

# Improving Online Quiz User Experience

Adding Offline Capabilities for Bad Internet Connectivity

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## ABSTRACT

As remote learning became popular during the COVID-19 pandemic, students of all ages became familiar with taking tests online using learning management systems. Today, the pandemic seems to be near its end, and many of the remote technologies used over the past year have been incorporated into many educators' class plans whether it is quizzes or exams. This paper is specifically focused on improving the user's experience while taking exams and quizzes remotely.

To collect data for potential improvements a user survey was conducted among students who use the Canvas learning management system. After analyzing the data collected it was found that users expressed frustration and concern when losing internet connectivity while taking an exam. Many of the users reported such issues and so we began our research on how to accommodate for this shortcoming. To improve this experience, we explore the idea that a progressive web application (PWA) solution can fix this bad user experience. By implementing offline capabilities when taking a test, we aim to improve the user experience and eliminate the concern of a poor internet connection causing unnecessary stress on the user.

## KEYWORDS

LMS, PWA, Human-centered design, Canvas

## 1 Introduction

Computers and computing technology continue to become more integral to society's day-to-day routines. Corporations rely on them to accomplish business goals, families rely on them to communicate and connect with each other, and students rely on them to learn and participate in education. This integration was sped up by the COVID-19 pandemic, which required people around

the world to adapt to social distancing and brought interfacing with machines up to the forefront of society's daily routines.

In this work, the authors contribute an Online Learning System Design for students taking quizzes and exams. The design aims to provide helpful feedback to students during their tests and allow them to continue working through a test even if there is a connection issue or disconnection to the service.

Informing our design choices are 1) User Interviews, 2) The application of User-Centered Design Principles, and 3) Drawing on inspiration from current Online Learning Systems. For this proposal, our expected end users are college students who interact with their classes either completely online/remotely or partially online with an in-person class component. The proposed system will be a Canvas Instructure™-like interface built as a progressive web application using the Angular framework. The backend will use an object-oriented language and a database to facilitate data interactions and storage between the user, the interface, the middleware, and the database server.

We hope to make an Online Learning System that gives better feedback during quizzes and exams to help our users obtain the grade they deserve by preserving their work in cases of technical difficulty and by helping to keep them calm and informed with feedback during the stressful exam-taking process. This will lead to more accurate measurements of student performance when they are tested via online learning systems, and it will also make the exam-taking process online less stressful.

## 2 End-User Interview Results

Canvas is one of the most used and popular Learning Management Systems currently. It has gained more popularity during the time of covid. The majority of university students are familiar with Canvas. For our interview, we have chosen the audiences who have already used Canvas for their academic purpose.

For the end user interview of this project, we have made an online survey with Qualtrics. The full dataset from the survey can be found in the appendix section. The survey evaluated the user's usage and satisfaction while taking quizzes on Canvas. The survey consists of 11 questions which include their age, gender, level of education (e.g., undergraduate or graduate), level of experience in quiz taking, level of satisfaction, frequency of quiz taking, etc. This survey also asks about their experience and the issues they faced during the time of taking quizzes on Canvas. Additional comments regarding the improvement of taking quizzes on Canvas have been asked also.

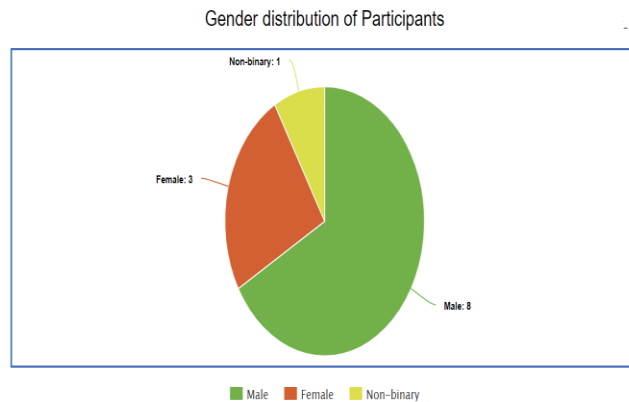


Fig 1: Gender distribution of the participants

The link to the survey was sent to the selected people. Among them, we have received 12 responses which consist of 8 male, 3 female, and 1 non-binary. Fig-1 shows a pie chart of the participants' gender. Most of the participants are between 15-24 years old and all of them are from 15-34 years old (Fig-4). Among the participants of this survey, most of their expertise levels in taking Canvas quizzes are high (Fig 3). This is due to the shift or transition of the learning system of post covid era more and more exams are taken online. Among the participants the number of graduate and undergraduate students was equal. Most of the participants were satisfied with the online quiz system of Canvas. Fig 5 shows the participant's satisfaction level.

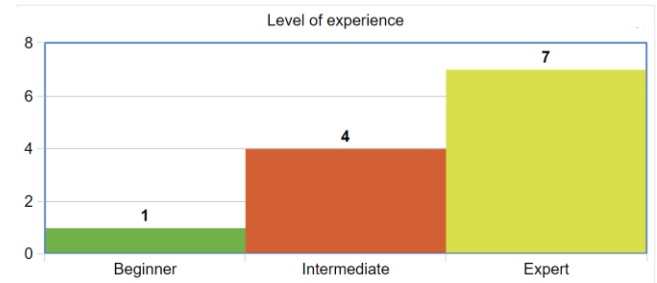


Fig 2: Histogram of the expertise level of the participants

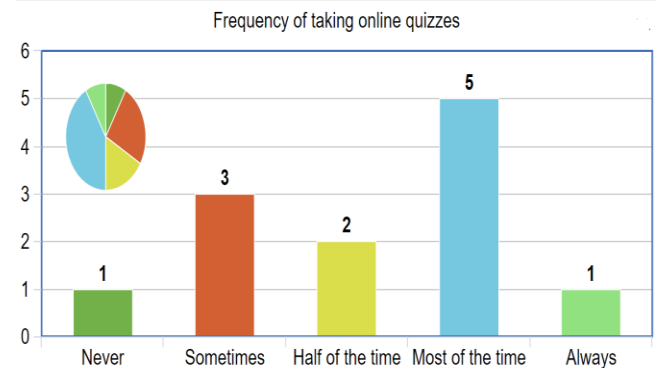


Fig 3: Histogram and pie chart of the usage of online quizzes

So far, from the information, it might be anticipated that, the quiz-taking system on canvas is flawless but when they were asked about the issues they faced during the time of online quizzes, the situation changes. Most of the issues mentioned by the participants were network-related issues. Some of the issues they have mentioned are the difficulties when they encounter a disconnection such as loss of exam time.

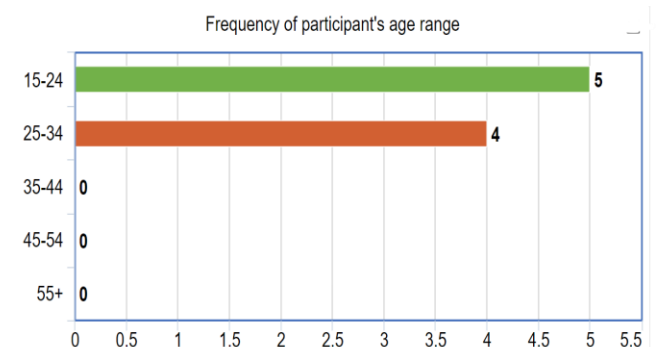


Fig 4: Age range of the participants

While asking about the improvements required for Canvas, most of the suggestions referred to a system that works properly during a bad internet connection. From the technical difficulties faced by the users and the suggestion for improvement, we get the idea that a system must be developed which will work even offline.

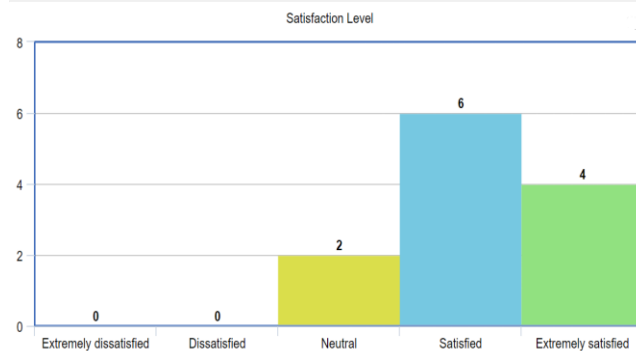


Fig 5: Histogram of the level of satisfaction of the participants taking online quizzes on Canvas

### 3 Current Interface Design

The current interface design users interact with is the Canvas web app by Instructure. Specifically, as it is related to our proposal, the current interface is the quiz/exam portion of the Canvas interface. This is accessed by going to a course link on canvas, and then selecting the quiz option listed in the course's window interface or by directly opening a link in the "TO-DO" or "Coming Up" sections of the home page of the Canvas interface.

The design of the interface for the quiz section of Canvas is as follows. The title of the quiz is at the top of the page, followed by the quiz's instructions. Depending on the window size, there is a list of questions to let the user know what question they are on, on the left side of the page and a timer under this list. If the window size cannot accommodate this information, it is moved to the bottom of the quiz after all the quiz questions. The users interact with the questions by either selecting multiple choice bubbles or true/false bubbles, entering text in text boxes, or selecting multiple checkboxes, depending on the question type. There is no submit button for any of the questions, as the question is presumed completed when the user answers it. The only feedback this interface gives to the user is the standard web interaction responses expected when interacting with multiple choice/true-false bubbles, text boxes, and checkboxes and a brief notification when there are 5 minutes and 1 minute left in the quiz. Finally, there is a submit button at the end of the quiz.

The current canvas quiz interface is suitable as an OLS test platform; however, it falters in feedback and disconnection scenarios. Immediately upon losing internet connection. The exam screen is changed to an "Exam Paused" screen [fig 8](#). It is not immediately known what the issue is that caused the window to

appear. A notification appears after about 30 seconds stating that the internet connection may have been lost [fig 7](#). When attempting to open the proctoring window, the window shows that the network has timed out [fig 9](#). Once the internet connection was reestablished the proctoring window closed automatically, but the exam was not resumed. At this point, there is no notification stating the application has come back online and how to proceed. When clicking the button to open the proctoring window there are steps to continue and relaunch the exam. Once the exam resumes it can be observed that the timer continued and did not pause during the exam pause. This resulted in the user losing time on the exam due to the exam being paused.

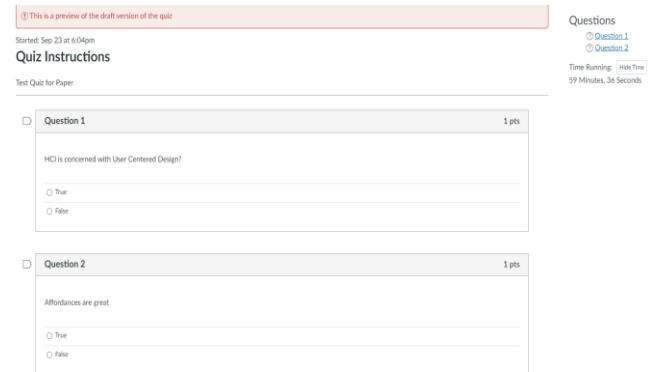


Figure 6: Canvas's Quiz Interface

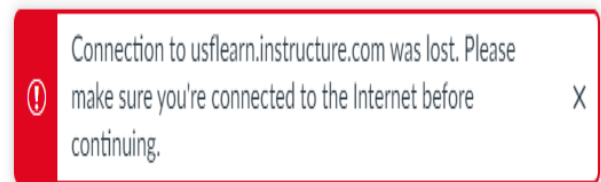


Figure 7: Notification received moments after going offline

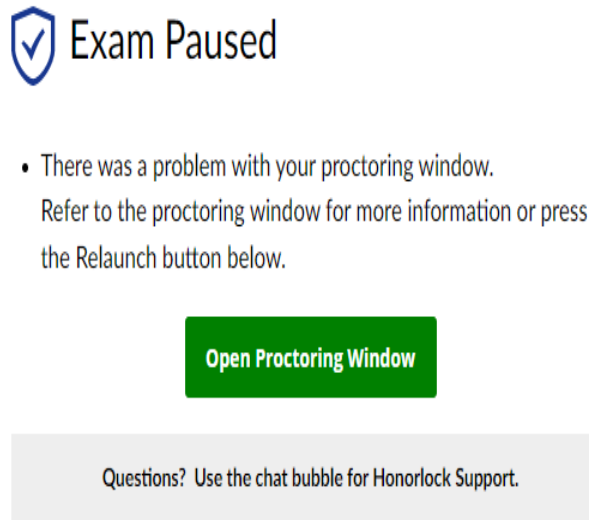


Figure 8: Exam window after losing the internet connection

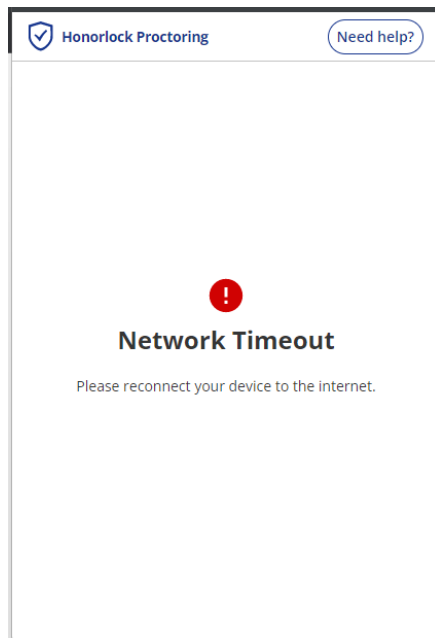


Figure 9: Proctoring window after clicking to view it

## 4 Current Solutions

In the literature, we found a few computerized exam testing systems [3] [4] [5] [6]. However, most of them seemed to not specifically mention the user experience around disconnections or feedback during examinations.

In [6] the authors review various online examination systems and find that none of them focus on the resumption of an exam after disconnecting. In this work, Younis et al. propose an online

examination system called OLES that allows for exam resumption after disconnecting by saving the exam state in the user's temporary storage. When the user reconnects, the data in the temporary storage is instantiated so that can continue the exam.

In [4], Zhenming et al. discuss an examination system that allows for client-side control, time control, and security control. This seems like it could have some possible functionality to protect students from disconnection issues, but it is not clear from the work.

## 5 Proposed Interface Design

### 5.1 UI

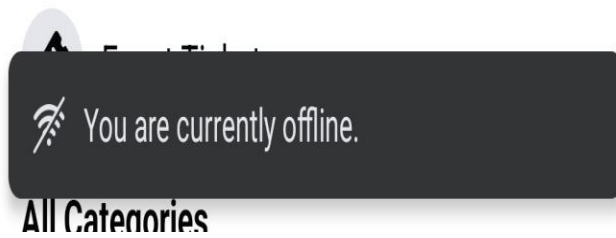
Users were generally satisfied with the current UI layout. We will use take a similar approach and add updates to the UI that were a result of the interview data. The general workflow of the exam will consist of the user navigating to the exam website and initiating the exam, the user will answer the questions and submit the exam when completed. Once the exam is started the questions will be retrieved and displayed to the user. A timer will be shown indicating how much time the user has left to complete the exam. The user will be given an option to hide the timer as this was one of the requests from an interview conducted. As the timer approaches the end time, the user will be notified to complete their work and submit it. Once the timer has ended the exam will be automatically submitted. If the user completes the exam before the timer, then the user submits their work by clicking the submission button at the end of the exam.

### 5.2 Offline Capability

As mentioned in [1] the challenge of online learning systems is to provide an experience close to a face-to-face experience. We considered how the interface can be improved to become closer to an in-person experience regarding exams. Reviewing the data from our interviews. The users experienced technical issues when their internet connection was lost. Traditional in-person exams do not have the issue of being disrupted by internet connectivity issues. The proposed interface design will allow the user to continue taking the exam uninterrupted instead of pausing exam. We intend to evaluate how this impacts overall user satisfaction when taking an exam online.

### 5.3 Notifications

Notifications will be added to prompt the user of certain events. A warning to let the user know the exam is about to end. The user will also receive a notification when the internet connection is lost and if the internet connection is restored [fig 10 and 11](#). We plan to evaluate the effectiveness of the notification and how it impacts their overall experience. We believe informing the user of the issue, but also allowing them to continue working on the exam will provide a better user experience as opposed to having to stop taking the exam and fix the issue. We also believe that this will positively affect the user psychologically and potentially produce better grades for the user over the current solutions.



**Figure 10 - Example notification showing that the application is no longer connected to the internet**



**Figure 11 - Example notification depicting a notification showing the application is connected to the internet after being disconnected**

#### 5.4 Front-end Technology

The proposed quiz system will be built as a web application like the current Canvas LMS and will be accessed through a web browser. A progressive web application (PWA) design will be implemented using the Angular framework. PWAs can be thought of as bridging the gap between web applications and mobile native apps. The PWA app was first developed by Google in 2015 as a solution for building build apps that have features of both a web application and a native application on mobile devices [2].

There are many features that PWA offers over a traditional web application, such as building only one app that works on both mobile and web and offline capabilities. For our research purposes for this paper, we particularly exploit the offline capabilities that PWA offers. The offline capabilities allow the PWA to operate with poor internet connections and allow the application to work offline to some degree that has been implemented by the developer.

#### 5.5 Back-end Technology

The application will also have a backend to support CRUD operations on a database and provide APIs needed for the UI to operate. The database may also store exam questions and answers and user data. The backend technologies will either be built using Java or Python programming languages and frameworks.

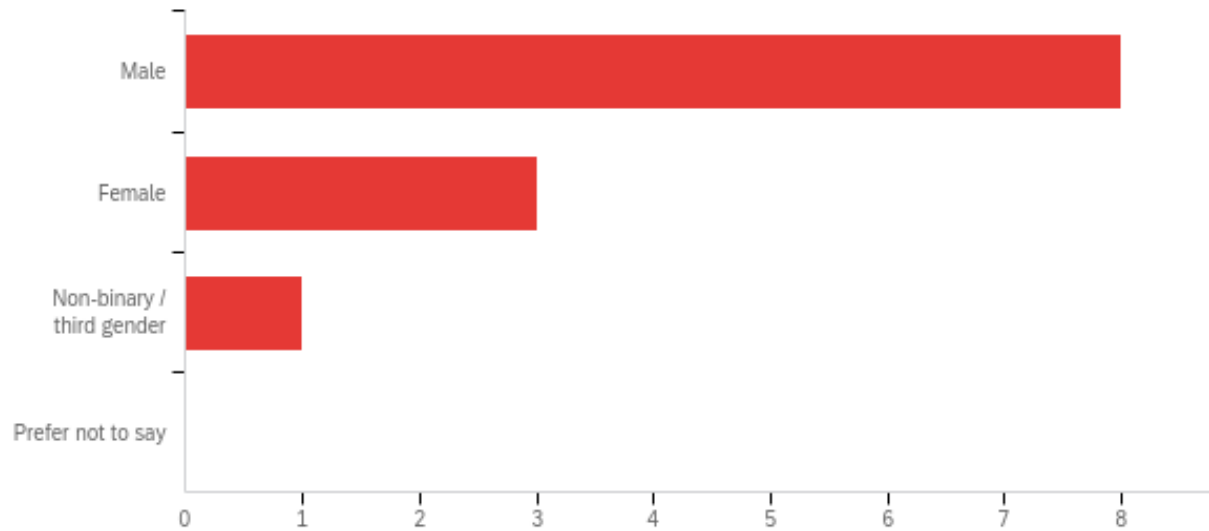
#### 5.6 Design Decisions

As a result of the interviews conducted by users of the Canvas system, the choice for a PWA became clear as we researched for capabilities that are supported offline and web-based. Many modern JavaScript frameworks have support for building progressive web apps, due to the team's web development

background the Angular framework has been chosen to build the application. Angular which is also maintained by Google is a popular framework with many libraries that can help speed up the development time, such as the Angular Material component library that will give the website a clean, minimalistic look that should be familiar to most users.

#### REFERENCES

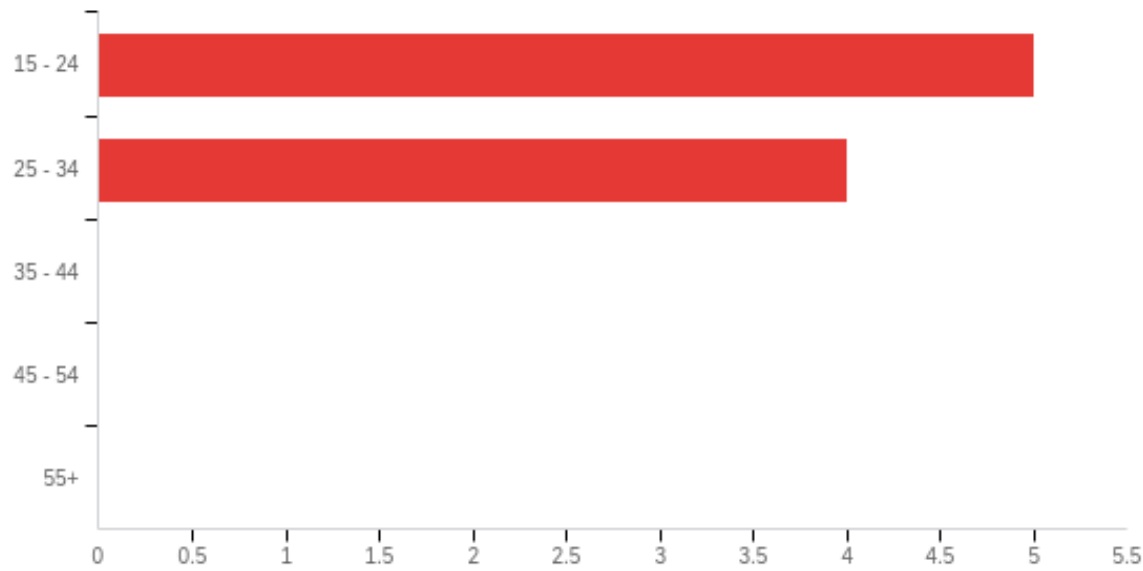
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**APPENDIX****Q1 - Gender**

| # | Field  | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|--------|---------|---------|------|---------------|----------|-------|
| 1 | Gender | 1.00    | 3.00    | 1.42 | 0.64          | 0.41     | 12    |

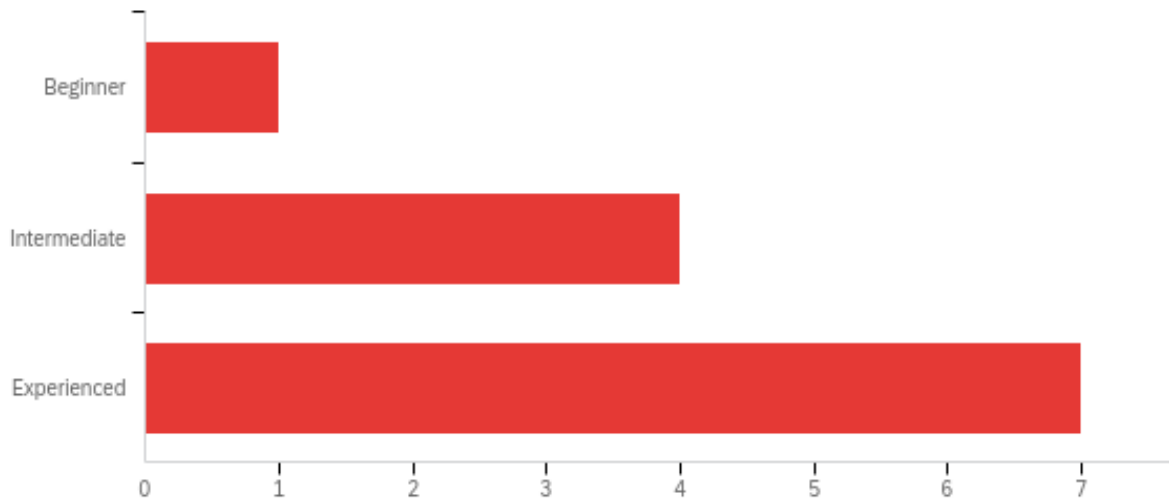
| # | Answer                    | %      | Count |
|---|---------------------------|--------|-------|
| 1 | Male                      | 66.67% | 8     |
| 2 | Female                    | 25.00% | 3     |
| 3 | Non-binary / third gender | 8.33%  | 1     |
| 4 | Prefer not to say         | 0.00%  | 0     |
|   | Total                     | 100%   | 12    |

Q11 - What is your age?



| # | Field             | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|-------------------|---------|---------|------|---------------|----------|-------|
| 1 | What is your age? | 4.00    | 5.00    | 4.44 | 0.50          | 0.25     | 9     |

| # | Answer  | %      | Count |
|---|---------|--------|-------|
| 4 | 15 - 24 | 55.56% | 5     |
| 5 | 25 - 34 | 44.44% | 4     |
| 6 | 35 - 44 | 0.00%  | 0     |
| 7 | 45 - 54 | 0.00%  | 0     |
| 8 | 55+     | 0.00%  | 0     |
|   | Total   | 100%   | 9     |

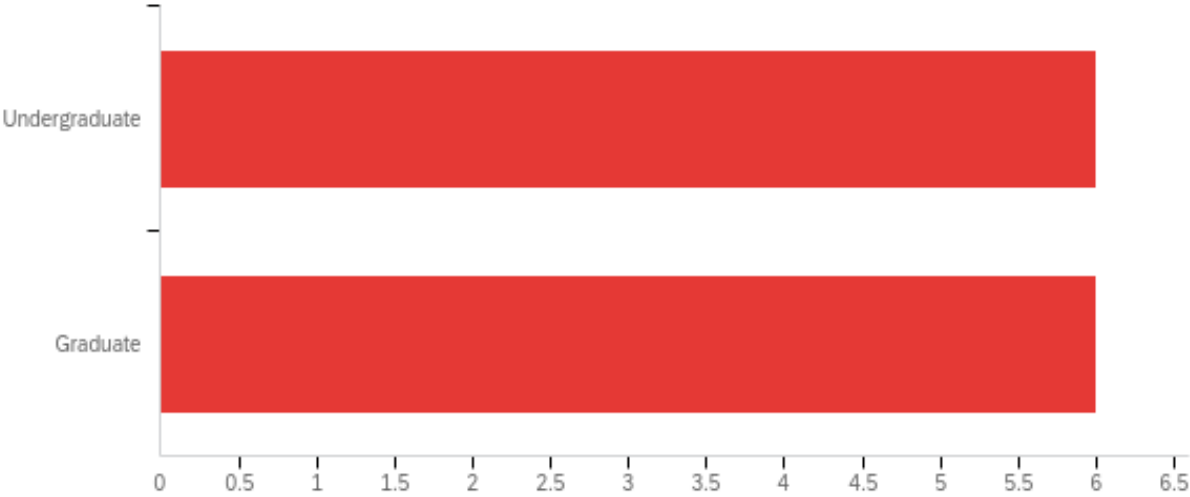
**Q2 - Level of experience taking quizzes on Canvas**

| # | Field  | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|--|---------|---------|------|---------------|----------|-------|
| 1 | Level of experience taking quizzes on Canvas | 1.00    | 3.00    | 2.50 | 0.65          | 0.42     | 12    |

| # | Answer       | %      | Count |
|---|--------------|--------|-------|
| 1 | Beginner     | 8.33%  | 1     |
| 2 | Intermediate | 33.33% | 4     |
| 3 | Experienced  | 58.33% | 7     |
|   | Total        | 100%   | 12    |

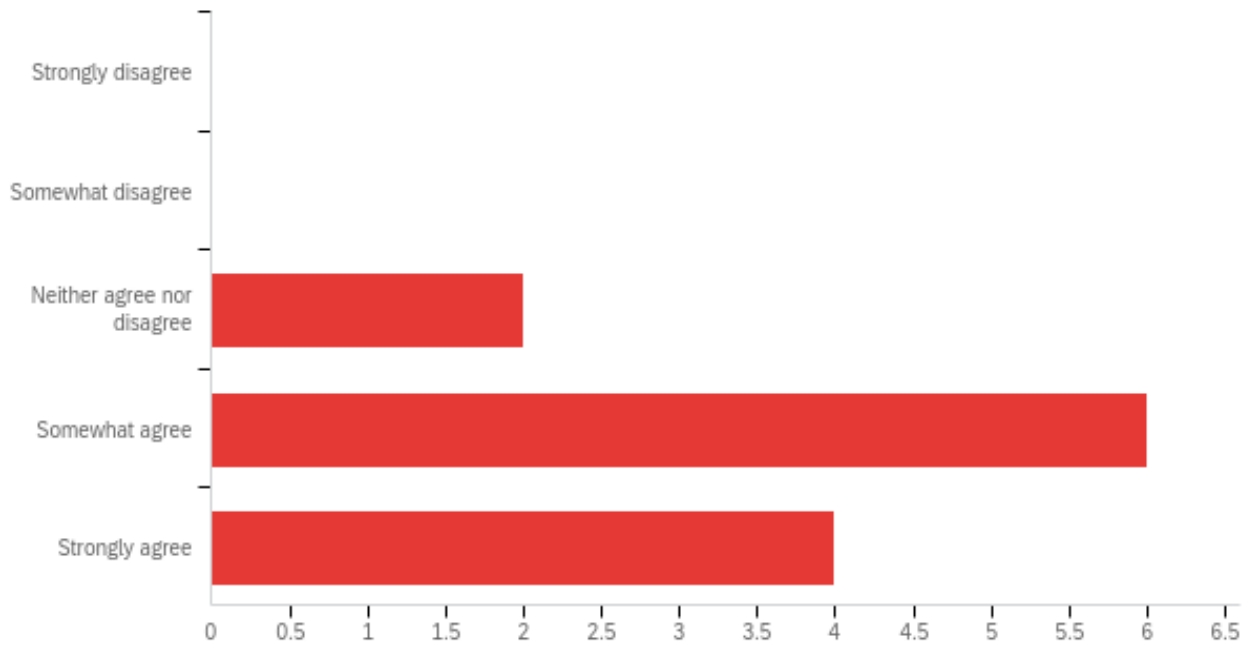


Q3 - Education Level



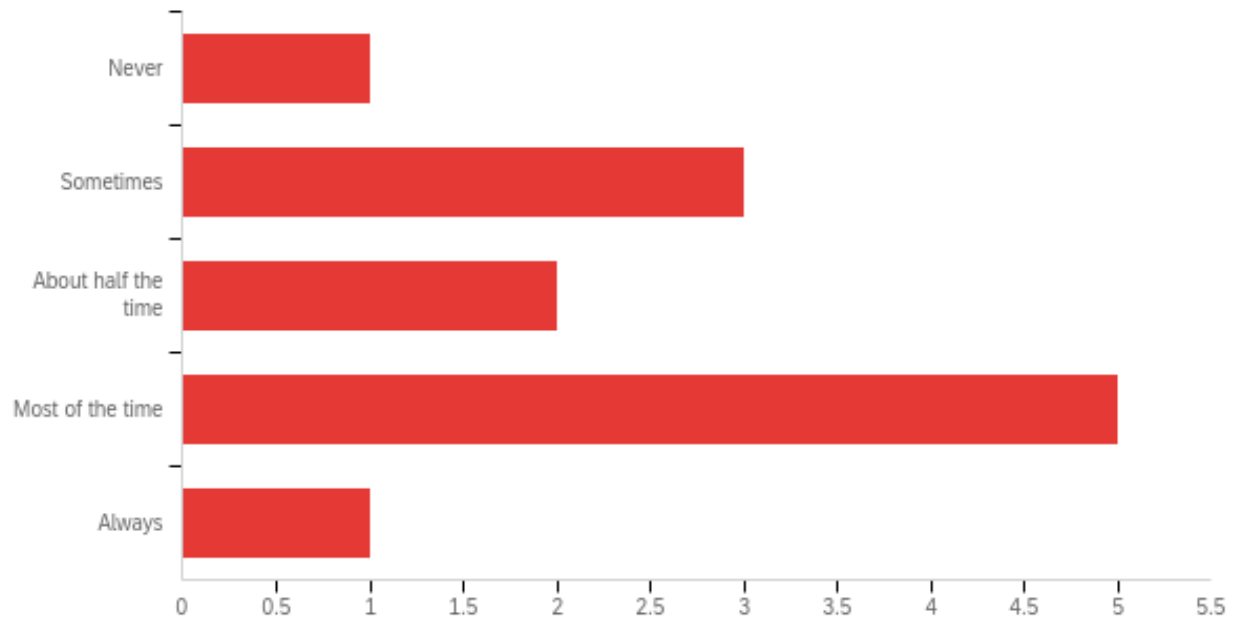
| # | Field           | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|-----------------|---------|---------|------|---------------|----------|-------|
| 1 | Education Level | 1.00    | 2.00    | 1.50 | 0.50          | 0.25     | 12    |

| # | Answer        | %      | Count |
|---|---------------|--------|-------|
| 1 | Undergraduate | 50.00% | 6     |
| 2 | Graduate      | 50.00% | 6     |
|   | Total         | 100%   | 12    |

**Q4 - You are satisfied with the overall user experience using the Canvas Quiz system**

| # | Field   | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---------|---------|------|---------------|----------|-------|
| 1 | You are satisfied with the overall user experience using the Canvas Quiz system | 8.00    | 10.00   | 9.17 | 0.69          | 0.47     | 12    |

| #  | Answer                     | %      | Count |
|----|----------------------------|--------|-------|
| 6  | Strongly disagree          | 0.00%  | 0     |
| 7  | Somewhat disagree          | 0.00%  | 0     |
| 8  | Neither agree nor disagree | 16.67% | 2     |
| 9  | Somewhat agree             | 50.00% | 6     |
| 10 | Strongly agree             | 33.33% | 4     |
|    | Total                      | 100%   | 12    |

**Q5 - How often are you required to take an online exam or quiz instead of in person?**

| # | Field   | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---------|---------|------|---------------|----------|-------|
| 1 | How often are you required to take an online exam or quiz instead of in person? | 1.00    | 5.00    | 3.17 | 1.14          | 1.31     | 12    |

| # | Answer              | %      | Count |
|---|---------------------|--------|-------|
| 1 | Never               | 8.33%  | 1     |
| 2 | Sometimes           | 25.00% | 3     |
| 3 | About half the time | 16.67% | 2     |
| 4 | Most of the time    | 41.67% | 5     |
| 5 | Always              | 8.33%  | 1     |
|   | Total               | 100%   | 12    |

## Q6 - Do you think the online test-taking system via Canvas can be improved and if so how?

Do you think the online test-taking system via Canvas can be improved and if so how?

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It is quite easy and straightforward as is.

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Yes, because well for 1 when people use proctorio, it flags a lot of things that is not related to the exam. False cheating accusations

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Yes, because "I have seen people cheating easily, there could be a better way by using sensors to prevent cheating"

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It is good, I haven't faced any issues while using it.

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None

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Canvas should allow you to scroll through quiz questions rather than pressing next each time

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I didn't use it. So can't say anything.

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The test system could be improved if it was more informative during tests

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No.

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I think the online test taking system via Canvas is already good.

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I really had no problems even when they had issues with proctario during the covid era but a lot of other students had trouble with it.

---

Better editor options

## Q7 - What is your biggest annoyances with the online exam system?

What is your biggest annoyances with the online exam system?

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None so far.

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I think um, sometimes in short response, not the essay ones but fill in the blank, if its not exactly the correct wording even if it is the same concept it gets marked incorrectly

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Network connections and and the extension requirements for honorlock

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Network issue.

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None

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Not being able to scroll through questions

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Internet issue.

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It doesn't give notifications well enough to help me manage my time while taking a test

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Sometimes a little slow.

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The only biggest annoyance with the online exam systems is when professors make it where you are not allowed to go back and look at the previous question when you hit next but that really has nothing to do with the system itself.

---

Sometimes I forget identification card and lose about 10 minutes trying to find it.

---

The timer at the top adds anxiety, would rather have the option to show/hide it

**Q8 - Have you ever had any technical issues while taking an online proctored exam? (i.e. disconnections, input devices stop working, etc)**

Have you ever had any technical issues while taking an online proctored exam? (i.e. disconnections, input devices stop working, etc)

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No.

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Yes, wifi connection, and some of the honor lock system not working properly

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Yes, one when using honorlock and it was not able to detect the USF ID, taking away his time and making nervous

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Yes

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None

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Yes - technical connections and drop outs

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Yes.

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No

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No.

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The only technical issues I had is during hurricane season when the power and internet turns off

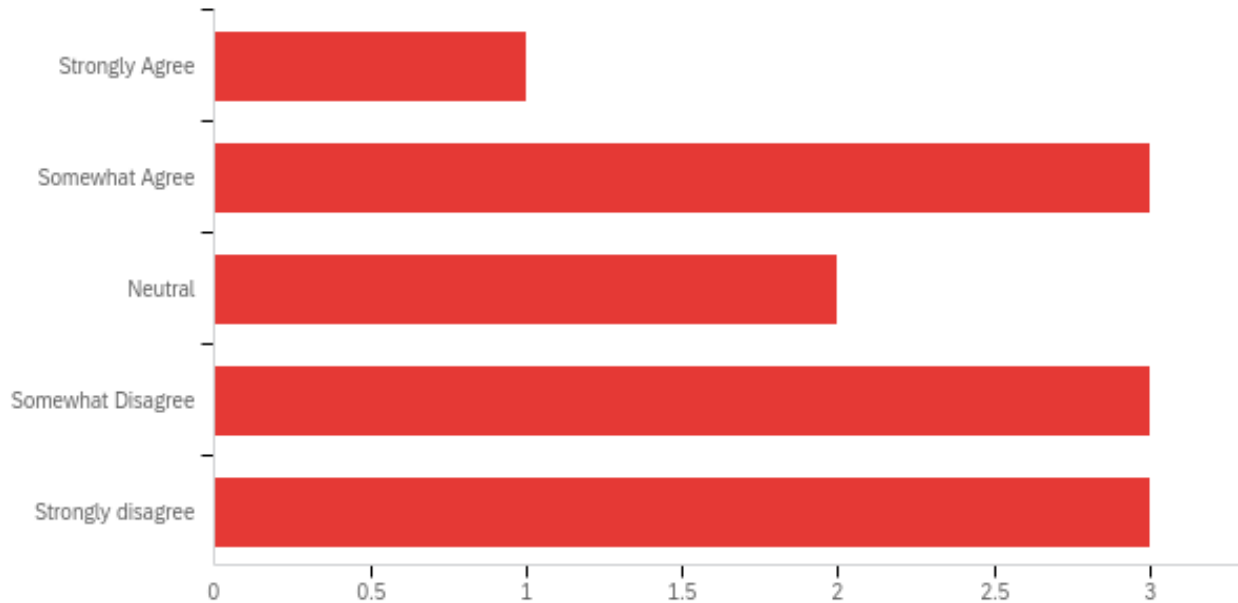
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I did once it needed an access code and I had to email the professor and I lost over 15 minutes of test time in which I didn't get back nor was it resolved. I think you are just shit out of luck when faced with that predicament.

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Yes I had a disconnection and had to get approval from teacher to resume the exam.

**Q9 - Do you sometime worry that your answers or the exam will not be properly submitted or that something will happen that will affect your grade?**



| # | Field   | Minimum | Maximum | Mean | Std Deviation | Variance | Count |
|---|---|---------|---------|------|---------------|----------|-------|
| 1 | Do you sometime worry that your answers or the exam will not be properly submitted or that something will happen that will affect your grade? | 1.00    | 5.00    | 3.33 | 1.31          | 1.72     | 12    |

| # | Answer            | %      | Count |
|---|-------------------|--------|-------|
| 1 | Strongly Agree    | 8.33%  | 1     |
| 2 | Somewhat Agree    | 25.00% | 3     |
| 3 | Neutral           | 16.67% | 2     |
| 4 | Somewhat Disagree | 25.00% | 3     |
| 5 | Strongly disagree | 25.00% | 3     |
|   | Total             | 100%   | 12    |

## **Q10 - Additional Comments Regarding your experience using the Canvas Quiz system**

Additional Comments Regarding your experience using the Canvas Quiz system

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I heard from others experiences that sometimes if you do not submit before the time runs out, chances are it submits or it doesn't submit. That's got to sting.