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Course Learning Outcomes Evaluation Through Online Assignments

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ABSTRACT: *This study explores the potential reasons behind higher scores observed in online quizzes during the COVID-19 pandemic. We hypothesize that factors such as increased test environment comfort, access to resources, technological advantages, adaptation to online learning, motivational changes, and variations in assessment design all contributed to improved student performance in the online format. Our findings support this hypothesis, as online courses exhibited both higher and more consistent Course Learning Outcome (CLO) achievement compared to traditional face-to-face settings. These results suggest that online learning environments may offer certain advantages that can enhance student success.*

KEYWORDS: Online, face-to-face, quizzes

INTRODUCTION

The COVID-19 pandemic has caused educational institutions around the world to rapidly shift to online learning, impacting student achievement in a variety of ways. Research suggests that the shift to online courses during this period may have both positive and negative effects on student achievement. On the one hand, online learning provides students with greater flexibility and access to course materials, potentially leading to greater engagement and self-directed learning (Hodges et al., 2020). Additionally, online platforms often offer features such as instant feedback and adaptive learning tools that can help improve student achievement (Means et al., 2009). Conversely, challenges associated with the sudden shift to online learning, such as technological barriers, lack of resources, and increased distractions in the home environment, may negatively impact students' ability to stay on task and perform at their best (Gewin, 2020).

In analyzing student performance in an introductory physics course, the use of online and in-person assignments during the COVID-19 pandemic represents a multifaceted approach to assessment and learning support. Online assignments provide students with flexibility in accessing course

materials and learning support. They can complete assignments at their own pace, accommodating different learning styles and schedules. These assignments often include interactive simulations, multimedia resources, and automatically graded tests that provide students with immediate feedback on their progress and understanding. In addition, online platforms allow teachers to monitor student engagement and identify areas that may need additional support, allowing for targeted intervention and a personalized learning experience. In contrast, face-to-face assignments provide opportunities for collaborative problem-solving, interaction with peers, and direct instruction from the teacher. Through face-to-face discussions, demonstrations, and laboratory experiments, students can deepen their understanding of physical principles and develop critical thinking skills in a supportive classroom environment. Research shows that integrating online and face-to-face assignments can lead to better learning outcomes and higher student satisfaction (Garrison et al., 2004; Means et al., 2009). By leveraging the strengths of both modalities, instructors can create a dynamic and inclusive learning environment that promotes student success in introductory physics courses. Current research on student performance in introductory physics courses, particularly related to the integration of online and face-to-face assignments, reveals a nuanced understanding of how these modalities affect learning outcomes. A study conducted by Nasri et al. examined the use of MasteringPhysics in teaching an introductory physics course at a university in the United Arab Emirates (Nasri et al., 2018). The course was on the topic of classical mechanics and was intended for science students. Online assignments were administered to assess course learning outcomes. Studies by Deslauriers et al. have shown that student learning and engagement were significantly improved through innovative teaching methods, including active learning strategies and online resources (Deslauriers et al., 2011). Pea highlights the crucial role of social and collaborative learning experiences in improving student comprehension and retention of physics concepts, especially in face-to-face environments (Pea, 2018). Furthermore, meta-analyses by Garrison and Kanuka (Garrison et al., 2004) and Means et al. (Means et al., 2009) demonstrate the effectiveness of blended learning models—combining online and face-to-face instruction—in boosting student achievement and satisfaction in higher education. These studies collectively suggest that integrating both online and face-to-face assignments can significantly enhance student performance and deepen understanding of introductory physics concepts.

In this paper, we investigated the impact of conducting online quizzes at home during the COVID-19 pandemic versus in-class quizzes on ten taught chapters. The Course Learning Outcomes (CLOs) were also analyzed. We analyzed and compared the average quiz grades of students between face-to-face quizzes and online quizzes taken at home.

METHOD

To test the feasibility of using Blackboard with Respondus LockDown Browser and Mastering Physics (provided by Pearson) as tools for conducting quizzes online at home during the COVID-19 pandemic and face-to-face in class, a pilot study was conducted in Spring 2021 and Fall 2023. The study focused on an introductory physics course (Newtonian Mechanics) and involved 132 students across three different sections. One section, consisting of 60 students of both genders, took the course and quizzes online at home, while two female sections, with 32 and 38 students

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respectively, took the course face-to-face and completed quizzes in class using their laptops.
To enhance students' understanding and learning before taking the quizzes, they were required to complete weekly MasteringPhysics homework assignments. These homework assignments included end-of-chapter discussion questions, exercises, and problems, which were due several days after the lecture. The assignments aimed to help students practice conceptual understanding, problem-solving, and critical thinking related to the basic physics concepts covered during lectures. The homework assignment was designed to tackle specific ideas and concepts, improving students' understanding and math skills. Additionally, MasteringPhysics provided hints to guide students to the correct answers. Students could also discuss their mistakes with classmates or the instructor, either online during the COVID-19 pandemic or in person during face-to-face classes.
The following points outline the steps taken to prepare students for the quizzes:

1) After each chapter, 5-6 days' were given for students to complete an online homework assignment.
2) After the homework assignment is done, the quiz is presented online to students during Covid19 pandemic at home during a time of 15 min (Spring 21), or in the class during the same time (Fall 2023).
3) The quiz questions were randomized.
The online quizzes through MasteringPhysics were used to measure the Course learning outcomes (CLOs). However, other traditional tests were scheduled to assess students' performance. The course of introductory physics contains ten chapters and is detailed in Table 1. Six quizzes were used during the semester covering the ten chapters of the course. Each quiz covers one or two chapters as detailed in Table 2. The Course learning outcomes (CLOs) of the course are given in Table 2.

Table 1. Chapters studied in the introductory physics course

Chapters	Chapter Title
Chapter 1	Units, Physical Quantities, and Vectors
Chapter 2	Motion a Long Straight Line
Chapter 3	Motion in Two or Three Dimensions
Chapter 4	Newton's Laws of Motion
Chapter 5	Applying Newton's Laws
Chapter 6	Work and Kinetic Energy
Chapter 7	Potential Energy and Energy Conservation
Chapter 8	Momentum, Impulse, and Collisions
Chapter 9	Rotation of Rigid Bodies
Chapter 10	Dynamics of Rotational Motion

Table 2. Chapters included in each quiz used in this study

Quizzes	Chapters
Quiz 1	Chapter 1&2
Quiz 2	Chapter 3
Quiz 3	Chapter 4&5
Quiz 4	Chapter 6&7
Quiz 5	Chapter 8&9
Quiz 6	Chapter 10

Table 3. The Course learning outcomes (CLOs) of the course

CLO's	CLO's description
CLO 1	Use vector algebra and dimensional analysis to obtain quantitative or qualitative solutions to basic problems in Mechanics.
CLO 2	Solve problems in kinematics by using equations of motion.
CLO 3	Apply correctly Newton's laws of motion
CLO 4	Analyze mechanical situations using the fundamental concepts of dynamics, conservation of energy, linear and angular momenta

RESULTS & DISCUSSION

Figure 1 shows the results of the average grade versus online and face-to-face quizzes. Analysis of the quiz grades revealed that the grades for quizzes taken online during the COVID-19 pandemic were higher compared to those taken face-to-face in the classroom. This disparity can be analyzed through several arguments: quiz environment and comfort, access to resources, reduced supervision, technological advantages, adaptation to online learning, motivational factors, and assessment design. Quiz environment like a familiar environment: students taking quizzes online at home are likely to be in a more comfortable and familiar environment, which can reduce anxiety and improve performance. Furthermore, in open book conditions even with measures like Respondus LockDown Browser, students might have greater access to textbooks, notes, or other resources during online quizzes. On the other hand, the level of supervision in an online environment is often less stringent than in a classroom setting, potentially leading to more opportunities for students to consult external resources. In general, online platforms like MasteringPhysics often provide immediate feedback and hints, helping students correct their mistakes during practice sessions, which might lead to better preparedness for quizzes. Thus, the use of online tools might offer functionalities such as automatic grading and detailed feedback, which can help students learn and improve faster. We have to note that during the COVID-19 pandemic, both students and educators rapidly adapted to online learning environments. Students might have developed better digital literacy and study habits tailored to online formats, contributing to higher performance in online quizzes. Indeed, online platforms can include

interactive elements and multimedia resources that engage students more effectively than traditional face-to-face instruction. One of the motivation factors is that the shift to online learning during the pandemic might have fostered a greater sense of responsibility and intrinsic motivation among students to perform well. The quiz design also can help by improving the online quizzes. The difficulty level of online quizzes might be perceived as different compared to face-to-face quizzes, either due to design or the nature of questions suited to online formats. Online quizzes often use question pools and randomization to ensure academic integrity, which might result in students encountering different versions of the test that vary in difficulty.

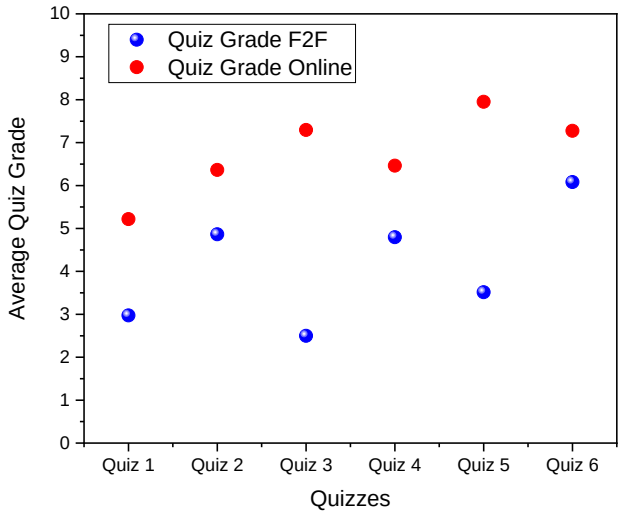

Figure 1. Results of the average grade versus online and face-to-face quizzes.

Course Learning Outcomes (CLOs) are essential components of educational programs, serving multiple critical functions that contribute to the effectiveness and accountability of the teaching and learning process. Figures 2 and 3 show that the course learning outcomes (CLOs) are higher in online quizzes compared to face-to-face quizzes. In face-to-face courses and quizzes, we note that CLO1 was not achieved, which is relative to the use of vector algebra and dimensional analysis to obtain quantitative or qualitative solutions to basic problems in Mechanics. We can attribute this to the fact that students are still new to the university and the teaching methods. Additionally, students tend to be less engaged in traditional face-to-face lectures, which affects their performance in in-class quizzes. However, CLOs 2, 3, and 4 were achieved by more than 60% of the students, with some variations among them. This observation aligns with the findings of a study published by Nasri et al. (Nasri et al., 2018).

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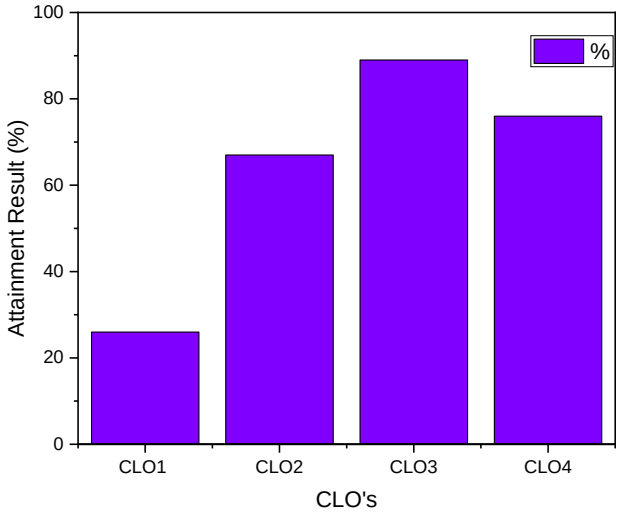

Figure 2. Assessment of four CLOs to measure students' ability to solve face-to-face quizzes related to the ten chapters in the course.

In online quizzes, CLOs 1, 2, and 3 were achieved, with results for these three CLOs ranging between 60% and 70%, as shown in Figure 3. However, CLO 4 was not achieved, likely due to difficulties students faced with Chapter 10 on the Dynamics of Rotational Motion. Additionally, students did not have enough time at the end of the semester to complete many applications.

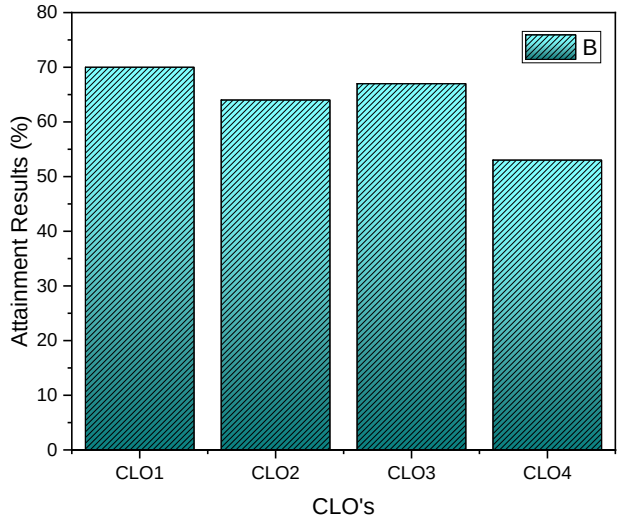

Figure 3. Assessment of four CLOs to measure students' ability to solve quizzes online at home related to the ten chapters in the course.

CONCLUSION

The higher grades observed in online quizzes during the COVID-19 pandemic can be attributed to a combination of factors, including a more comfortable test environment, access to resources,

technological advantages, adaptation to online learning, motivational factors, and differences in assessment design. These elements collectively suggest that the online format provided certain advantages that contributed to improved student performance in quizzes. This trend was observed by measuring the course learning outcomes (CLOs), which are higher and more stable compared to face-to-face quizzes in online courses. These elements collectively contribute to an improved educational experience, leading to higher student performance and achievement of learning outcomes in online courses and quizzes. Further research could explore these factors in more detail to understand their individual and combined impacts on student success.

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