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The Design and Successful Implementation of Anonymous, Informal, Mid-Semester Feedback for Improving Undergraduate Engineering Education

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The Design and Successful Implementation of Anonymous, Informal, Mid-semester Feedback for Improving Undergraduate Engineering Education

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Abstract

A recurring theme in teaching pedagogy is the value and importance of feedback as a means to improve learning experiences for students. Although many collegiate classrooms aim to use feedback as a structured, professional method to adapt and revamp courses, too often the major comments are not formally addressed until the end of the semester. This causes a major disconnect and time-delay in identifying, adjusting, and implementing any potential changes. The work presented herein discusses how to strengthen a course with the use of Anonymous Informal Mid-semester (AIM) feedback. By exploring how to design the questionnaire to maximize effectiveness, faculty can target specific aspects of their course to adapt for any given student cohort. This manuscript covers both classical research on questionnaire creation in addition to practical implementations that improve the quality of student responses. Furthermore, by generating a dialogue between learners and instructors, one can explain the pedagogical rationale behind specific decisions and further motivate students. This dialogue is propagated by summarizing general trends provided by AIM feedback and presenting them back to the class. The work concludes with analysis and examples of AIM feedback in multiple first-year electrical and computer engineering courses and how these improvements led to better knowledge retention and overall student satisfaction of the course.

Introduction

A cornerstone of modern day academia is the use of student feedback as a means of obtaining data. Students, being the recipients of the course content, have steadily continued to be involved in both course and faculty evaluation systems. A good deal of research has explored the benefits of these surveys as tools for continuous improvement. Rowley presents methods for constructing effective surveys [1]. Both Richardson and Mandouit descibe how one can use those results to improve the quality of teaching [2] [3]. Lastly, Watson covers how one can customize effective actions based on the specific comments [4]. However, numerous studies have discussed the potential problems with incorporating students (many of whom have no formal training in pedagogy or teaching) as

dominant factors in course structure, teaching styles, or even assessment style [5], [6], [7], [8]. In higher education, these results often have impacts beyond just course improvements, being used as additional documentation for faculty promotion or bonus considerations. This has led to a general feeling of skepticism or frustration at the end-of-semester evaluations [9], [10]. Furthermore, it has been well documented that higher scores on feedback forms do not necessarily correlate with student learning outcomes; factors such as race, gender, ethnicity or expected GPA all are features that introduce strong levels of bias on course ratings [11], [12], [13]. Recent works have even demonstrated that student likability of the course instructor could accurately predict evaluation results [14]. End-of-semester student feedback forms have evolved from a means of gauging the academic content to one of a consumer satisfaction model. As such, it behooves instructors to try and glean relevant information beyond just those obtained at the end of the course. General trends based on genuine student evaluations have a role to play in providing formative feedback for faculty.

As each cohort of students have different backgrounds, knowledge bases, and learning styles, simply waiting for the end of the course to reassess and re-evaluate course methods can lead to frustration amongst students. Researchers have explored using informal student feedback over a wide range of frequencies, ranging from daily [15] to upon completion of an undergraduate degree [16]. Responding to students' comments or making appropriate changes can lead to increased motivation, better learning, and potentially improved end-of-semester student ratings [17], [18]. The work presented herein is focused on running a specific type of feedback at the mid-semester point of a course. Specifically, the protocol for this type of student survey is one in which the student submits Anonymous Informal Mid-Semester (AIM) feedback. Each of these elements is crucial to maximize both the quality of responses, but also alleviate any potential stress students may feel when commenting on a course that still has assignments or grades in the future.

Each element of AIM feedback balances between the others to lead to a mutually beneficial result. Running AIM feedback at the midpoint of the semester helps mitigate the resurgence of revenge or reciprocity, both natural bi-products of nameless feedback. Allowing students to remain anonymous incentivizes students to offer honest thoughts, even if those include criticisms. Lastly, by enforcing an informal setting, students are not pressured by their responses, and the instructor can address them in a positive fashion.

The remainder of the work is structured as follows; first, specific examples of how to structure and design Anonymous, Informal, Mid-semester feedback forms are covered. Further discussion follows the logistic process of using AIM feedback in a constructive manner. Documented examples are cited and discussed. Following that, the next section discusses how lecturers should use the surveys to improve their class; specifically without compromising academic rigor in technical vocations. Some potential drawbacks are covered. AIM feedback was implemented across multiple semesters of first-year electrical engineering courses. The results are covered. Lastly, directions for future studies and explorations are addressed.

Structuring Anonymous, Informal, Mid-semester Feedback Evaluation Forms

Anonymous, Informal, Mid-semester feedback is an additional tool to give instructors and learners information on how the course is going and specific changes that can be implemented to build a

better learning environment. Students' willingness to meaningfully participate in teaching evaluations is affected by their expectation that they will be able to provide feedback that makes a genuine change to the course [5].

Course evaluations and improvements are a continuous process, and receiving specific details on improvements are more helpful than general student statements (e.g. 'I liked the course,' 'this course was boring,' etc.) As such, student evaluation forms that are short and answer only open-ended questions, (e.g. "What is being done well in the course?" or "What would you change about the class?" etc.) have been shown to be the least effective in improving courses [19] due to their vague or tangential relevance. Lecturers are those with the pedagogical experience, and often student responses focus on logistical complaints (e.g. the quality of the room, difficulty/length of homework, handwriting, etc.) that are relatively useless or impossible to change [20], [21]. While they can provide anecdotal information or general trends, these on their own are insufficient in receiving high-quality data for faculty to adjust a course in the middle of a semester. Therefore, it is crucial to balance out open-ended questions with precise, targeted ones designed by the proctor.

Different courses (whether they be a traditional lecture based class, a flipped classroom model, hands-on laboratory experiment, etc.) all have specific nuances and structure imposed within them. As such, AIM feedback can be specifically designed to ask questions about these implementations in a quantitative manner. These also allow for direct statistical analysis (mean, standard deviations) that can also be used to relay the results back to the class.

The extensive work on survey design in academia ([22], [23]) can be helpful in constructing a set of questions that not only are meaningful to individual course structures but also specific enough to allow for meaningful, rapid action. One key analysis of the failures of student feedback questionnaires on student learning outcomes demonstrates that one major potential pitfall is that survey questions "may have lacked flexibility and appropriate focus" [21]. AIM feedback allows for targeted, specific questions based on the specific course. This may involve probing students for a numerical response on some scale about specific aspects of the semester. This can also allow for self-reflection by the students, for example, asking if quizzes are helpful for reinforcing their own knowledge. Structuring the feedback in this fashion can give instructors valuable insights on student learning outcomes that would otherwise be unavailable, especially during end-of-semester surveys.

For open-ended style questions, it is beneficial to explore various levels in Bloom's taxonomy. Rather than simply asking to recall individual strengths or weaknesses of the course (which simply involves remembering specific moments), it may be better to ask sets of questions about topics in the course, for example, sequencing a question recalling a certain topic with one asking about a memorable aspect of that lecture or if the homework/quiz corresponding to that topic was helpful to reinforce their learning.

The length of these feedback forms is also imperative to the quality of the responses. AIM feedback should be specifically targeted to be completed in 5-10 minutes; ideally during time allocated in the classroom environment. Researchers have mixed conclusions about the ideal number of questions and structure ([24], [25]) and studies have often included short, medium, and long survey lengths. Our experiences have qualitatively found that it is important to minimize student friction to complete the form, so making it shorter (9-15 questions) and handing out hard copies

directly are important to guarantee honest, informative feedback with as few complications as possible. Furthermore, by disconnecting the grade in the course with the form, and allocating class time to complete it, students have every incentive to provide genuine answers.

Lastly, lecturers who implement AIM feedback should be open-minded. One should be willing to respond to the comments on the forms. Since these questions should be specific, faculty must be prepared to handle criticism on those specific aspects. If certain elements of the class are inflexible, it is suggested that faculty avoid asking questions about them.

Incorporating Anonymous, Informal, Mid-semester Feedback in the Collegiate Classroom

There are several logistical implementations that should be considered by any instructor seeking to include AIM feedback as a means to supplement their course.

The first is that the privacy concerns of any student should be held paramount. A common misconception that can exist is the feeling of bias from faculty. As such, students may feel like any pessimistic analysis of the course may lead to retaliation by the instructor if not guaranteed anonymity. It is important to balance confidentiality with incentives to get sufficient meaningful responses. One method to do so is to correlate a supplemental component of student performance, such as a quiz or attendance just before the AIM feedback with a recorded grade. Students are rewarded for participating, not for their statements. This can be a double-edged sword, as students may not offer genuine responses if their participation points were already obtained. Our experiences have found this to be the minority; students very often want to have an impact on their own education. To go one step further, it is straightforward to have a large folder or box at the front of the classroom in which students can submit their forms to add another layer of anonymity to the process.

Furthermore, it is useful to ensure that student comments should be informal. Having an unofficial method of students providing relevant feedback in a casual setting lessens the burden on the students and demonstrates a desire from instructors to take their comments into consideration in a meaningful way. This too, has some potential issues, most notably that it might lead to a lack of professionalism in the classroom if handled poorly.

Another major hurdle that must be kept in mind with the implementation of AIM feedback is to ensure that a majority of the students offer genuine and honest commentary on the class. The easiest way to overcome this is to run the survey in-person (when able) and allocate time in the lecture to do so. In order to continue a relaxed setting, the faculty member should also ensure that they are not impacting the results by looking over students as they complete the form, or looking at results prior to everything being collected.

The final, but arguably most important aspect of implementing Anonymous, Informal, Mid-semester feedback is presenting the results of the survey and constructing a response to the students. One should look through both the quantitative and open-ended questions and organize the relevant trends in a visual format. The next section then discusses how lecturers should describe what differences will occur or offer a positive explanation as to why certain pedagogical choices were made. It is also important to be honest about what complaints cannot be changed, but to

emphasize it in a positive light. This way, the learners remain a part of the conversation and can experience a perspective that they may not have understood.

The process of assessing and evaluating student feedback is also crucial. While numerical analysis can be fairly straightforward (e.g. calculating the mean, median, and standard deviation) parsing the longer answers requires care and scrutiny. Common patterns should be noted, especially on what is positive in the course. Constructive commentary is most likely to be accurate and representative of instructor strengths [26]. Furthermore, when seeking out specific criticisms, lecturers should focus on general trends that can be improved upon.

Potential Detriments of Anonymous, Informal, Mid-semester Feedback

While many of the possible advantages to AIM feedback are discussed, AIM feedback is prone to the same sort of negative effects as end-of-semester surveys.

Organizing and planning AIM feedback within a specific course requires some forethought. AIM feedback, much like any student-centric assessment, is prone to bias [27]. AIM feedback in particular can be influenced by recent events. Student responses may vary wildly based on the lecture immediately prior to the survey, or if the most recent homework or exam was too difficult. While this can be somewhat mitigated (by allocating certain questions to those assignments) any negative sentiment may bleed into the open-ended questions and lead to overall negative commentary.

Much like end-of-semester surveys, there might be a series of topics brought up by students that are tangential or irrelevant to the course at hand. As opposed to professors, students are not experts in their field nor in pedagogy, yet many will make comments that are directly contrarian to evidence-based best practices. One such example would be disliking active learning mechanisms, even though it's been shown to enhance learning and reduce failure rates [28].

In addition, a small but non-negligible percentage of students make take this opportunity to make offensive or unprofessional statements using the guise of anonymity as a shield against potential repercussions [29]. Students are expected to follow their respective codes of conduct, but bad actors may lash out if they are frustrated about their grades or workload. Academics should be prepared to handle abusive or unprofessional comments. These should be largely ignored, but may lead to poor mental health. Extreme cases may lead to reaching out to administration which would be detrimental to everyone involved.

Lastly, due to a need for rapid analysis and response of the submitted works, it does accrue an additional time and energy cost by faculty. Instructors need to be able to process the results, and possibly change multiple weeks of content as a way of coordinating with the student responses.

Case Study: Survey Results in 1st year Electrical Engineering Courses

Over the course of two semesters starting in Fall 2023, first year STEM students (primarily those in Electrical or Computer Engineering) participated in Anonymous, Informal, Mid-semester feedback assessments at Johns Hopkins University. Approximately 120 students participated over this time window. The structure of each of the courses was one in which there were weekly quizzes

worth a small percentage of the overall grade (utilizing the benefits of High-Frequency, Low-States assignments [30]). High-Frequency, Low-States assignments are a type of formative assessment that has a minimal effect on course grades. Their ongoing use (in this case, weekly) combined with rapid grading (quizzes were done on Fridays and returned by the following lecture on Monday) allow for both students and faculty to monitor student performances and learning objectives over the course of the semester. Application of Anonymous, Informal, Mid-semester feedback was as follows. First, students were asked to sign an attendance sheet. They were told that their signature was the participation for the quiz of the week, and that the completion of the 10-question feedback form (which was printed out and provided to them) was used solely to improve the quality of the class. The questions were a mix between rating on a scale (e.g. "On a scale from 1 to 5, with 1 being too slow and 5 being too fast, the pace of the content being presented in class is..." or "The weekly quizzes are helpful to reinforce my learning, with 1 indicating useless to 5, indicating they are very helpful") and open-ended questions (e.g. "What aspects of the class are most beneficial?"). Students were given 10 minutes in class to complete the form, and were told multiple times that their anonymity was guaranteed. To that end, students were instructed not to put their names on the forms and upon completion to insert it randomly into a large folder. Students with concerns about handwriting were told to print their results, or complete only the rated portion. Students were explicitly told about the reasons for the surveys and given all opportunities to abstain from the study if they did not consent to providing such feedback.

As a means of measuring student retention and satisfaction, a second informal set of feedback questions were given at the end of the course. These questions were identical to the first form and students were instructed to focus on the second half of the semester for their feedback. The statistics were then compared with the AIM feedback. A subset of the results can be seen in Tables 1 and 2

Table 1: AIM vs. End of Semester Feedback for Class 1 (Fall 2023). 51 students participated.

Question	Class 1: AIM Results	Class 1: End of Semester Results
Pace of Content (1=slow, 5=fast)	3.81	3.4
Examples have helped my understanding (1=Not at All, 5=Very Much)	4.88	4.87
The quizzes are (1=Too Easy, 5=Too hard)	3.35	3.06
The quizzes are helpful to reinforce my learning (1=Useless, 5=Very Helpful)	4.72	4.86
The homework assignments are helpful to my understanding (1=Useless, 5=Very Helpful)	3.93	4.14
What aspects of the course are beneficial?	-	-
What would you change about the class?	-	-

As a means of better characterizing the effect of AIM feedback, Class 2 was given two additional questions at the end of the semester specifically asking if AIM feedback improved the course (logistics, quality of content/in-class examples, etc.) and whether AIM feedback improved student learning. Both groups were given two open-ended questions. While the numerical results do not appear in the tables above, specific numbers of positive and negative comments were noted. Spe-

Table 2: AIM vs. End of Semester Feedback for Class 2 (Spring 2023). 46 students participated

Question	Class 2: AIM Results	Class 2: End of Semester Results
Pace of Content (1=slow, 5=fast)	3.72	3.21
Examples have helped my understanding (1=Not at All, 5=Very Much)	4.91	4.87
The quizzes are (1=Too Easy, 5=Too hard)	3.25	3.10
The quizzes are helpful to reinforce my learning (1=Useless, 5=Very Helpful)	4.73	4.73
The homework assignments are helpful to my understanding (1=Useless, 5=Very Helpful)	4.40	4.73
Student AIM feedback improved the course (1=Not at All, 5=Very Much)	-	4.8
Student AIM feedback improved my learning (1=Not at All, 5=Very Much)	-	4.3
What aspects of the course are beneficial?	-	-
What would you change about the class?	-	-

cific trends were observed, mixed between unchangeable logistics (the classroom and the lecture recording mechanisms), and constructive criticism on the length of the homework assignments. Students also requested more examples in class to assist their learning.

In general, the trends at the end-of-semester showed dedicated improvement over the AIM results. Faculty said that the student responses guided their lecture style, most notably slowing down the pace of the content and adding more example problems. A recurring theme for the first set of AIM forms were quotes such as ”The pace is a bit too fast.” This aligns with the student responses in Class 2, noting that their feedback on the lecture pace and problems directly lead to improving the course and subsequently their own learning.

Other common concerns were that the ”HW is too tedious” or ”Homework takes too long.” Rather than just shorten homework assignments, the associated faculty member was able to have a straightforward conversation with students about why the assignments felt tedious (”The students should be exposed to the tediousness of the underlying problem so that when presented with state-of-the-art algorithms, they get a feel for the intuition behind how they were designed.”)

There is still further analysis that can be done with this data. Specifically, it would be beneficial to explore how it compares to a normal distribution or to set up controls to validate such results. These are topics for further work.

Conclusions

The work presented herein described the nature of incorporating AIM feedback into collegiate classrooms. As long as instructors are proactive in the implementation of AIM feedback and are aware of potential risks, the resulting rewards can be beneficial to learners along an axis that few other pedagogical methods can approach. Specifically, one can adapt in real-time to each different cohort of students and their diverse set of backgrounds, experiences, and prior knowledge.

Weaving in these methods can have lasting positive effects on course pedagogy, student learning and more with little up-front work. Each new cohort of learners is unique, with a wide variety of different experiences, skills, and base knowledge. Anonymous, Informal, Mid-semester feedback allows for faculty to tune existing lectures, modules, or projects to emphasize targeted student learning outcomes.

Future studies will include more detailed implementations of some of the topics and try to further correlate to what extent AIM feedback directly affects student learning outcomes. In addition, work will explore applying this beyond just the engineering school and will document the successes and failures. In addition, a more detailed analysis and data-collection method for quantitative measuring of AIM feedback and potential benefits will be explored. Furthermore, comparisons to student evaluations (held through the university) could provide further comparison points.

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