CS0 vs. CS1: Understanding Fears and Confidence amongst Non-majors in Introductory CS Courses

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ABSTRACT

Previous research has been devoted to improving the experience of non-majors in introductory CS courses. In this study, we compare the experiences of non-majors in two different introductory CS courses, specifically with respect to fears about taking the course and change in confidence levels. CS0 is a computing course intentionally designed for non-majors, and CS1 is a more traditional introductory computing course. Both of these courses were composed primarily of non-majors and were taught by the same instructor. Survey data was collected from 124 students enrolled in CS0, and 502 students enrolled in CS1. Through qualitative analysis, we found that the fears of non-major students entering both of these introductory CS courses fell into one or more of nine distinct categories (e.g., Coding, Perceiving STEM as Difficult, Managing Workload). Additionally, using students' confidence levels at the beginning and end of the courses, we found that students in CS0 had a greater increase in confidence level than those in CS1. Finally, we explored connections between students' fears and how their confidence changed by the end of the course. We found that students across both courses with fears related to coding, lack of preparation, and being left behind had the highest average increase in confidence levels.

CCS CONCEPTS

• **Social and professional topics** → **Computer science education**.

KEYWORDS

CS0; CS1; Fears; Confidence; Non-majors; Computing Education Research

ACM Reference Format:
Emma Hogan, Ruoxuan Li, and Adalbert Gerald Soosai Raj. 2023. CS0 vs. CS1: Understanding Fears and Confidence amongst Non-majors in Introductory CS Courses. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2023), March 15–18, 2023, Toronto, ON, Canada.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3545945.3569865

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SIGCSE 2023, March 15–18, 2023, Toronto, ON, Canada

ACM ISBN 978-1-4503-9431-4/23/03.
https://doi.org/10.1145/3545945.3569865

1 INTRODUCTION

As computing becomes increasingly relevant in other fields, there is a growing need for computing courses for non-majors. Prior work has identified many benefits to improving CS education for non-majors, such as addressing the growing need for CS skills in other fields and increasing CS participation from URM groups [17].

As applications of computing are increasingly incorporated into other disciplines, a growing number of non-CS majors are either choosing or required to take introductory CS courses. Prior work has addressed the importance of making CS accessible to non-majors, including CS0 (intro CS course intentionally designed for non-majors) and non-major oriented course design [1, 4, 19]. However, due to course scheduling constraints it is not always possible for non-majors to take a separate CS0 course and instead have to take a traditional CS1 course (intended for CS majors).

One aspect of non-majors' experience that has not yet been explored, to our knowledge, is what fears they have in pursuing computing. Also, while advancements have been made in the design of introductory CS courses for non-majors[1, 4], we do not yet understand the difference taking a CS0 vs. CS1 course may have in terms of students' confidence levels and its relationship with their fears. We address these gaps by answering the following research questions:

(1) *What are the fears of non-majors taking an introductory CS course?*
(2) *How do confidence levels of non-majors differ in CS0 vs. CS1 courses?*
(3) *Is there a connection between fears expressed and change in confidence of non-majors in CS0 vs. CS1?*

Our study contributes a deeper understanding of the fears of non-majors taking a CS course and explores how their confidence levels compare in CS0 vs. CS1 courses based on initial fears expressed.

2 RELATED WORK

2.1 Concerns of Engineering Students

An international study across five countries was conducted to identify the primary concerns of computing students transitioning into higher education in CS [21]. This study analyzed student responses to a survey regarding a wide range of concerns. Six of the top ten concerns were related to Course Concerns: 'The possibility of failing, and any repercussions', 'Workload expectation', 'Managing my time well', 'Feeling prepared', 'Being good at the course', and 'Liking the course'. Notably, these categories aligned with those that we identified in this study.

Another study [12] measured gender differences in engineering students' fear of failure, the top concern reported in the study above [21]. This study found that female engineering students reported

higher fear of failure than males and were also significantly more likely to experience shame and embarrassment in front of others, had less belief in their skills and abilities, and had more fears about their future.

2.2 Introductory CS Courses for Non-CS Majors

Previous work has explored introductory CS course design specifically for non-majors [1, 4, 19]. Previous studies have shown the benefits of having context to help students understand why they should care about computing [4], preparing students to apply concepts to their respective fields of study [19], and refining learning goals to make the workload more manageable [1]. Prior work has also identified three important factors affecting the success of non-majors in learning to program: previous programming experience, perceived self-efficacy, and knowledge organization [20].

2.3 Confidence and Self-Efficacy

The relationship between confidence and self-efficacy beliefs and students' success has been shown in computing education literature [6], and in other fields such as psychology [9]. Multiple studies have addressed what shapes CS students' self-efficacy beliefs [2, 6, 8]. Previous work has also identified factors that positively impact students' self-efficacy in CS [11, 14, 15, 18, 22], as well as those with negative impacts [3, 7, 8, 13, 16]. Finally, numerous studies have focused on gender differences in confidence and self-efficacy beliefs amongst CS students: Women under-predict their performance on exams [5], are less likely to have prior programming experience [17], and are more likely to respond to early failures in CS courses by revising their self-efficacy beliefs [11].

3 METHODS

3.1 Study Population

Our study was conducted at a research-intensive public university in the United States. We compare experiences of non-CS majors in two different introductory CS courses, CS0 and CS1, described below. The same instructor taught both of the courses. Importantly, neither course expects any prior knowledge of programming.

CS0: CS0 is designed for non-majors and uses Snap! programming. The course had open-ended, creative programming assignments to make it more inclusive for non-majors. While it fulfills the same requirement as CS1 for non-majors, the course is offered infrequently, in which case non-majors then need to enroll in CS1 instead.

CS1: CS1 is a traditional introductory CS course using Python designed for CS majors as the first part of a two-part introductory series. CS majors take CS1 in the Fall, while the Spring offering of the course is comprised primarily of non-majors with few exceptions.

3.2 Description of Survey Collection

A pre-survey during the first week and a weekly survey during each of the following weeks were conducted in both courses with questions on prior experience in CS, attitudes towards the course, and other general information. The pre-surveys and weekly surveys[1] differed slightly between the two courses, with certain questions added or omitted. However, the surveys included two identical questions which we used for our comparison and appeared at the same position in both versions. All students were informed of the research and given the option to consent to participate. Weekly surveys after the first week were included in each programming assignment, and completion of the survey counted for a small portion of the assignment grade as an incentive. The number of survey submissions from the first and last weeks of the course differ, as students added and dropped the course between these points. All survey data was deidentified before use in our data analysis.

Student Response	Open Coding
"the coding as well as the work load with other out of class responsibilities"	coding; workload
"Falling behind because the material is too difficult for me"	fear of falling behind; concern about the difficulty of the class

Table 1: Examples of responses assigned multiple codes

Fears and concerns: The following open-ended question was presented identically on the pre-surveys for both courses: *What do you fear the most about taking this class?* The question was required in order to submit the survey but had no length requirements.

Confidence level: In both classes, the following 5-point Likert scale question was presented on the pre-surveys as: *On a scale of 1 to 5, how confident are you about your ability to do well in this course?* and every week after that on a weekly survey as: *At this point in the course, how confident are you about your ability to succeed in this course?*. Students' confidence levels were collected as an ordinal variable on a Likert scale from 1 to 5, where 1 was accompanied by the text 'Not at all confident' and 5 with 'Extremely confident'. In this study, we analyze students' confidence level during the first and last weeks of the quarter.

3.3 Data Analysis

3.3.1 Data Analysis for RQ 1. A total of 626 student survey responses were submitted through Google Forms, 124 from CS0 and 502 from CS1[2]. Many student responses included more than one concern and therefore corresponded to multiple labels[3] as shown in Table 1. Consequently, in our open coding process, we chose to label each student response with all of the labels that applied.

Qualitative Coding Process: We began by analyzing the CS0 data. In the first round of coding, the first and second authors independently performed open coding on the first 30 responses (approximately 5% of our total data). In each round we compared all of our codes and resolved differences by consensus, and updated

[1]The surveys, edited for anonymity purposes, can be found here. Pre-survey: http://bit.do/cs_pre; CS0 weekly: http://bit.do/zero_weekly; CS1 weekly: http://bit.do/one_weekly

[2]Not all of these students completed the respective courses, and the final enrollments for CS0 and CS1 were 144 and 474 respectively. We included the fears reported by all students, even those who dropped the course.

[3]In this paper, we use 'label' interchangeably with 'code' to refer to the codes from our Qualitative Coding process, to avoid confusion since we also refer to 'coding' as in programming.

our code book (adding, editing, or removing codes) so that we began each new round with identical code books.

We began open coding of the CS1 data using the final version of our code book from the CS0 data, which included 15 codes. We independently coded the first 30 CS1 responses and preliminarily determined that our code book was sufficient. After independently coding the next 250 student responses, two new themes emerged: concerns around asking for or getting help ('help'), and concerns about losing interest in the subject ('fear of loss of interest'). We added these two additional codes to our code book and coded the rest of the CS1 data independently.

Inter-rater Reliability: We calculated an inter-rater reliability (IRR) score for the CS0 and CS1 data separately. We first computed the Cohen's kappa value for each label, then calculated the average of these values for a final IRR score. The Cohen's kappa values represent how consistently we applied it, and the final IRR score represents our average consistency across all of the labels. Initially, we computed final IRR scores of 0.828 for CS0, and 0.701 for CS1. For each of four labels that had a Cohen's kappa value of <0.5 for the CS1 data, we reviewed our disagreements and refined label properties to be more specific. After this process, our re-computed IRR score for the CS1 data was 0.889 which means near perfect agreement.

3.3.2 Data Analysis for RQ 2. The surveys contain multiple close-ended questions regarding students' attitudes and personal experiences as the course went on. We selected the questions that explicitly asked about students' confidence levels for analysis. We performed a Mann-Whitney U test on the initial, final, and change in confidence of CS0 and CS1 students to compare the two groups, as the confidence levels were reported as ordinal values.

3.3.3 Data Analysis for RQ 3. To assess whether changes in confidence were connected to the categories of fears, we first classified the changes in confidence into four categories (shown in Table 4). We computed the average change in confidence level for each of the fear categories in CS0 and CS1. Lastly, we performed Mann-Whitney U tests on all category-based groups across the two courses (e.g., 'coding' in CS0 vs. CS1). We used Bonferroni correction to account for multiple comparisons due to applying the Mann-Whitney U test on all nine categories (new alpha = original alpha / number of categories = 0.05 / 9 = 0.0056).

4 RESULTS

4.1 Fears of Non-majors taking Introductory CS

Student responses to the open-ended survey question about fears were classified in one or more of the following categories: 1) coding, 2) comprehension, 3) being left behind, 4) perceiving STEM as difficult, 5) managing workload, 6) grading, 7) preparation, 8) disappointment in course, 9) no fear. The individual labels from open coding that were included under each category are shown in Table 2 and described in detail below.

4.1.1 Coding. This category encompasses fears related to programming. Two labels were included in this category:

The 'coding' label was applied to responses with at least one of the following properties: 1) fear about coding or programming, 2) fear about the process or part of the process of coding (e.g., debugging). An example is: *"Coding seems very intimidating"*.

The 'not being able to code independently' label included the following properties: 1) fears related specifically to coding or programming "on my own" or "by myself", 2) fears about independently writing a program from scratch. A sample response is: *"(I fear) writing a program on my own"*.

Categories	Open Codes	% of Total
coding	1. coding 2. not being able to code independently	19.65%
comprehension	1. not being able to understand the material	19.65%
being left behind	1. fear of falling behind 2. help	19.33%
perceiving STEM as difficult	1. concerns related to CS peers 2. CS in general 3. concern about the difficulty of the class	18.69%
managing workload	1. workload 2. concern about personal organization 3. fear of experiencing negative emotion	15.97%
grading	1. fear of poor outcome	13.90%
preparation	1. lack of technological fluency 2. not enough prior experience	14.06%
disappointment in course	1. not achieving desired learning goal 2. fear of loss of interest	4.95%
no fear	1. no concern	3.35%

Table 2: Individual codes included in each category, and the total percentage of student responses associated with it (Note: the sum of the percentages exceeds 100% because responses could be included in more than one category)

4.1.2 Comprehension. This category represents fears of not being able to understand the course material. This category includes one label, 'not understanding the material', which was assigned to any response with one or more of the following properties: 1) fears about not understanding or being able to understand the material, 2) fears about not understanding a specific concept in the course. For example: *"I fear that I won't understand the material."*.

4.1.3 Left Behind. This category represents fears of being left behind in the course. This category includes two labels:

The 'fear of falling behind' label included the following properties: 1) fears about falling behind in the course, 2) fears about not being able to keep up with the pace of the class, 3) fears about getting lost. An example is: *"I fear that I may get lost and be unable to recover"*.

The 'help' label was a new category that emerged in the CS1 data and included the following properties: 1) fear about needing to ask for help, 2) concern about ability to get help when needed. An example is: *"not getting enough help"*.

4.1.4 Perceiving STEM as Difficult. This category encompasses fears about taking the course due to perceiving CS and/or STEM as difficult. This category includes three labels:

The 'concerns related to CS peers' label includes the following properties: 1) fear of judgment or superiority from STEM majors, 2) fears due to hearing from peers that CS is difficult. For example: *"I have heard from friends who are CS majors who say how difficult their work is so it seems really intimidating."*

The 'CS in general' label includes the following properties: 1) fears about CS or STEM in general, 2) fear due to negative prior

experiences with CS and/or STEM. For example: *"I struggle with STEM classes so I am afraid it will be hard to pick up."*.

The 'concern about the difficulty of the class' label had the following property: fear that the class or a specific component of the class will be too difficult. A sample response is: *"I am nervous that some of the assignments or tests may be very challenging."*

4.1.5 Managing Workload. This category includes fears about managing the course workload. This category includes three labels:

The 'workload' label includes the following properties: 1) fears about the amount of work and/or time commitment, 2) fears about managing the workload alongside other courses or responsibilities outside of class. One representative response is: *"the amount of work required to succeed in the class"*.

The 'concern about the personal organization' label has the following property: fear of making preventable mistakes due to lack of personal organization or poor study habits. An example is: *"accidentally missing assignments"*.

The label 'fear of experiencing negative emotion' has the following property: fears about experiencing negative emotions, such as frustration and stress, related to the course. One example is: *"getting very confused and stressed out"*.

4.1.6 Grading. This category represents fears of not succeeding in the course from a grading standpoint. This category includes one label, 'fear of poor outcome', which was applied to responses expressing: 1) fears about failing or not doing well in the class, 2) fear of getting an unsatisfactory grade. An example is: *"I fear that I would fail the class or get a grade I am not proud of"*.

4.1.7 Preparation. This category represents fears about lacking adequate preparation going into the course (even though neither course requires prior experience with CS). This category includes two labels:

The 'lack of technological fluency' label was applied to responses that expressed 1) fear about having a lack of technological fluency, or not being "tech savvy", and/or 2) fears due to unfamiliarity with the digital tools that will be used in the course. An example is: *"I am afraid that my lack of tech-savviness will hinder my performance in the class"*.

The 'not enough prior experience' label was applied to responses that expressed 1) concerns related to having no or not enough prior experience with CS courses, CS in general, and/or coding. For example: *"That it's something I have very little exposure to before and will feel very behind"*.

4.1.8 Disappointment in Course. This category represents fears of the class falling short of students' expectations for what they hope to gain, or not being enjoyable. This category includes two labels:

The 'not achieving desired learning goal' label has the following properties: 1) concern that the course will not lead to a specific learning goal or outcome that the student has in mind, and/or 2) concern that the course will not lead to a desired level of understanding. An example response is: *"not learning something worthwhile"*.

The 'fear of loss of interest' label emerged only in the CS1 data and was applied to student responses that expressed 1) fear that the course will not be enjoyable, and/or 2) fear that they will lose interest in the course. For example: *"finding out that I don't like computer science"*.

4.1.9 No Fear. Finally, this category includes responses that do not report any specific fear. This category includes one label, 'no concern', with the properties 1) having no concerns or fears about the course, and 2) student answers blank, or "I don't know". Examples include: *"nothing"* and *"I don't know"*.

4.2 Confidence Levels in CS0 vs. CS1

We compared the initial, final, and change in confidence level for CS0 vs. CS1. Since the data is ordinal, we performed a Mann-Whitney U test to determine whether there was any statistically significant difference between the two groups. The alpha was chosen to be 0.05. The results are summarized in Table 3.

Conf.	Pop.	N	M	Mdn	SD	U	p	r
initial	CS0	124	2.9	3.0	1.0	27841.5	.053	0.11
	CS1	502	3.1	3.0	1.0			
final	CS0	99	3.9	4.0	0.9	20197.0	<.01	-0.18
	CS1	346	3.6	4.0	1.0			
change	CS0	99	0.9	1.0	1.2	20878.5	<.001	-0.26
	CS1	335	0.4	0.0	1.1			

Table 3: Results of comparing initial, final, and change in confidence levels among CS0 and CS1 students
Conf. - Confidence; Pop. - Population; N - Number of students in each group; M - Mean; Mdn - Median; SD - Standard Deviation; U - Mann-Whitney U statistic; p - p-value; r - Rank-biserial correlation effect size

As seen in Table 3, CS0 students reported a lower initial confidence level (M = 2.9, Mdn = 3.0) than CS1 students (M = 3.1, Mdn = 3.0); however, the difference between the two groups was not statistically significant (p = .053). CS0 students reported a higher final confidence level (M = 3.9, Mdn = 4.0) than CS1 students (M = 3.6, Mdn = 4.0) and the difference was statistically significant (p < .01) with a small effect size. Figure 1 shows the distributions of initial and final confidence levels among CS0 and CS1 students. The percentage of students who reported an increase in confidence level was higher in CS0 (67%) when compared to CS1 (46%). CS0 students also reported a higher change in confidence level (M = 0.9, Mdn = 1.0) compared to CS1 students (M = 0.4, Mdn = 0.0). The difference was statistically significant (p < .001) with a small effect size (see Table 3). Figure 2 shows the distribution of the change in confidence level among CS0 and CS1.

4.3 Connections between Fears and Change in Confidence in CS0 vs. CS1

For each of the categories of fear that emerged from our qualitative analysis, we computed the average change in confidence for all students with responses included in that category. We categorized the changes in confidence level in four intervals, shown in Table 4.

Figure 3 shows the distribution of change in confidence among all category-based groups in CS0 and CS1 in descending order. In both CS0 and CS1, 'preparation', 'coding', and 'being left behind' are in the top four category-based groups that showed the highest increase in confidence. While all category-based groups in CS0 had

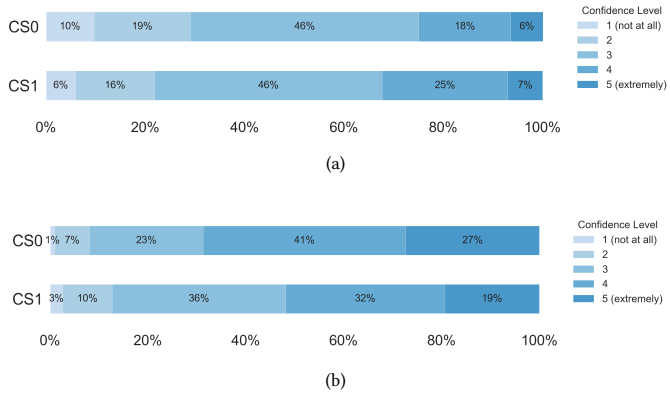

Figure 1: Distributions of initial and final confidence levels among CS0 and CS1 students

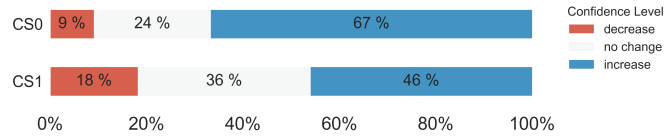

Figure 2: The stacked bar chart shows the distributions of the change in confidence level among CS0 and CS1 students.

an increase in confidence, the group 'no fear' in CS1 had an overall decrease in confidence.

Table 5 shows which fear categories were associated with the intervals defined in Table 4 for CS0 vs. CS1. Four fear categories in CS0 were in the 'high increase' interval, and none in CS1. In CS0, while only one category-based group fell into the 'low increase' interval, compared to five groups in CS1.

Change in Confidence	Confidence Change Interval
< 0	decrease
0 - 0.5	low increase
0.5 - 1	moderate increase
1 - 1.5	high increase

Table 4: Confidence change intervals established for categorizing the change in confidence levels

	Low Increase	Moderate Increase	High Increase
CS0	1. no fear	1. disappointment in course 2. managing workload 3. perceiving STEM as difficult 4. comprehension	1. preparation 2. coding 3. grading 4. being left behind
CS1	1. comprehension 2. managing workload 3. perceiving STEM as difficult 4. grading 5. disappointment in course	1. coding 2. being left behind 3. preparation	N/A

Table 5: Distribution of category-based groups in CS0 and CS1 among the four confidence change intervals (the 'decrease' interval was not included as only one group from CS1 showed a decrease in confidence)

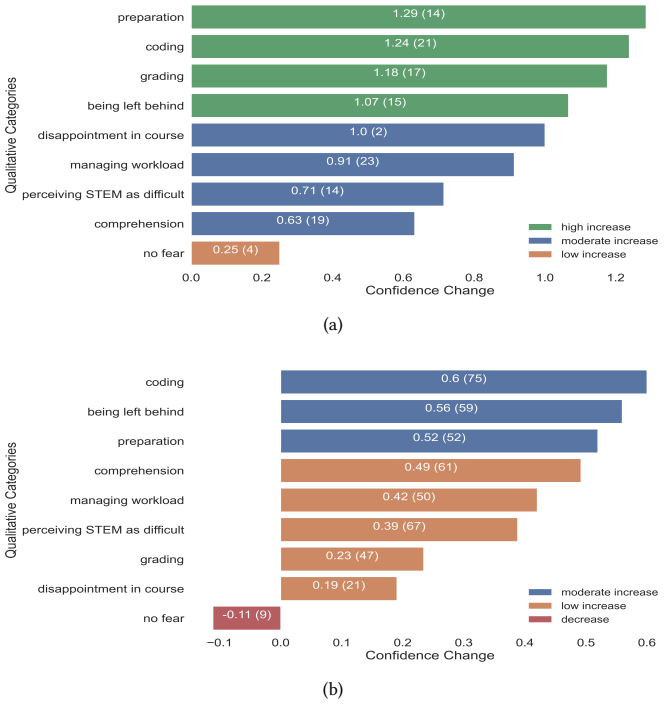

Figure 3: Average change in confidence level among different fear categories in (a) CS0 and (b) CS1, with the change in confidence and number of students in each category-based group (in parentheses) shown in the horizontal bars

As shown in Figure 3, all category-based groups in CS0 showed a higher increase in confidence compared to their counterparts in CS1. In order to test if the difference in change in confidence across the two courses is significant, we performed the Mann-Whitney U tests on all category-based groups from both courses. As seen in Figure 3 and Table 5, all fear categories showed a higher increase in confidence level in CS0 than in CS1. However, the difference was not statistically significant for any of the fear categories between the two courses.

5 DISCUSSION

5.1 Interpretation of Results

5.1.1 RQ1. After our qualitative coding of the fears reported by non-major students, we found that several of our codes were not only consistent across the two courses, CS0 and CS1, but also with prior work on the fears of high school students transitioning to undergraduate CS across multiple countries [21]. Although worded differently, the categories related to Course Concerns in the Zarb et al. study [21] correspond to our codes and/or broader categories (e.g., 'Feeling prepared' and 'Preparation'). This suggests these fears are prevalent amongst multiple different populations entering undergraduate-level introductory CS courses for the first time.

We found several major themes emerge from the student responses pertaining to their fears about taking an introductory CS

course that were rooted in a lack of self-efficacy beliefs. For example, one of the largest categories, 'coding', revealed the prevalence of concern amongst non-CS majors specifically about the programming aspect of the course. This could reflect a dramatized perception of how difficult it is to learn programming: while almost one fifth of students reported fear related to coding, this group experienced one of the highest increases in confidence by the end of the course. These concerns could be derived from how programming and programmers are portrayed in media and society, or as other students mentioned, word-of-mouth from peers in CS.

For the other most popular category, 'comprehension', students reported fear that they would not be able to understand the material. Similarly, this could be a result of a lack of self-efficacy beliefs pertaining to STEM in general. Furthermore, the next largest category, 'being left behind', is related to beliefs about oneself in comparison to how they imagine their peers will perform in the course (in this case predicting that they will perform worse).

Students who reported fears categorized under 'preparation' expressed feeling unprepared to succeed in the course, either due to a lack of background knowledge or experience, or a lack of technological fluency (even though neither course required any background knowledge in CS). This was another category that saw high levels of confidence increase by the end of the course, suggesting that students underestimated their preparedness.

While student responses categorized under the 'perceiving STEM as difficult' category explicitly articulated this belief, other categories as described above could be deeply related to these perceptions. These widespread beliefs among non-majors revealing a lack of self-efficacy in a pre-course survey is significant: recent research has shown self-efficacy beliefs pre-course to impact students' experience in computing courses [3, 11, 15], and even course outcome for groups that are currently underrepresented in computing (e.g., women, Black, Latinx) [10].

5.1.2 RQ2. One of our main findings regarding non-major's experiences in CS0 and CS1 courses with respect to confidence was that, overall, CS0 students experienced a statistically significant increase in confidence than those in CS1. We controlled for variables such as instructor, university, and time period. Another explanation for the greater increase in confidence from CS0 students could be that non-major students enrolled in CS0 reported lower initial confidence, which could have resulted in a greater increase by the end. However, we argue that this is not the case by showing that there is no statistically significant difference between the initial confidence levels of CS0 and CS1 students. Therefore, we theorize that this is most likely due to the fact that CS0 is a course specifically designed for non-majors as opposed to the more traditional CS1 course. This has implications in computing education best practices for improving the experience of non-major students, revealing the significant positive benefits of offering a course specifically designed for non-major students.

5.1.3 RQ3. One important finding regarding the connection between the category-based groups and change in confidence was that 'preparation', 'coding', and 'being left behind' belonged to the top four groups that had the highest increase in confidence in both CS0 and CS1. One possible explanation for that could be both courses are introductory CS courses targeting students who are new to programming and focused on addressing common fears related to learning a relatively new subject. However, in CS0, four groups including 'preparation', 'coding', 'grading', and 'being left behind' fell into the high increase confidence interval while no group in CS1 fell into this interval. This could be because CS0 was intentionally designed to be a fun and creative course that allows non-majors to explore the broader picture of computer science using Snap! while CS1 was designed as a more traditional introductory course in Python with the intention to serve CS majors. Our results suggest that CS0 may be a better fit for non-majors than CS1 by helping to improve confidence about succeeding in a CS course.

5.2 Limitations and Future Work

One limitation of our results categorizing student fears is the lack of specificity in some student responses. While we theorize above that many of the fears reported by non-major students could be rooted in lack of self-efficacy beliefs and reflect a disproportionate amount of fear in certain areas like coding and preparation, we were restricted in our ability to confirm this reasoning. Future work could explore deeper into non-major students' beliefs behind their fears by conducting interviews with students.

Another limitation of our work is that confidence levels could be influenced by a variety of factors unrelated to students fears going into the course. Additionally, we use survey responses from the first and last weeks of the course to compare confidence levels, which excludes students who ended up dropping the course. Therefore, our results in RQ3 only suggest that there could be a connection between students' fears and confidence levels. In addition, while we note the patterns of confidence increases and decreases for different categories across the two classes, future work could use different methods to more accurately measure success in addressing the fears of non-majors.

6 CONCLUSION

In this study, we identified nine categories of fears expressed by non-major students entering CS0 and CS1 courses, analyzed how their confidence levels changed in CS0 vs. CS1, and found connections between fears expressed and changes in confidence across the two courses. This study contributes a detailed understanding of the range of fears experienced by non-majors based on their own words. Additionally, our results affirm the need for expansion of course offerings in CS intentionally designed for non-major students. Our analysis revealed a clear distinction between non-major students in CS0 vs. CS1 as we conclude that these students are able to experience higher increases in confidence in CS0 compared to CS1. We also suggest that these fears are better addressed by taking CS0 as opposed to CS1 based on our results. Lastly, our results identify which fears of non-major students are currently being addressed the best across both introductory CS courses (preparation, coding, and being left behind) as well as identifying specific fears that should be targeted for improvement.

ACKNOWLEDGMENTS

We thank the staff of both courses for helping us conduct the surveys, and the students for completing them. We also thank the anonymous reviewers for their valuable feedback.

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