisite allows an instructor to assume student knowledge of specific content." Instructor preparation is a major purpose brought up by instructors (Section 4.1.2). That is, from the instructor viewpoint, instructor preparation is a primary rather than derivative purpose.

### 5.2 Emergent Concept: Responsibility

Responsibility is a concept that emerged through further analysis of the interviews. Instructors view prerequisite courses' fulfillment of their purposes as a network of responsibilities among instructors, students, the department and the institution. Here we describe the list of responsibilities.

At a high level, instructors brought up administrative guidelines (Section 4.1.4) that are the responsibility of the institution and department. Calibrating course offerings and alignment across prerequisite chains is the responsibility of the instructor, as well as the department administration (Section 4.2.2). The responsibility of student preparation lies with the students themselves to put in effort to learn the material, but also with the department and instructors to stop students from entering a course if the students do not meet the requirements (e.g., transfer or AP credit, and petitions; Section 4.1.1). During a course, instructors are responsible for teaching the required content in a way that is salient (Section 4.2.3). They must also fail students who have not learned the material, which also includes identifying any cheating and enforcing consequences, an additional point brought up by instructors (Section 4.1.1).

A responsibility that has become more prominent in the past few years due to the COVID-19 pandemic is adjusting courses based on world events and individual student needs (Section 4.2.2). The institution and department play a role in this responsibility, but it ultimately falls on instructors. Instructors mentioned that adjusting to world events sometimes caused conflicts with their responsibility to ensure students progressed through the program with ensuring student learning outcomes.

### 5.3 Many Conflicting Pressures on Instructors

The discussion of responsibility highlights the pressures on instructors regarding prerequisite courses, many of which are conflicting. Instructors described the pressures they face from students, the department, and the institution, such as not to adversely impact students' time-to-degree and to be well-liked by students (Section 4.2.3). This pressure has been amplified by the COVID-19 pandemic.

Given the limited resources available, instructors must make tough choices. One such resource raised by instructors is time: time available in a given day, week, or term. Instructors need to balance time spent on teaching with other responsibilities such as identifying and reporting academic integrity violations.

As seen in the interviews, instructors vary in how they cope with conflicting pressures. One such example is the pressure of trying to accommodate students who do not have the required incoming prerequisite knowledge and the pressure to cover all required course content so students are prepared for subsequent courses. For some instructors this meant cutting back on new content to ensure students have a solid foundation of previous content, while others focus on covering their course content—at least one instructor mentioned they do not review any required prerequisite content.

### 5.4 A Need to Focus on (Benefits of) Learning

Many instructors shared their belief that students are entering their courses without the required knowledge and expected skills. Throughout Section 4.2, regardless of whether instructors say that the purposes of prerequisites are being fulfilled, they cite several factors over which instructors (we believe) have some control, albeit while experiencing pressure from all sides. These include: lack of student interest (some students “just try to get it over with” (Section 4.2.1)), grade inflation (Section 4.2.2), and a focus on grades over learning (Section 4.2.3).<sup>3</sup>

It is important that instructors align student learning outcomes with their actual knowledge at the end of the course. There are many promising techniques that may help with this problem, such as active learning for frequent formative assessment [18], standardized exams to provide comparisons with other populations in similar courses [19], and equity grading [7] to ensure grades are based on individual performance. As we already use active learning in many of the courses at our institutions, we suspect that active learning alone is not a solution to this problem.

Another possible solution is to embrace mastery learning as it focuses entirely on student learning outcomes. Mastery learning is the idea of organizing learning goals into well-defined units of concepts such that students must master a unit before moving on to the next one [3, 16]. The mastery learning perspective claims that conveyor-belt approach of passing students without mastery of the current course material is a major flaw in our current educational systems. Mastery learning is valuable but recommends a different approach to education that may be difficult to enact.

Although mastery learning puts a strong focus on learning, it does not, *per se*, provide internal motivation for the student to *want* to learn. It would need to be complemented by achievement goal interventions such as messaging from the instructor on the

importance of the material for the next course or their careers [6]. As cited by our instructors, the issue of students not coming forward for help also needs to be addressed.

### 5.5 Limitations and Threats to Validity

Our results are based on interviews with instructors from our two institutions which may limit generalizability of our findings. However, both of these programs follow the curriculum guidelines from the Joint Task Force on Computing Curricula Association which are often used in curricular design [10] and therefore the instructors' perspectives are likely similar to those of instructors at similar institutions. We did not interview instructors from liberal arts or community colleges and therefore may not have encompassed all of their perspectives in our results.

While our instructors came from our two institutions, due to the differences in sizes of the programs we did not have an even number of instructors from both institutions, with the majority, 15 instructors, coming from one of the two institutions. Additionally, one possible threat to validity is that it is possible that instructors forgot to mention a purpose of prerequisites or stopped after explaining several purposes in order to shorten the interaction. We believe that interviewing 21 instructors likely mitigated this issue.

## 6 CONCLUSION

Prerequisite courses are a prominent feature of CS curricula. Yet, little was known about what instructors' views are on prerequisites. We interviewed 21 CS instructors at our two institutions who taught key courses in the typical CS curriculum. We then employed phenomenography on the resulting transcripts to uncover the variety of views instructors have on the purposes of prerequisites and whether those purposes are being fulfilled.

The instructors articulated a surprising range of purposes. Instructors also varied in their views on the fulfillment of those purposes. This exposed a range of views on who had the *responsibility* for fulfilling the purposes of prerequisites, that is, the degree to which the responsibility fell to instructors or students. Additionally, instructors noted that their efforts to fulfill the purposes of prerequisites were challenged by a wide range of pressures from students, administrators, and fellow instructors.

It is apparent that prerequisite courses, as far as instructors are concerned, have a complex and central role in their curricula. Moreover, some instructors view the fulfillment of prerequisite purposes as contested territory, variously occupied by instructors, students, and administrators. Future research should quantify the degree to which instructors hold these different views and administrators would be advised to consider how the results presented here might inform the design and administration of prerequisite courses, such as the use of mastery learning and achievement goal interventions.

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<sup>3</sup>Education and psychology literature provides ample evidence that having the wrong achievement goals reduces learning. A starting point is [29].

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