Real-Time Smart Feedback System for Effective Course Evaluation

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1   Abstract

The collection of formative feedback from students in the classroom contributes significantly to learning and teaching excellence as well as students' success in higher education. The feedback obtained from course evaluations are multipurpose and are typically used to improve the content and pedagogy of the courses. The traditional, end-of-the-semester course evaluation system that exists in universities, colleges, and educational institutions, although they provide the necessary summative feedback, is not free of flaws; namely that it is usually performed once per semester, is complex in nature, and any improvement resulting from it is not applicable to its related semester. In this work, we propose an anonymized course evaluation system that allows students to submit their feedback at any point in the semester. The collection of this continuous feedback can result in appropriate modification to the course material and method of delivery to the students, benefitting the current and future students of the course. A survey of over 40 students was conducted to confirm the simple and effective nature of the proposed system. Over 75% of students who participated in the survey concurred that the system was easy to use, that it was not distractive, and that communication with the instructor could be strengthened whilst using the system.

2   Introduction

Teaching and learning, which both contribute to student success, are important topics in higher education. Improving teaching or learning can be done by investigating and implementing existing tools, or by developing new tools. Some tools are feedback- or evaluation-centered, such as Just-in-Time Teaching (JiTT) [1], holistic student success platforms such as Navigate [2] or Avisio [3], and traditional end-of-semester course evaluation system. In feedback- or evaluation-centered tools instructors receive feedback as a combination of students' answers to instructor set questions, comments on an evaluation sheet, or a score calculated by the evaluation system. Instructors can use this feedback to evaluate the course, make adjustments to the course, and improve their teaching. Other tools focus on the reinforcement of concepts taught in class, such as the traditional peer tutoring, facilitated study groups, or embedded tutors. Reinforcement tools are helpful to students giving them valuable support to succeed in their courses, however, reinforcement tools do not typically provide *instructors* with the feedback they need to help students. Instructors are usually not involved in the tutoring process; therefore, instructors may not be aware that students are struggling, or on which topics they require assistance.

Our work is feedback- and evaluation-centered. To improve instructor teaching and student learning, the proposed system focuses on *continuous* evaluation by gathering feedback throughout the semester and not just once at the end as performed in the tradition course

evaluation system. In universities the scores and feedback from the traditional course evaluations are typically used to help instructors to improve the course content and pedagogy, and to help in the overall improvement in curriculum. However, the traditional end-of-semester course evaluation can have some weaknesses: evaluation is done too infrequently, the response rate can be low, the questions may not be clear to students, and the calculated scores may be presented in an unclear way to instructors.

The Real-Time Smart Feedback System for Effective Course Evaluation (RT-Eval) being developed is an anonymous course evaluation system that continually evaluates the course throughout the semester using simple student and instructor interfaces, unique evaluation models, and incentivization techniques to encourage student participation. Therefore, RT-Eval seeks to mitigate the weaknesses of the traditional end-of-semester evaluation by evaluating the course more frequently, incentivizing students to leave feedback, presenting a clear and simple feedback collection interface to students, and presenting relevant information to instructors.

3   Feedback- and evaluation- centered tools

Since RT-Eval is feedback- and evaluation-centered, this Section focuses more specifically on summarizing other feedback- or evaluation-centered tools.

Traditional course evaluation

Most universities use the traditional end-of-semester course evaluation. It should be noted that the traditional evaluations may be repeated more than once during the semester, but these evaluations are usually given only once at the end. While traditional course evaluations are very useful to instructors, the traditional end-of-semester evaluations typically have the following characteristics:

- Assesses once at the end of the semester, therefore, any changes made to the course based on the feedback would not have helped the students who have just completed the course and may not be applicable to future student taking the same course.

- May have a low response rate. The average response rate at Wentworth Institute of Technology was low in the previous academic year. Figure 1 shows the response rates for three instructors over four semesters from Summer 2020 to Summer 2021. As seen in Figure 1, the response rate varies among different instructors where some instructors have a high response rate and others having a lower response rate. The response rate can even vary from semester to semester for the same instructor. Instructors at our university typically teach three courses per semester resulting in approximately 12 datapoints over the four-semester period (Figure 1). In the graph, for each instructor, the last three datapoints represents the percentage of students who complete the course evaluation for the three courses taught in Summer 2021. The previous three datapoints are for Spring 2021, etc. As seen, the response rate varies among instructors and can even vary from semester to semester for the same instructor with the lowest rate being 15% for Instructor 2 in a course in Summer 2021. Low response rates are undesirable since instructors depend on feedback to adjust their teaching style and course material.
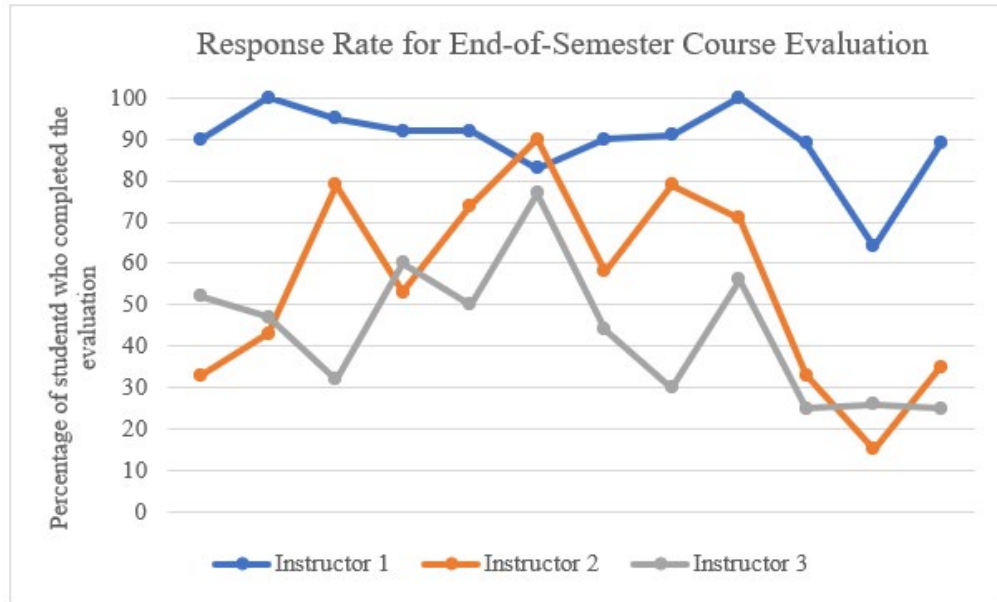
Figure 1 The response rate for three instructors over a four-semester period.

- May present unclear questions to students and the numerical results presented may be difficult for the instructors to interpret.

- May capture only a snapshot of the course since the evaluation is given once at the end of the semester. Students may not reflect on the entire course when doing the evaluation. Additionally, the evaluation is usually given at a stressful time in the semester.

Just-in-Time Teaching

Just-in-Time Teaching (JiTT) [1], is a technique where instructors use student responses to pre-lecture activities to tailor the upcoming lecture sessions to meet the needs of the students. Typical pre-lecture activities include short written response activities where students must analyze problems or written text, mathematical computations, or multiple-choice questions. JiTT is similar to our proposed system in that both systems provide instructors with the information needed to tailor content and lecture sessions to the students' needs during the semester. A popular variation of JiTT is pairing competency-based learning with a flipped classroom. With this combination students unlock assignments by completing online activities and the instructor also uses the current state of the class – for example, the number of students successfully completing the online activities – to determine which problems are emphasized in the upcoming session. The disadvantage of JiTT and its variations is that instructors must spend a long time preparing and grading the pre-lecture and online activities. Some instructors are unwilling to spend this additional time beyond the typical course preparation. RT-Eval requires no additional preparation since the questions and responses are built into the system. Additionally, JiTT may not match the teaching style for some instructors. RT-Eval works for both the traditional lecture style as well as for courses which use JiTT and its variations; in all cases, our system will provide the real-time feedback during the session.

4   The real-time smart feedback system for effective course evaluation (RT-Eval)

RT-Eval continuously gathers feedback from students throughout the semester. The goal of continuous evaluation or assessment is to systematically collect "information about student learning, using the time, knowledge, expertise, and resources available, in order to inform decisions that affect student learning" [4], [6], [7]. Therefore, teaching and learning could improve by gathering timely and actionable feedback from students through continuous formative evaluation for faculty throughout the semester using anonymized student input, providing responsive instruction, and addressing the learning needs of the students during the semester [5], [8] using a system like RT-Eval.

Characteristics of RT-Eval

The main characteristics of RT-Eval were developed based on the characteristics of the traditional course evaluation system that we are seeking to improve (Section 3):

- RT-Eval will be used throughout the semester. Instructors can choose to adjust their content and delivery as issues, such as students struggling with a current topic, are identified. Therefore, adjustments made benefit the current students in the course.

- RT-Eval will use incentivization where the students in the class work towards a common goal of unlocking bonus points at the end of the semester. Through incentivization, RT-Eval may improve the response rate. An improved response rate means more feedback is gathered from students. With an increased amount of feedback, it is more likely that any issues that occur will be identified early.

- RT-Eval presents a simple interface to the students and clear results to the instructors which can be easily interpreted at-a-glance.

- RT-Eval will collect data more frequently (per lecture), cf. the traditional evaluation, giving us more datapoints spread throughout the semester. This data can be used to address issues as they arise during the semester. The data can also be used to look for trends, and to trigger automated messages that help instructors improve their teaching and students improve their learning.

RT-Eval components

This Section summarizes the components needed to attain the characteristics identified above.

- Student interface – RT-Eval allows students to enter real-time anonymous feedback, as often as they would like, during every lecture session using the student interface shown in Figure 2. To leave feedback, students enter ratings by selecting the appropriate emoji, then select the item being rated, for example, the current topic, denoted by the Topic icon. Students may also, optionally, leave an open-ended comment.

- Database and security – students' real-time feedback is anonymized, encrypted and stored in the database. This feedback is used to determine the overall mood of the class, generate reports, and generate automated messages to students and instructors.

Class Reward Progress dashboard showing an individual student's participation, the number of students in the class who participated, and a status bar indicating overall progress towards unlocking the end-of-semester bonus.

Students enter their rating using emoji.

Students select the item they are rating using the icons.

Students may leave additional open-ended comments.

Figure 2 The student interface.

- Instructor interface and algorithms to determine overall mood – the instructor interface allows instructors to monitor the overall mood of the class. The feedback entered by the students are input into several algorithms that determine the overall mood of the class in real-time; this information is displayed on the instructor interface. For example, based on the student feedback and algorithm, the instructor interface may indicate that 95% of students are excited about the current topic, or 50% of students are anxious/confused. As more feedback is entered during the session, the overall mood of the class may change. The course instructor can monitor the overall mood of the class during the lecture and can immediately pivot their teaching to address issues as they arise.

- Smart reports – RT-Eval creates reports for instructors and administrators that are simple to read and easy to interpret. Along with the ability to monitor the overall mood of the class during sessions, instructors can also generate reports that show the overall ratings and feedback over previous time periods, for example, an instructor may want to view feedback over the last month. RT-Eval also presents reports to Deans and the Provost allowing them to assess the overall student well-being of their School or University, an important metric in student success.

- Automated messages to students and instructors – the feedback gathered during lectures is also analyzed for trends and can trigger automated messages to instructors or students. Instructors receive messages about possible ways to improve teaching, for example, if the overall mood of the class is anxious/confused, the instructor would receive a message suggesting that the instructor presents more examples in the topic. Students receive messages about reflecting on the course and improving their learning techniques. For example, if RT-Eval determines that a particular student's rating for understanding of a topic was consistently low, the system would suggest a meeting with the instructor or a tutoring session. If the student's rating for understanding the topic then increases, the

system would send an automated message prompting the student to reflect on what they did to improve and encouraging them to try the same technique in the future.

- Rewards system for incentivization – RT-Eval allows students to work together to unlock rewards at the end of the semester based on the amount of feedback submitted. This rewards component will encourage a high participation rate among students. Students can check their participation and the overall participation of the class in the Class Reward Progress dashboard on the student interface (Figure 2).

5   Experiment and results

Experimental setup

A prototype system was created with a student interface (Figure 2) and a database to collect the feedback from the students. The prototype system was used by 44 students during a full 1- hour lecture session in three Sections of a Sophomore level course. Before the experiment, students were asked if they were willing to use the system, and it was explained to the students that the purpose of the system was to allow them to submit anonymous feedback at any point during a lecture session. Once they consented to using the system, students were instructed on how to access the system using their laptops, how to create an account, and how to enter feedback.

Students were allowed to create an account in the prototype system where they chose a random identifier to be associated with their responses. Students were instructed not to use their name, school ID number, or any other identifier that would allow the instructor to associate the feedback in the database with a particular student so that feedback would be anonymized. It should be noted that this simple anonymization was used for the prototype system only, and that full anonymization and encryption will be implemented in the actual system.

After the account was created, the students were asked to enter at least two sets of feedback at any point during the lecture period, however, they were told that they can leave as much feedback as they wanted. Finally, the 44 students who tested the prototype system were asked to take a survey based on their experience with the prototype and with the traditional end-of-semester currently used at our university (survey questions are included in the Supplemental Material).

Results and analysis

The results of the test run of the prototype system along with the survey, show that three of the characteristics listed in Section 0 are be fulfilled by RT-Eval (1) identify content and delivery issues early, (2) improve the response rate, and (3) present an evaluation interface that is clear to students and easy to use. It should be noted that since the prototype is not the complete system, all characteristics cannot be demonstrated at this point. Note: questions listed below are summarized, the full questions can be found in the Supplemental Material.

1) Identify content and delivery issues early

The following survey questions were used to evaluate the RT-Eval prototype for this section:
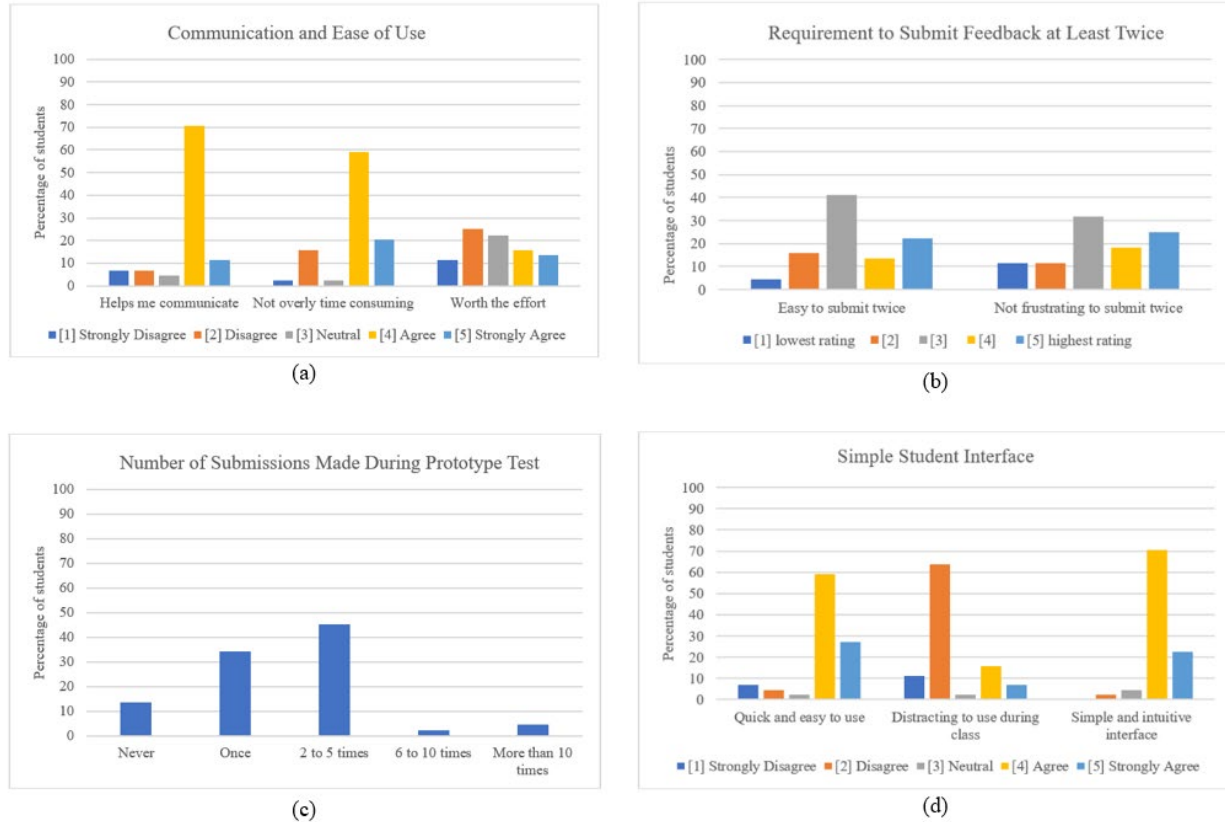
Figure 3 The summarized results of the survey taken by 44 Sophomore-level students.

- Question 4: [RT-Eval] will really help me communicate with my instructor. Scale used: 1 - strongly disagree to 5 - strongly agree.

- Question 12: In the trial run today, giving feedback was not overly time consuming. Scale used: 1 - strongly disagree to 5 - strongly agree.

- Question 9: Rate the required frequency of use of at least two times per lecture on a scale of 1 to 5. In this case a 5 represents that the students strongly agree that it is worth the effort.

The results in Figure 3(a) show that 82% of respondents believed that the system enhanced communication between the instructor and students, and 80% of respondents reported that RT-Eval was quick and easy to use. Therefore, RT-Eval could help students communicate with their instructor, and in turn, instructors can use this information to identify and address issues as they arise. As issues are identified, instructors can make adjustment to content and delivery to meet student needs. Fig 3(a) also shows that 30% of students agree that using the system is worth the effort while 22% are neutral. It should be noted that these students participated in a trial run of the prototype system. In this short 1-hour trial students could not evaluate the full effect of the system, i.e., as they continue to leave feedback throughout the semester, the instructor will likely tailor the course based on the feedback. When the full system is used students would see that their daily feedback could influence instructors to make adjustments in the course and may find the system more worthwhile.

2) Improve the response rate, or gather feedback from more students

The following survey questions were used to evaluate the RT-Eval prototype for this section:

- Question 6: Rate the required frequency of use of at least 2 times per lecture on a scale of 1 to 5 - a rating of 5 represents that the student strongly agrees that it was easy to submit at least twice.

- Question 8: Rate the required frequency of use of at least 2 times per lecture on a scale of 1 to 5 - a rating of 5 represents that the student strongly agrees that it was not frustrating to submit at least twice.

- Question 10: In the trial run today, how many times did you submit feedback?

With a quick and simple to use system and student interface, students are more likely to submit feedback during the lecture. With an increased amount of feedback, it is more likely that any issues will be identified early. From the results in Figure 3(b) we can conclude that the target frequency of use was easily achievable and not burdening the classroom experience. Most respondents (77%) agreed that the required frequency of use per lecture, two submissions, was an easily achievable goal for each person. Of those same respondents, 75% also agreed that the required frequency of use per lecture was not frustrating to complete.

However, when asked how many times they had participated in the RT-Eval system during the trial run in Question 10 (Figure 3(c)), only 50% had submitted at least two feedbacks per lecture. This indicates a small disconnect between people who responded stating the goal of two feedback submissions per lecture is easily achievable, and people who had actually submitted twice throughout the lecture. This can be attributed to the lack of familiarity with using the platform during lectures and can possibly skew upwards with more frequent use during lecture.

3) Present an evaluation interface that is clear to students and easy to use

The following survey questions were used to evaluate the RT-Eval prototype for this section:

- Question 2: The Real-Time System was quick and easy to use. Scale used: 1 - strongly disagree to 5 - strongly agree.

- Question 3: [RT-Eval] was distracting to use during class. Scale used: 1 - strongly disagree to 5 - strongly agree.

- Question 11: The interface is simple and intuitive to use. Scale used: 1 - strongly disagree to 5 - strongly agree.

Based on Figure 3(d), it is confident to presume the RT-Eval student interface is simple, quick to navigate, and easy to comprehend. According to the survey, 86% of respondents agreed the real time feedback submission was quick and easy to use while 93% also concluded that the interface used to submit feedback was simple and intuitive to use. The majority of students also found that the interface and system was not distracting.

6 Conclusion

This paper presented an overview of the Real-Time Smart Feedback System for Effective Course Evaluation (RT-Eval) which allows students to continuously submit anonymous feedback throughout the semester. Using our proposed system instructors can use the feedback submitted by students in each lecture to identify any issues that arise during the semester, adjusting the course to meet the needs of the students. This is unlike the traditional system where the feedback is received too late to help the students currently in the course. To improve the response rate in RT-Eval vs the traditional system, RT-Eval will contain an incentivization component where users are encouraged to leave feedback to unlock bonus points at the end of the semester. Using a prototype system and a survey tool, this paper shows that students agree that RT-Eval is simple and intuitive to use and could help students easily communicate with their instructor.

7 Acknowledgement

8 References

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