Combining Take-Home and In-Person Exams to Improve Student Performance and Improve Instructor Grading Efficiency

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1 Abstract

This paper presents a methodology to evaluate students' performance by combining take-home exams with in-person exams. In-person exams are usually timed, closed-book exams that are stressful for students. Take-home exams give students more flexibility and a less stressful exam experience, however, these exams are problematic since they offer students an easier opportunity to collaborate with other students. In order to minimize the temptation to collaborate with others, the instructor in this study combined a take-home exam with an in-person exam. Students were aware that they were not allowed to collaborate during the take-home exam, and that there would be an in-class assessment where they must demonstrate that they understand the material on the take-home exam by answering similar questions. Results of this study show that this method increases students' overall performance in the exams. This methodology also reduces the number of exam collaborations in the take-home exams, and this method can be applied to both programming classes and traditional lecture classes.

2 Introduction

Summative assessments, such as course exams, are important tools in higher education. These exams help instructors evaluate their students' performance and help instructors determine whether their students are meeting the learning outcomes, Summative exams also motivate students to master the subject matter since the students know that they are being assessed. Traditionally, course exams have been in-person, closed-book, and strictly-timed assessments designed to be completed in a one- to two-hour session. One alternative that has been growing in popularity, the take-home exam, relaxes the restrictions of the in-person exam by allowing students to use notes and other resources, and by extending the exam timetime to several hours or even days. Because of this, take-home exams can be less stressful for students, however, these exams can also create more opportunities for academic misconduct, particularly through prohibited collaboration.

This paper uses a hybrid-exam consisting of a take-home portion of the exam followed by an in-person portion. The take-home portion is opened-book where students are allowed to consult their course notes, however, students are not allowed to collaborate or communicate with anyone. The in-person portion contains questions similar to the take-home portion, is closed-book, and takes place during a lecture or lab session with the instructor. The in-person portion is used by the instructor to assess the student as well as to determine whether the student engaged

in academic misconduct – if a student cannot answer a question in-person when that question is similar to a take-home question, it is likely that the student did not do their own work on the take-home exam.

This study used two versions of the in-person exam. One version is the more traditional in-person exam where students are given a question paper and they fill in their answers. The second version is more applicable to programming courses; in this case students participated in a live-coding exam where they had to produce code, modify code, or answer questions about given code. Both variations have the advantages listed above, but the live-coding exam has an additional advantage, it helps the instructor effectively evaluate a student's thought process making it easier to evaluate their code and exams.

The hybrid method therefore benefits both students and instructors by combining the advantages of both methods. Students have more time and flexibility to work on exams and are able to review their notes during an exam in the take-home portion. Instructors are able to truly evaluate students' performance and potentially find any academic misconduct by comparing students' scores on their in-person and take-home exams. It should be noted that cases of academic misconduct can be reduced with the hybrid method since students are aware that they would need to prove their work submitted on the take-home portion by answering similar questions on the in-person portion. The results show that this hybrid-exam is effective in improving students' performance when comparing the hybrid method with the regular in-person exam.

3 Summative course exams

This section presents some background information on summative assessments, their role in higher-education, and different methodologies.

The need for summative course exams

Summative exams evaluate students across several topics in a course; these are typically course exams, midterm exams, or final exams. While these exams can be stressful for many students, most instructors at universities still give them since they help with evaluation and help with student learning. Exams allow instructors to gauge whether students understand the material and whether the learning outcomes of the course are being met. If the exam is earlier in the semester, for example a midterm exam vs. a final exam, the students' performance on the exam can also signal to the instructor any key topics that need more attention before moving on to other topics in the course. Exams also motivate students to study [1] and to learn. Several studies [2], [3], [4] have shown that when students prepare for, and then take an exam, particularly an in-person exam, their learning can improve. The exam preparation helps students practice skills and knowing that there is an upcoming exam forces retention.

In-person exams vs take-home exams

An in-person exam is typically a closed-book, and strictly-timed assessments designed to be completed in a one to two-hour session. Some advantages of the in-person exam are that studies have shown that they improve student learning and retention [2], [3], [4], and that they are closely supervised which decreases the chance of academic misconduct. A major disadvantage of these exams is that they can be very stressful for students.

Conversely, take home exams are opened-book exams that are taken over a longer period, for example, students may have several days to prepare and submit their answers. The advantages of take-home exams are a less stressful environment and that students have more time to fully prepare and process their knowledge. Additionally, the longer period can allow instructors to evaluate the higher-level taxonomy, such as design and synthesis, since students have more time to complete the exam questions [5]. The major disadvantage is the increased opportunity to engage in academic misconduct. In this case, academic misconduct could include working on the exam with other classmates (collaboration), asking classmates for help, engaging third parties to take the exam for them, or posting problems in popular homework help websites [6].

4 The hybrid exam: combining take-home exams with in-person exams

Take-home exams are not a new phenomenon, a study on take-home exams vs in-person exams in 1984 [7] proved that take-home exams were already becoming more commonplace at universities in the early Eighties. Take-home exams have been growing in popularity once again with the introduction of online degrees, and certainly during the recent pandemic. As universities transition back to either fully in-person or hybrid learning, we once again have the option of in-person exams. Instead of abandoning the take-home exams used over the pandemic, this study combines the take-home and in-person exams as a way to improve student performance on exams, decrease student academic misconduct, and to provide a method of effective evaluation for the faculty.

The hybrid exam has two parts:

- A take-home portion where students have days to complete the exam while consulting their notes. Students are aware that they are not allowed to collaborate or communicate with anyone during this exam.

- An in-person portion where students will answer questions that are similar to the take-home questions during a lecture or lab session. The in-person exam is done after the take-home exam. The in-person portion can be done as a more traditional written exam, or as a practical exam depending on the course. An example of a practical exam would be a live-coding exam for a programming course as used in this study. In this case students participated in a live-coding exam where they had to produce code, modify code, or answer questions about given code in as session with their instructor.

Combining take-home and in-person exams allows us to combine the benefits of both methods, therefore, the hybrid exam methodology used in this study has the following characteristics:

- A less stressful exam experience – the take-home portion of the has been shown to be less stressful for students. Because students know that the in-person questions are closely related to the take-home questions, they are likely to be more relaxed in the in-person portion of the exam as well.

- Can improve student performance in exams – students can use their notes and course resources to help them do well on the take-home portion of the exam. In turn, the take-

home portion of the exam helps students to prepare for the in-person portion of the exam, therefore, student performance could be increased.

- Can evaluate across various levels of the learning objective taxonomy – higher-level learning, such as design and synthesis, can be evaluated on the take-home exam, while lower levels can be evaluated on both the take-home and in-person exams.

- Reduces the likelihood of academic misconduct – since students know that they will need to answer question in-person that are related to their take-home questions, they may be less likely to obtain their answers from other sources.

- Allows instructors to efficiently grade practical in-person questions – for example, in the live-coding exam where students demonstrate their work in person, instructors can fully understand students' thinking process and efficiently grade students' exams.

- Detect potential academic misconduct – if a student is struggling to answer an in-person question similar to a take-home question that was answered correctly, there is a possibility that academic misconduct occurred on the take-home portion. In a case like this, instructors can ask more question to determine why the student is having difficulty.

5 Experiment and results

Methodology

In this proposed hybrid method, students must complete a take-home and in-person exams. Students received a day or more to complete and submit their take-home exam. The take-home exam is an opened-book exam and students were allowed to consult their course notes. However, students were not allowed to collaborate or seek help from anyone. The in-person exam occurs within a week from the deadline of the take-home exam. The in-person exam is a closed-book exam and students have to complete their exam within the time limit. Questions in the in-person exams are similar to the questions in take-home exams. Questions in take-home exams include several topics that must be evaluated while questions in in-person exams are a few selected (no more than three) topics from the topics evaluated on the take-home exam. Students' scores are calculated from average scores of both exams.

In this study, the proposed methods are used in a regular lecture course and a programming course. The in-person exams for regular lecture courses are similar to normal in-person exams; students have to complete their exam on paper within a time limit. For programming courses, a live-coding exam is used in-person so that instructors can understand the student's thinking process, and therefore, efficiently evaluate the student's performance. During the live-coding exam, students have to meet with an instructor one-on-one. Students were asked to demonstrate their take-home exam and to modify their code to match with the in-person questions. Each student had approximately 15-20 minutes to complete their exam.

Results and discussion

The proposed methods have been used in various types of classrooms i.e., in-person, hybrid, and fully virtual classrooms. Subjects of this study are Sophomore and Junior Engineering students. In this study, data from a regular lecture course and programming course are considered.

A. Student performance

1) Programming Course

In programming courses, exams are quite challenging for both students and instructors because there is more than one solution for a given problem. This data is measured from 2 semesters in the same course, Spring 2020 (26 students) and Spring 2021 (16 students). Exams in 2020 were fully in-person and students had two hours to complete a closed-book exam. Students were allowed to use the Microsoft Visual Studio application to write and debug their code and had to submit their work before leaving the exam. This exam was set to be a 2-hour exam however the instructor extended the exam time as long as students need; total exam time is approximately 4 hours in total. The exams in 2021 were hybrid with a take-home and an in-person portion. Students received approximately 3 days to work on their take-home exam. Then, each student had 20 minutes to meet with their instructor for a one-on-one live-coding exam to demonstrate their work. During the one-on-one exam, additional questions were given related to the take-home questions, and students had to modify their code in real-time.

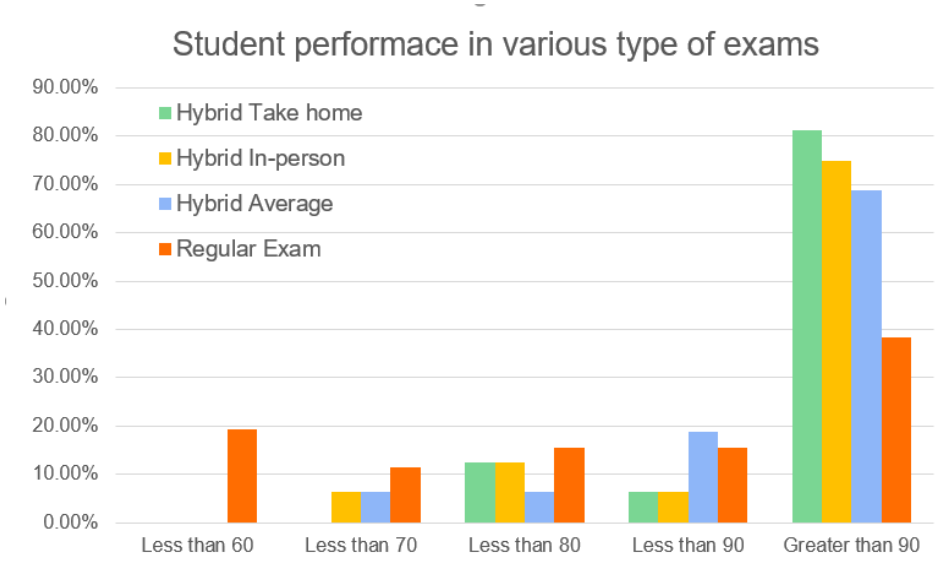

Figure 1 Students' performance in various type of exams in the programming course

Figure 1 shows the performance on Exam 1 for the 2020 students who had a fully in-person exam (Regular) and the performance on Exam 1of the 2021 students who had the hybrid exam; the graph displays the take-home score (Hybrid Take-home), the in-person score (Hybrid In-person), and the actual Exam 1 grade which is the average of the two scores (Hybrid Average). The graph shows the percentage of students who failed the course (Less than 60), the percentage who scored 60 to 69 (Less than 70), etc. Figure 1 shows that students performed better on the

hybrid exam vs the fully in-person exam. Table 1 presents average score and standard deviation of students' performance on different types of exams.

Table 1 Average and standard deviation of students' scores in the programming course

	Average	**Standard Deviation**
Regular exam	80.98	22.10
Hybrid take home exam	93.06	9.457
Hybrid in-person exam (Live code)	88.19	10.66
Hybrid average score	90.63	9.237

When considering the difference in students, scores between in-person and live-coding exam, average difference is -4.875 with standard deviation of 8.317. One student significantly improved their score in an in-person live-coding vs the take-home exam (increased by 16 points). Only 1 student did very poorly on the in-person exam. Their score on the live-code exam is lower than his score on the take-home exam by 23 points.

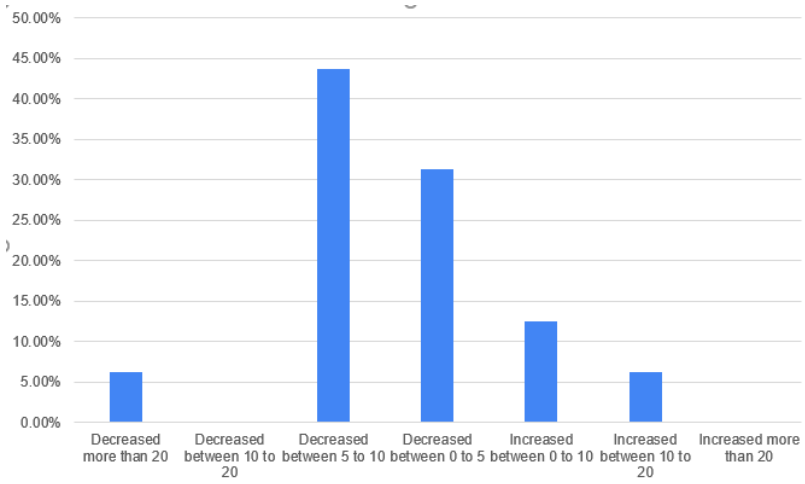

Figure 2 Difference of students' scores between an in-person portion and take-home portion in a hybrid exam

Figure 2 presents the difference of students' scores between the in-person portion and the take-home portion of a hybrid exam. Results show that on average, students' scores are approximately similar. Students did a little better in the take-home portion however their scores between take-home and in-person exam are not significantly different. Table 1 together with the graphs shows that the hybrid exam allows students to perform well on the take-home portion while using their course material and that the take-home exam is an effective tool to help students prepare for the in-person exam.

2) Lecture Course

This section discusses the results for a course with lectures and exams. Unlike the programming course where the in-person exam was a practical live-coding exam, in this case, for a lecture course, the in-person exam is a written exam. For this course the students were divided into two groups: fully online (22 students) and hybrid-mode (24 students). Due to COVID-19, the classroom capacity is limited. For the hybrid-mode section, students take turns attending the lecture in-person and attending remotely. There is no data for fully in-person classrooms. Both groups of students took a hybrid exam. Students received approximately 2 days to work on their take-home exam. This was followed by a written in-person exam supervised by the instructor.

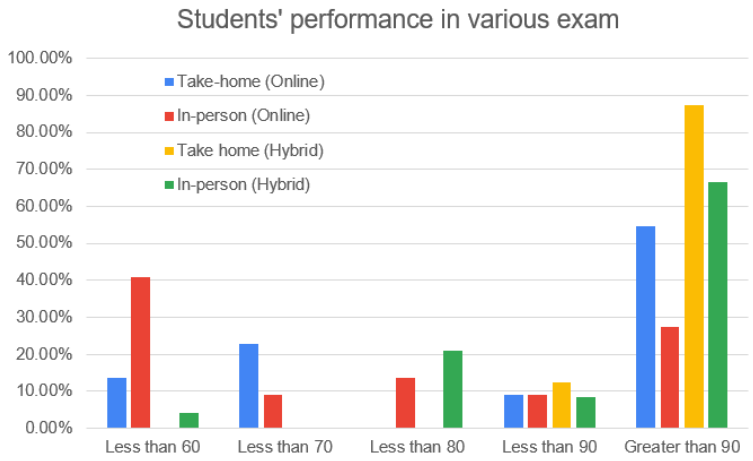

Figure 3 Students' performance in various type of exams in the lecture course

Figure 3 shows the performance on the hybrid Exam 1 for the fully online students (Take-home (Online) and In-person (Online)) and for the hybrid-mode students (Take-home (Hybrid) and In-person (Hybrid)). For both groups, students did better on the take-home exam vs the in-person exam. An interesting finding was that the performance of students in the fully online section was lower than the performance of students who attended in hybrid-mode. This deficiency is likely due to the online students not being fully engaged in the course, an issue experienced very often during the pandemic, and not a consequence of the hybrid exam methodology.

Table 2 Average and standard deviation of students' scores in the lecture course

	Average	**Standard Deviation**
Take home (Online)	84.44	18.89
In-person (Online)	66.89	29.84
Take home (Hybrid)	100.24	10.08
In-person (Hybrid)	91.29	15.03

When considering only the score on an in-person exam, the average score of students in the fully online section is only 66.89 with the standard deviation of 29.84 while the average score of in-person exam of hybrid section is 91.29 with the standard deviation of 15.03.

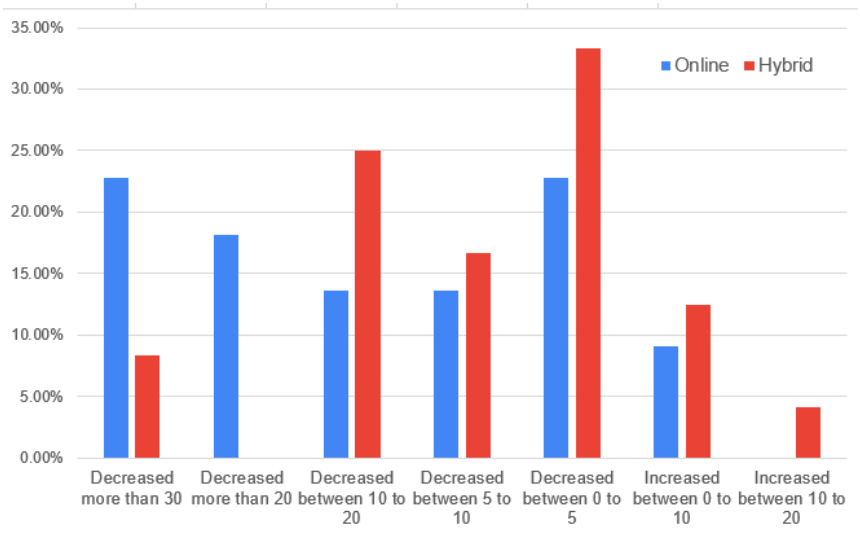

Figure 4 Difference in individual score between in-person and take-home portions of the hybrid exam

Figure 4 compares the individual student's in-person exam score to their take-home exam score by using the formula `difference = in-person exam score - take-home exam score`. The data is plotted for both the fully online section (Online) and the hybrid-mode students who had some on-campus, in-person contact with the instructor (In-person). The first set of data shows that, for the online students, the difference is a value less than -30, meaning those students scored at least 30points less in the in-person exam vs the take-home exam. As shown in Figure 4, more than 20% of students in the online section did very poorly in their in-person exam when compared to their take home exam. Approximately 50% of students in the online section scored at least 20 pts less when they worked on an in-person exam compared to their take-home exam. These results underscore the importance of on-campus, face-to-face interaction between students and instructors.

B. Grading efficiency and detecting or decreasing academic misconduct

This section discusses how the hybrid exam can make grading more efficient and detect potential academic misconduct.

The hybrid exam can shorten the grading time especially in practical courses such as programming courses. In a programming course the proposed method helps instructors to evaluate their students' performance in real-time during the live-coding exam. These exams allow instructors to ask students questions so that they can learn the student's thinking process and how they approach problems; this is valuable information since there can be multiple correct solutions to one coding problem. As shown in Figure 1 and Table 1, a student's score on the live-coding exam is typically close to their take-home exam score, therefore, once the live-coding exam has been completed, the instructor has an idea of the student's thinking process, problem areas, and the general score expected in the take-home exam. Without the hybrid method,

instructors can take days grading student's solutions since they must take their time to understand and follow each student's thinking process.

The hybrid exam may deter students from engaging in academic misconduct. This is true particularly in the programming course since students were aware that that they had to modify their work and answer questions in a one-on-one live-coding session with the instructor. Since students' take-home and in-person scores were close, it is likely that they did their own work answering the take-home questions because they were able to do the same in the in-person exam. The proposed method also helps instructors identify possible academic misconduct including collaboration on the take-home exam. The large differences between the in-person and take-home exam scores, especially in cases where the take-home score was much higher (Figure 3), could indicate academic misconduct. After looking at the differences and doing a further investigation, there is evidence that 9 students from the fully online section collaborated during their take-home exam showing that the proposed hybrid exam is a good indicator.

6 Conclusion

This paper presented a hybrid exam methodology which combined take-home exams with in-person exams. This methodology can improve students' performance, discourage academic misconduct, help instructors detect possible academic misconduct, and help instructors to grade efficiently. The hybrid exam can work in lecture courses as well as practical courses such as programming courses. This proposed exam works well when students are fully on-campus or in a hybrid learning environment where they attend some session online and others in-person. It can be difficult to implement in a fully online environment for two reasons: in general, unrelated to the hybrid exam method, students do not perform as well when fully remote, and it would be difficult to replicate the in-person exam over a video-conferencing tool while ensuring that students do not have any prohibited material with them at their remote location.

7 References

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