

Student Perceptions of Submission-Based Progress Reports

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Abstract

Feedback is a critical tool in education, as it can drive our students to become more educated and effective professionals. Two common forms of feedback are knowledge-based (e.g., content knowledge, assignment efficacy) and behavior-based (e.g., submission habits, engagement) feedback. Previous research has considered knowledge-based feedback in some detail, but feedback support in terms of behavior-based skills has received comparatively little attention. This type of feedback can be critical in developing good work habits, which can be essential for success and continuation in STEM education. To better understand the impacts of submission-based feedback, we investigated student perceptions about the use of a submission-based feedback tool in an introductory computing course. We utilize an existing framework for feedback design to develop a submission-based progress report email, which we evaluate using students' perceptions on measures from existing literature and themes discovered through qualitative analysis. We do this by conducting nominal group technique sessions to find impacts not considered in the literature, followed by an online survey covering all identified measures. Our results suggest that students perceive submission progress reporting as helping in the dimensions identified in literature and by our focus groups, and that these benefits are not uniquely experienced across demographic groups.

1 Introduction

Feedback is one of the most essential elements of education, as it is formed directly as a response to and consequence of student performance [1]. Feedback is the medium through which we communicate to learners their proficiency, and the channel through which courses can have long term impact through measures such as grades and GPA. Prior work suggests that feedback is a powerful factor in determining academic outcomes, but that the impact is also mediated by factors related to the delivery and relevance of feedback [2, 3]. The ways in which we provide feedback have expanded significantly since these studies, with entire areas of research concerned with feedback such as achievement-based gamification [4] and student-facing learning analytics [5].

A point of friction when utilizing existing tools for feedback is the focus on the grade and content knowledge. The focus on providing feedback solely for content knowledge may fail to recognize the role that behavior plays in academic performance, for example when students either fail to submit assignments or submit them late. By highlighting behavior-based feedback, we may provide more information to enable students to improve in the course, and keep track of their

course related behavior. Additionally, as more systems are developed to evaluate students in alternative ways such as mastery, specification, or contract based grading, traditional tools and reporting methods fall short due to their focus on grades as feedback. Many of these practices exist under the umbrella of equitable practices, which seek to remove disparities in outcomes for students [6, 7]. As such, when we build a tool that may also be utilized in the context of equitable practices and alternative grading, we believe it valuable to provide early suggestions as to whether or not this practice itself is also fair to all students.

In order to better understand aspects of behavior-based feedback, this work focuses on the design, implementation, and evaluation of a submission-based feedback system, designed to give students feedback on whether or not assignments have been submitted. Submission-based feedback is a specific manifestation of behavior-based feedback, which seeks to provide feedback to students on submission behavior. To do so, we utilize a structured approach to generating meaningful feedback for students, and a code-based tool to generate progress reports for students. We evaluate this implementation utilizing a mixed-methods approach, where we utilize qualitative data collection through Nominal Group Technique (NGT) [8, 9, 10] to inform and expand the scope of data collected through quantitative methods. While they do not represent all dimensions of students, verifying impacts across both gender and race cover some of the more salient cultural differences our students may have encountered. As such, for the purposes of this experiment, we chose to investigate impact across these two dimensions to determine if any group is uniquely impacted, either positively or negatively. This study addresses two primary research questions:

- **RQ1:** Do students perceive submission-based progress reporting as a beneficial form of feedback?
- **RQ2:** Are the benefits of this progress reporting uniquely experienced by any gender or race?

2 Background and Related Work

Feedback is a critical element of a course for helping guide and reassure students in their academic journey [11, 12, 1]. Despite this importance, research suggests a disconnect between student and instructor perceptions of effective feedback [13]. Prior work has investigated the most critical elements of feedback, such that it can be effective in guiding students. Orsmond et al. found that students often used feedback to motivate themselves, enhance their learning, enhance their ability to reflect on their work, and clarify their progress [14]. Mulliner and Tucker suggest that some of the most critical elements of any feedback are timeliness and clarity of steps to improve [15]. These ideas together suggest that feedback should be timely and clear, and that it can impact students in dimensions of motivation, learning, reflection and understanding of progress. To create a timely and clear form of feedback, we focused our efforts on developing an automated, text based progress report that communicates a limited set of clearly defined metrics. In this study, we define progress reports and progress reporting as items given to students which communicate various measures related to the type of report, such as grades for grade-based progress reporting, or assignment submissions for submission-based progress reporting. The dimensions of impact addressed by Orsmond et al. could then be used to determine dimensions of

analysis for feedback driven work.

This work, like many existing interventions, focuses on applying feedback effectively in early computing courses [16, 17], in part due to the importance of formative learning and experiences in these classes. Introductory courses often coincide with students' first steps into higher education, when they are more likely dealing with changes in environment, education, and relationships [18]. The movement to help reduce the barrier to participation and continuation of computing education is shared by equitable grading and practices [6, 7], which submission-based progress reporting works with more easily than knowledge-based progress reporting. In considering whether or not barriers exist within our practices, we consider the historical under-representation of certain identities in computing [19], and validate that impacts are not uniquely beneficial to identities over-represented in the field. Three dimensions of concern in this regard are gender, race, and the intersection of the two [20], which itself is a unique identity. By showing a lack of unique impact across these dimensions, we can suggest that this practice is fair and supports all our students, in every aspect this practice impacts.

To design the content and flow of the progress report, we utilized the feedback model suggested by Hattie and Timperly [1], which was created by meta-analysis of other research focused on feedback. This framework suggests that effective feedback should address three things: (1) the students' goals, (2) their progress in completing them, and (3) what their next or future goals are. These three components may be combined together or carried out individually. By designing feedback which directly addresses these three components, students can determine their current course standing and refine their work strategies. With this background, we developed a progress report utilizing the framework of Hattie and Timperly [1]. Our progress report is coupled an evaluation based on Orsmond et al.'s identified impacts of motivation, learning, reflection skills, and clarity of progress [14], which are adapted unique case of submission-based feedback.

3 Progress Report Design

The progress report we utilized for this study was constructed by scaffolding from the three important feedback questions proposed by Hattie and Timperly [1], *Where am I going?*, *How am I doing?*, and *Where to next?*. By answering these three questions in the design of feedback, we provide students an outline of what their course goals were, how they achieved those goals, and what subsequent goals will/should be.

To answer the first question, *Where am I going?*, we include a list of the assignments due each week in the progress report, labeled as "List of Module Assignments" in Figure 1. The goal of this list was to remind students of all the work that was due for submission in the prior week, which provides them a list of goals for submission during that week. This was followed by answers to the second question, *How am I doing?*, which we provided at both the level of instructional unit, such as modules or weeks, and overall course progress. We did this at the instructional unit level by implementing a short component in the email which lets students know, out of the total number of assignments which required submission in the previous instructional unit, how many of them they had successfully submitted. At the course level, we provided the same statistic but with reference to the entire course, i.e. how many assignments have been successfully submitted in the course so far versus the total number of required submissions so far.

These two components are labeled as “Module Assignment Completion Count” and “Course Assignments and Completion Goal” respectively in Figure 1.

For the design of the final question, *Where to next?*, the goal was to try to orient corrective behavior for students, rather than focusing solely on what is upcoming in the next instructional unit. This was implemented by creating a list of assignments which had not been submitted previously (i.e., missed assignments). In the course this intervention was implemented in, students had the ability to submit work late for partial credit, so this component was labeled as “Late Assignment List” in Figure 1. This list only rendered for students who had missing assignments, so students without missing assignments only saw answers to the above two questions, and thus only positive feedback related to their successful submissions.

Dear Student,

Before checkpoint 3 we wrapped up the current module. This email provides a progress update on your completion of the module and the course as a whole as of today.

----- Current Module -----

This module had 3 assignments, which were:

- Assignment 1
- Assignment 2
- Assignment 3

List of Module Assignments

As of this email, you have completed 2 out of 3 assignments for the module.

Module Assignment Completion Count

----- Course Completion -----

You have completed 19 with the goal being 20 by now.

Course Assignments & Completion Goal

In order to catch up, you can complete the following assignments:
-Assignment 2

Late Assignment List

These metrics do not reflect any grades, only completion of assignments. If you have any questions, please contact members of the instructional team, or check the course Canvas Page.

Figure 1: Example Progress Report Email

To generate these emails, we utilized mail merger software with a template email to send reports to all students in the course at the end of each instructional unit. The student information was gathered and prepared for use by the mail merger software via a script which would utilize a combination of a gradebook export and the API of the course learning management system. The

course instructor defined the submission criteria using a particular score (0, or no score) or submission status (submitted vs. not) to determine whether an assignment was successfully submitted. This allowed the tool to account for and report on assignments which had no direct LMS submission, such as an external textbook, to be tracked correctly by the tool and reports.

A total of six reports were sent to students over the course of the semester, with minor modifications to the language and phrasing of the progress reports by the course instructor to account for changes in course context and progression. The overall structure and answers to the feedback questions were maintained between all versions, however. Students received two reports in the first half of the semester and four in the second half.

4 Method

For this study, we utilized two primary instruments — qualitative focus group sessions via NGT, and a quantitative survey to collect from a larger portion of the student population. The qualitative sessions were conducted primarily to inform and revise the quantitative survey prior to distribution, in order to assure that as many dimensions of impact and experience were adequately covered by the survey. The NGT sessions were conducted over two weeks halfway through the course, to allow for time to analyze and revise the survey and submit proper paperwork to maintain institutional review board compliance. The survey was given at the end of the semester, a week before finals. Both elements had an incentive of extra credit in the course, as a single point with relatively marginal impact on the course grade.

Nominal group technique is a structured method to conduct focus group interviews in small groups of 4-8 participants, with a focus on participants reaching consensus on responses and providing structured data [8, 9, 10]. It has been utilized in prior research to effectively gather the perspectives and experiences of students in educational contexts [21, 22, 23]. NGT works by promoting discussion of responses or answers among the participants, by first collecting prompt responses via round-robin contribution, where each participant can contribute equally. Then participants discuss each idea, proposing potential modifications, combinations of existing ideas, or removal of ideas. These actions are only taken with the consent of the participant who originally proposed the idea, to maintain ownership over ideas. Once all ideas are discussed, participants then rank each response — from those they most agree with to those they least agree with. This entire method allows each participant to wholly express their individual opinions while still facilitating orderly discussion and consideration.

For this study, NGT was employed to survey additional student perceptions prior to distribution of the survey in the course. This was done to source perceptions not just from existing literature, but from our students, to assure that as many impacts and perceptions were accounted for as possible. We recruited participants via an online survey of availability and consent form, which was announced in the courses' learning management system.

After receiving availability from participants, we would schedule them into sessions of five participants each. This was done to ensure that even if one participant did not show up, the session can still be conducted appropriately. Students who missed a session, or attended a session which could not be run, were invited to participate in a later session, but this was not enforced.

Students would receive the extra credit simply by showing up to their session, even if the session was not conducted. Each session was scheduled to take approximately 45 minutes, and physical forms were created to allow for data collection.

During the session, participants were first given an overview of the NGT method by the member of the research team conducting the session. They were then given a picture of a sample progress report, and prompted to search their email inbox and look at the most recent progress report they received to refresh their memory. They were then given the following prompt, and they had five minutes to brainstorm their responses: *“How has the progress tracking email system impacted your experience in the course?”* Participants were additionally given the context that answers should be simple and represent a single idea, in order to encourage separation of multiple ideas into separate responses. After all ideas were collected, participants would discuss changes or revisions to the list of ideas, and then individually rank them. Only the participants’ ranked responses were collected from them. This was done using a form that contained no identifying information that could be used to connect responses to individual participants.

To determine which NGT responses to include in the survey, we identified the responses with the highest level of agreement among participants. This was done by calculating the presence, as a proportion, for each idea in the top three ideas for each participant. This methodology assured that only ideas agreed upon by participants (not in the bottom half of selection) were represented, and that sessions with more ideas presented were not overrepresented. For consideration of inclusion on the survey, we only looked at ideas whose presence proportion was greater than or equal to 0.5, that is to say, that they were present in the top three responses of half or more of participants’ ranked responses for their respective session.

To further understand students’ perceptions of the practice, we utilized a survey with Likert style and demographic questions, to validate the impacts both generally and across student identities. We developed four questions based on the use cases of feedback identified by Orsmond et al. [14], using on the question stem “The progress report email...” followed by individual tails to the question. Since this work does not focus on knowledge or grade-based feedback, but instead on submission habits, the uses cases of “Enhance Learning,” “Reflect on Knowledge,” and “Clarify Understanding” were adapted to “Enhance Time Management,” “Reflect on Work Habits,” and “Clarify Progress,” as these terms were considered analogous to the originals in the context of successful submission habits. As such, the four Likert question tails are as follows:

- “...helped motivate me to complete coursework”
- “...helped improve my time management in the course”
- “...helped me reflect on my work habits”
- “...helped me understand my progress in the course.”

It is also important to note here that these questions are positively framed: while this may introduce some bias in student answers, particularly in the lack of a neutral selection, we believe that this framing helps students most easily consider the impacts of the progress reports on their behavior.

These questions were rated on the scale of Strongly Disagree, Disagree, Agree, and Strongly

Agree. Furthermore, for each of the components of the survey identified in Figure 1, we included a Likert scale measuring the helpfulness of each component on the scale of: Very Unhelpful, Unhelpful, Helpful, and Very Helpful.

The Likert scale used for these questions had four responses, omitting the additional neutral case traditionally included in Likert scale questions. This was done to prompt students to consider whether their feelings were more positive or negative, and rank their response accordingly. As such, when analyzing the Likert style questions, the neutral average is 2.5, as opposed to a traditional three on a five point scale.

Basic demographic data was also collected and subsequently processed, to have the necessary information to determine if the impacts of the practice are unique to any student group. Students had the opportunity to self identify their gender via an open ended question, with the instructions “Please enter what most accurately describes your gender, such as: cis woman, cis man, trans woman, trans man, non-binary, etc. You may also enter ‘Prefer not to answer’, or leave this question blank.” Students then answered two questions related to race and ethnicity, modeled after historical census categories. This meant a question related to being of Hispanic / Latino origin, with answers “Yes,” “No,” or “Prefer not to Answer.” The question for students to input their race allowed them to select multiple, or enter their own, from the answers “Black or African American,” “Asian,” “American Indian or Native Alaskan,” “Native Hawaiian or Pacific Islander,” “White,” and “Prefer not to answer.”

To consolidate the answers to these questions, the authors mapped the various responses to a smaller number of categories. While we acknowledge this lowers the representativeness and dimensionality of our work, we take this step to try and make surface level trends and generalization apparent, and encourage subsequent work to more accurately represent the identities of their student populations. For the gender question, students were mapped to “Man” or “Woman,” if they clearly identified as such, regardless of using sex or gender terminology, alongside other words. If students identified as transgender, non-binary, or any other identity, they were categorized as “Gender Diverse.” All responses in which the gender mapping was unclear, or a non-answer or no answer was provided, were categorized as “Unknown.” A similar methodology was applied to the questions of race and ethnicity. First, students who identified solely as White or Asian were categorized as such. Any student who identified with multiple groups, including identifying as being of Hispanic / Latino origin, were categorized as “Mixed Race.” Finally, all other singular identities, including Black or African American, American Indian or Native Alaskan, or free response versions of this identity or others were categorized as “Underrepresented,” while all unclear cases were marked as “Unknown.”

We also investigated the intersectional experience [20] of gender and race identities, based on the above categories. Students were mapped based on the combination of the three gender categories, and the four race categories. Any student with Unknown values for either gender or race was excluded from this analysis, but were included in the individual level analyses for both gender and race.

Utilizing the categories in gender and race and the intersectional identities, we test for differences compared to all other students utilizing Brunner-Munzel non-parametric tests to find significant differences, utilizing a two-tailed test with $\alpha = 0.05$, testing for significant differences. This is

done by comparing a student group to all other students who do not have that identity, i.e., White vs. $\neg$ White. While Brunner-Munzel tests can compare between multiple groups, we elect to combine all other groups to test for difference between each student identity group and the rest of the body, rather than individual groups. All analyses are run without a correction, as we want to consider possible differences which may arise at standard levels of significance. For each analysis, all “Unknown” responses are omitted from analysis, since we cannot determine whether or not these students may be members of the group being tested or not. In the results section, we specify the number of tests run across all questions and identities, but only present the specific tests which have statistical significance.

This research was conducted in a large enrollment course at a public university located in the south-eastern US with high research activity. The course is called *Introduction to Computer Science II*, with a focus on reinforcing computational thinking and learning and applying Object Oriented Programming principles. This course is required by students in both Computer Science and Data Science majors, and by students with a Computer Science or related minor.

This specific section was offered in Spring 2025, and had an enrollment of approximately 700 students. The course was primarily taught through a combination of large lecture sections provided by the course instructor, and smaller lab sections which were led by teaching assistants. Most instructional units in the course consisted of a few standard assignments given during every instructional unit (such as labs), alongside other assignment types and exams which were more sporadically assigned.

5 Results

For the overall study, we first conducted NGT sessions and analyzed the results, which then informed the questions used in the survey of students administered at the end of the term. A total of 13 NGT sessions were made available each with a maximum capacity of six students. Registration for participation was available to students for two weeks, during which 65 students signed up to participate. Students were matched into sessions based on their availability, with the goal of at least five students in each session. Sessions with fewer than four students were not conducted, and students were given the opportunity to reschedule. A total of six sessions were run with 26 students, resulting in a session conduct rate of 46%. Ten more students showed up for sessions which did not have enough participants to run, meaning we had an attendance rate of 55% and a participation rate of 40%.

Our Top three analysis method yielded 19 responses as having a presence rate greater than or equal to 0.5, out of a total of 54 responses. These responses were then compared to existing questions identified from the background, and whether or not the responses were related to perceptions of impact or feedback for the intervention. Seven of the 19 responses were considered to be covered by the existing questions related to motivation, time management, reflection on work habits, and understanding of course progress, as well as questions related to the helpfulness of individual components. Five of the remaining 12 responses were identified as being feedback for the implementation of the intervention (i.e. “It would be helpful if it told me about partially complete assignments.”), leaving seven responses being identified as student perceptions not currently addressed by the survey. These responses are shown in Table 1.

Table 1: NGT Responses Not Addressed by Survey

Response #	Response Text
1	It shows me assignments I missed so I can do them.
2	It helps me see what I missed so I do not get a zero on it.
3	It reassures me when I have done everything.
4	I do not check the emails.
5	It helps me keep track of late and missing assignments.
6	It makes me feel like my instructor cares about my success.
7	It lets me know what I can do when I am behind.

Table 2: Percent Agreement with Likert Experience Questions

The progress report email...	Agree or Greater	Strongly Agree
...helped motivate me to complete coursework.	87.1%	22.4%
...helped improve my time management in the course.	78.1%	19.7%
...helped me reflect on my work habits.	82.2%	28.0%
...helped me understand my progress in the course.	92.2%	42.3%
...helped reduce anxiety about my progress in the course.	65.5%	20.4%
...made me feel like the instructor cared.	86.4%	32.8%
...helped me keep track of or catch up on late work.	90.0%	38.2%

To account for the seven responses from the NGT sessions not specifically included in the survey, four additional survey questions were designed to cover these responses. All responses besides #4 were accounted for by creating three additional Likert style questions, in the model of “The progress report email...” followed by a statement, similar to the existing four survey questions. The added components, completing the stem, were “...helped reduce anxiety about my progress in the course.” (Response #3), “...made me feel like the instructor cared.” (Response #6), and “...helped me keep track of or catch up on late work.” (Responses #1, 2, 5, & 7). The final response, response #4, was addressed by adding a question related to frequency of usage, which is not addressed in this work.

We had 411 students respond to the survey. We analyzed overall trends in experiences by calculating the percentage of students whose responses were positive, shown in Table 2. All questions received >65% agreement rate, meaning that there is some level of agreement with each statement. For the original four measures determined from Orsmond et al. [14], the lowest agreement level is 78.1%. This suggests that the progress reports achieved these outcomes to some extent. Looking at the percentage who strongly agreed, we see that the first three measures range between 20-30%, while the final measure, “...helped me understand my progress in the course,” has 40% strong agreement. This is most likely due to the fact that the most direct and clear goal of the progress reports to students was letting them know where they were in the course.

Examining the measures derived from the NGT sessions, we see strong agreement on the last two measures related to instructor care and keeping track of or catching up on late work. The first likely received strong support due to the email coming from the instructor and helping students

Table 3: Percent Agreement with Component Helpfulness

Component was helpful?	% Helpful or Very Helpful	% Very Helpful
List of Module Assignments	92.5%	40.4%
Module Assignment Completion Count	91.7%	44.5%
Course Assignments & Completion Goal	91.7%	42.8%
Late Assignment List	91.5%	47.2%

Table 4: Gender-Race Intersectional Demographics

	Man	Woman	Gender Diverse	Unknown	Total
Asian	64	37	0	18	119
Mixed Race	28	13	1	3	45
Under-Represented	59	32	0	10	101
White	78	16	4	22	120
Unknown	9	4	0	13	26
Total	238	102	5	66	411

understand the course. The latter also likely feeds into this, as students likely appreciated reminders or notices related to late work. The first measure, related to anxiety, received lower support than all other measures, but was still positive overall. Several factors may account for this, such as anxiety related to feedback or concerns over missing assignments. Despite this, all seven experience related questions showed strong positive support, suggesting that this practice supports the prior literature and suggests progress reporting can also reduce anxiety, improve feelings of instructor care, and help students with missing assignments.

We then analyzed the four questions related to how helpful was each component of the email, shown in Figure 1. The results of this analysis are also presented as percentage agreement, shown in Table 3. All components had high agreement among the student body as being helpful, with each component having nearly half of students rating each component as “very helpful”. This suggests that each component of the progress report is important, and that each serves a role that students appreciate or utilize.

After performing this general analysis, we shifted focus to the demographics of the student sample, as well as the difference between identities on the 11 questions covered more generally above.

5.0.1 Demographic Analysis (RQ2)

Student demographics were processed utilizing our categorization methodology, to facilitate identity based analysis, as shown in 4 for the total number of students identifying in each category. We specifically want to call attention to the lack of gender-diverse students in our sample, which is a clear limitation to our ability to analyze them meaningfully.

For gender based and intersectional analysis, we did not analyze Gender Diverse students in comparison to the rest of the student body, due to the low representation ($n=5 \sim 1\%$). Across the 11 tests and two genders, 22 statistical tests were utilized. Only one test showed significance,

where students who identify as Men agree less with “The progress report email helped me understand my progress in the course” than women or gender diverse students (3.29 vs. 3.46, $p=0.015$). This suggests that there is not significant difference in the experience of submission-based progress reportings benefits across the genders, outside of the fact that men agreed less that the progress report helped them understand their course progress.

For race based analysis, no groups were excluded due to a lack of representation. Across the 11 tests and four categories, 44 statistical tests were run. Again, only one returned significant results: Asian students agree more strongly with the statement “The progress report email helped reduce anxiety about my progress in the course.” than other student race groups (2.91 vs. 2.68, $p=0.022$). Outside of this single statistically significant difference, the other 43 tests returned non-significant results.

Intersectional analysis was performed in a similar manner to the gender and race based tests, except across every combination of identities. All other intersections were retained. Like the race tests, each group was compared to all other students, testing for significant differences. Across 11 questions and eight identities, 88 tests were utilized. Four of the tests had significant results, which we detail below.

The first test returning significance found that students who identify as white women agree less with the statement “The progress report email made me feel like the instructor cared.” than other groups (2.56 vs. 3.23, $p<0.01$). The second found that underrepresented women agree more with the statement “The progress report email helped me understand my progress in the course.” than other groups (3.59 vs. 3.32, $p=0.03$). It was also found that underrepresented women agree more with the statement “The progress report email helped me keep track of or catch up on late work.” than other groups (3.56 vs. 3.27, $p<0.01$). Finally, it was found that Asian men agree more with the statement “The progress report email helped reduce anxiety about my progress in the course.” than other groups (2.98 vs. 2.69, $p=0.02$).

6 Discussion

Our results provide clear answers to the two research questions guiding this work. For **RQ1**, students perceive progress reporting to be beneficial, helping them in the dimensions of motivation, time management, reflection on work habits and course progress as suggest by literature, and in dimensions of anxiety reduction, instructor care and keeping track of missing assignments suggested by our exploratory NGT sessions, with the anxiety reduction having less, yet still positive, agreement. Students also found each component to be helpful, with little suggesting any components of our progress reports were unhelpful.

For **RQ2**, out of 154 statistical tests run comparing student groups to others, as highlighted in the results section we only found that six had significant differences as $\alpha = 0.05$. While these differences are important and should be looked into in future research, we also want to reiterate that no correction was used to reduce the threshold for significance across the large set of hypotheses. There is a likelihood for rare things to occur in a set of hypotheses this large, and as such, these particular differences should be investigated more to determine if they are actual differences or simply anomalies found when performing a large number of statistical tests. The lack of differences found across these categories, however, is the primary contribution of this

work, as it suggests that this form of educational intervention does not support any gender or race based student significantly more than any other. While this is the null hypothesis, verifying that there is not any meaningful or plentiful differences reinforces this idea, and allows the educational community to have stronger support in the assumption that these practices impact students equally.

Additionally, this work is informed by student perceptions, as opposed to validated measures; future work could validate the results found here by utilizing more objective measures, to concretely say how this practice benefits students. Future work should also strive to include larger samples, especially in intersectional ways, such that student groups are not excluded due to sample size (Gender Diverse students), and that multiple identities do not need to be grouped for analysis (underrepresented and mixed folks).

Future work could expand on this by addressing the limitations noted above, while also expanding on the progress reports themselves. For example, subsequent work could investigate how including more metrics, such as grades, attendance, and resources in the progress reports could impact student perceptions, expanding on the basic progress report features here. As part of this, we plan to incorporate learning analytics and gamification, helping drive interest and engagement with the report to see if effects are increased as the content becomes more engaging or informative. We also plan to explore the impact in the context of frequency of delivery, determining if higher frequency reporting yields better results than lower frequency reporting. Finally, we would like to apply this tool to higher level classes, where students may have already developed the skills to manage their work, but may still appreciate the function of a progress report to remind them of their work and encourage them to move forward.

7 Conclusion

Our work presents the analysis of a submission-based progress reporting tool as a form of feedback to students implemented in an introductory CS course. We find that students have positive perceptions of the progress reports and their impacts in the context, based on the impacts defined in the literature and the impacts determined by our NGT analysis. Our findings also suggest that this practice in general does not advantage or disadvantage students across gender or race, suggesting that the utilization of progress reports may be fair to all students, but further work is needed to demonstrate this. This emphasizes that students appreciate and utilize the information we give them in more ways than we may expect, giving them a strong foundation for their future education. Overall, our results show that behavior-based feedback in general — and submission-based feedback specifically — can be a viable and valuable complement to knowledge-based feedback for our students.

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