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TESTTIME: AN ONLINE EXAMINATION SYSTEM

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Biographical Sketch

The author, Andrew Joseph L. Ramos, is an IT professional currently employed in the BPO industry. A Bachelor of Science in Computer Science graduate of De La Salle University, Manila, he first started working as a mobile developer for a startup company in Ortigas called Wireless1. He then moved to Clark, Pampanga and worked as a web developer for a Korean-led e-commerce company, the now defunct Auction.ph. He has now spent 13 years working as IT support, development team leader, and IT manager for Ecell Philippines, a foreign-owned BPO and manufacturing company with headquarters in the United Kingdom.

Prior to being a student at UPOU, the author was enrolled at UPDEPP for the Master in Management program. He applied for and was admitted to the Master of Information Systems program back in 2020 with the goal of furthering his education and broadening his skillset on IS.

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Dedication

For the students and faculty of UPOU

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Abstract

The UPOU Office of Student Affairs or OSA Examination Services Program has begun administering exams in either online non proctored or online proctored double set up due to the ongoing COVID-19 pandemic (UPOU OSA, 2020). The project, entitled TestTime, is an online examination system that will help UPOU provide exams to their students in a streamlined manner without sacrificing exam integrity. The online examination system has the functionality to register users such as students and teachers. If the user is a teacher, the system has the functionality to add/edit/delete examinations as well as to add/edit/delete grades. If the user is a student, the system has the functionality to browse, read, take, and review examination questions and submit examination answers, as well as to submit answers for clarifications and regrading. It also allows a user who is either a teacher or faculty member to use a proctoring system while the student is taking an exam. This includes a webcam or screen capture of the student during the exam that allows the proctor to monitor the student in real time. The project includes a review of online examination systems and existing alternatives. The results were evaluated by gathering the input of students on the usability of the system's functionality and features. Recommendations on how the system can be improved with further development were also included.

Keywords: UPOU; online exams; examination systems; proctoring

Chapter I

THE PROBLEM DOMAIN

Statement of the Problem

The University of the Philippines Open University or UPOU is an academic institution that offers online education and distance learning. The project was done to address the following gaps in the current UPOU online examination system:

1. Lack of features in terms of managing exam questions and answers
2. No straightforward mechanism for student and teacher feedback on exams
3. The absence of built-in proctoring functionality

Background and Objectives of the Project

The ongoing COVID-19 pandemic has caused academic institutions to implement several changes to their methods of teaching and assessment. As governments implement lockdowns to enforce social distancing rules, more and more learning has shifted from the offline to online modes. This shift from the physical to the virtual space has included testing and student examinations. Previously, examinations were held in specific locations where the students would go, armed with pen and paper or computing devices, proctored by faculty. Now, it is fully online, and the students will either not be proctored or be monitored in other ways. These ways can be described as “new opportunities for the inclusion of innovative pedagogies and assessment where examinations are considered necessary” (Butler-Henderson et al., 2020).

According to Abass et al. (2017), examinations are conducted for the following reasons:

1. Evaluate student progress

2. Review and measure teacher effectiveness

3. Guide students on their learning

4. To help select students for awards or certifications

Critically, the goal of examinations is to assess a student's academic performance. This in turn gives importance to selecting the method of examinations to elicit the best outcome for students and teachers. These methods can be narrowed down to two: traditional and digital. The familiar pen and paper tests fall under the traditional method while online examinations, using personal computers and connecting to the Internet, fall under the digital method. There are pros and cons for each method. From the student's perspective, it may be less distracting to take exams in school classrooms rather than at home. From the teacher's perspective, it may be less difficult to grade exams if they were done online rather than on paper. Convenience and ease-of-use may have been some of the deciding factors on which method to choose for testing. However, the pandemic has forced academic institutions to move most if not all examinations to the digital method.

Significance and Scope of the Project

The project was initiated with the objective to propose improvements and/or enhancements to the UPOU online examination system. There is a need to provide additional functionality to the existing system as is demanded by the current environment. In Ngqondi et al. (2021), the authors discussed several studies on student performance with examinations done under the traditional method and those done under the digital method. The traditional method with a physical proctor present was compared with the digital method where a remote proctor was set up via webcam. The results were comparable. When surveyed, 70% of students answered that an

online examination with a remote proctor dissuaded them from cheating. The presence of a remote proctor also made the students “feel supported” and valued and made the examination more credible.

The scope of the project is limited to providing UPOU with an online examination system that has the functionality of providing teachers with the ability to create and grade exams, as well as providing students with the ability to take exams and send feedback. The system also allows teachers to proctor their students remotely. The end of the project includes a survey from students about the usability of the system.

Documentation of Existence and Seriousness of the Problem

Students and teachers alike are faced with several problems during online examinations. In the traditional method, the key to resolving most of the challenges is by being physically present to take the exam as a student and to give the exam and/or proctor it as a teacher. The student will find it harder to cheat without being found out by those in the same room, and simply fails the exam if they are absent without a valid reason. The exam also does not happen if for some reason the teacher is not present. In the digital method, students and teachers face even more challenges. Bhardwaj (2020) identified the following issues:

1. Malpractices and suspicious activities
2. Identification and verification
3. Infrastructural barriers
4. Use of human evaluators and proctors

Malpractices and suspicious activities stem from the physical separation between student and teacher or test taker and provider. The “absence of supervision”

makes it more difficult to police these suspicious activities, primarily those engaged in cheating. Identification and verification issues arise from not being present in a single location. There are concerns that need to be addressed such as the teacher being made fully aware that the actual student is taking the online examination and not somebody else. Infrastructural barriers can present as problems with Internet connectivity, power/electricity, the student's device at home, or the web server the teacher is using to host the online exam. These can also relate to the lack of certain devices that teachers can require students to take the exams, such as webcams for proctoring. The devices can also be present or available but found inadequate, such as a slow computer for a student, or a webcam with very low resolution that cannot be used for remote proctoring. The use of human evaluators and proctors also give rise to problems such as increased labor cost and a longer turnaround time to deliver the results of examinations. All of these issues combined threaten to "compromise the integrity, security, and objectivity of online exams" (Muzaffar et al., 2021).

Chapter II

REVIEW OF EXISTING ALTERNATIVES

Online examination systems have been the subject of numerous studies and there are a wide range of existing alternatives from those that are free and open source to those that are paid and proprietary. Moodle, which is currently in use by UPOU, is one example of open-source software with support for online exams. Canvas LMS, with add-ons, is an example of proprietary software. Hameed et al. (2017) lists down other examples such as:

1. SIETTE or System of Intelligent Evaluation using Tests for Tele-Education
2. EMS or Exam Management System
3. CBTS or Computer Based Test System

SIETTE is a web-based examination system for creating tests that can adapt to its users based on their answers to the self-assessment questions. EMS is an examination system that primarily deals with exam management, grading, and report generation for teachers. CBTS is an online examination system that has features on exam integrity such as automatic submission of answers after the permitted time has elapsed, among others.

In Martono, et al. (2020), the authors discussed the following studies of online examination systems:

1. Assessment of online exam system acceptance
2. Analysis of the benefits of online exam Information System implementation
3. Design of online examinations that are web-based

4. Online exam application using PHP and MySQL

5. Online examination system using Latent Semantic Analysis

The study on user acceptance of online exam systems noted that the rate of acceptance was 61.8% among users who found the system convenient to use. The analysis of the benefits of online exam systems found that user satisfaction was a key indicator to perceived benefits. Web-based online examination systems built using PHP as the programming language and MySQL as the database engine were also studied. Latent Semantic Analysis, which deals with natural language processing, was another area considered due to its applications for essay-type online examinations.

With these studies, the project was able to implement existing best practices for online examination systems such as ease of use, a focus on user satisfaction, adding features for exam management, and building on available technologies.

Chapter III

APPROACH TAKEN IN THIS PROJECT

Theoretical Framework

The project followed the framework shown below, which was patterned on the research methodology outlined in Teplechuk (2013):

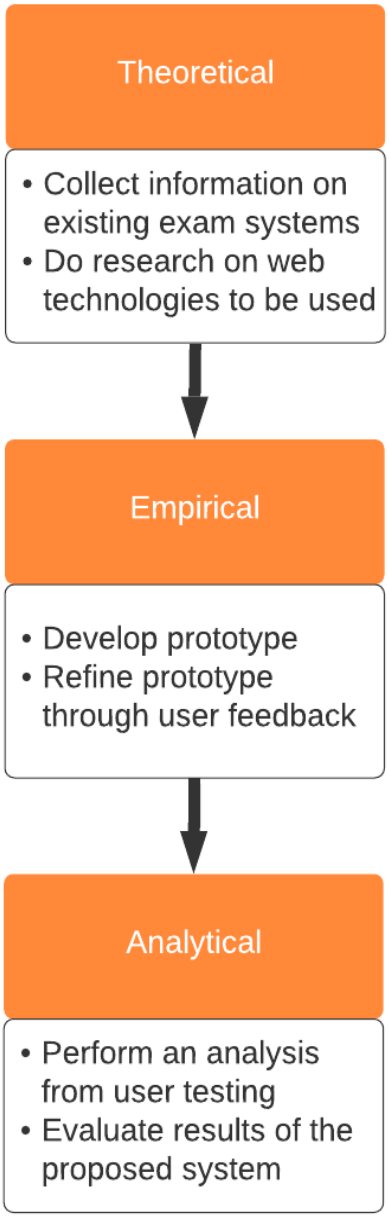

Figure 1. Proposed framework

Rationale for the Framework

In the development of information systems, there are two approaches that can be used: prespecification and prototyping (Albacea et al., 1998). Prototyping is a method of development that allows for open and constant communication with the development team and the end users in terms of feedback from the use and testing of prototypes. It provides a way to learn from users during the development process and get ideas from them on improvements to the system.

The framework chosen centers on prototyping to help get immediate feedback from users which in turn will lead to a better system that is attuned to their needs. The prototype was then refined based on this feedback. The final stage consisted of gathering and analyzing the results from a user survey. These results were then used to conclude if the project has achieved its goals in addressing the gaps with the current online examination system.

Technologies used

Several open-source web technologies were used on the project, including the following:

1. Ubuntu 20.04 or greater for the operating system
2. Apache 2.0 or greater for the web server
3. PHP 5.6 or greater for the programming language
4. MySQL 8.0 or greater for the database
5. JavaScript libraries such as Parsley for form validation and PeerJS for webcam streaming

Ubuntu is an open-source operating system developed by Canonical Ltd. It is based on the Linux kernel which was created by Linus Torvalds. The most recent version of Ubuntu as of this writing is 21.10.

Apache HTTP server is a robust open-source web server software developed by the Apache Software Foundation. The most recent version of Apache as of this writing is 2.4.52.

PHP is a server-side programming language that is used for web applications. It is the backend of some of the most popular websites in the world, such as WordPress and Facebook (during its early stages). The most recent version of PHP as of this writing is 8.1.1.

MySQL is a database management system that can be freely downloaded and used under the GNU General Public License. The most recent version of MySQL as of this writing is 8.0.27.

JavaScript is a popular scripting language that has libraries available that provide access to web APIs such as those used to perform asynchronous form submission, validate input fields, and view a user's webcam or screen.

Open-source technologies were chosen to develop the project as against existing alternatives that might be proprietary or need paid licenses to be used. For the purposes of development and testing, an entry level tier virtual machine instance was set up on a cloud provider, specifically Amazon AWS.

Contributors or Collaborators

The project work and responsibilities were done solely by the author.

Chapter IV

PROJECT DETAILS

Concept

The online examination system, entitled TestTime, has the functionality to register users such as teachers and students. If the user is a teacher, the system has the functionality to add/edit/delete examinations as well as to add/edit/delete grades. If the user is a student, the system has functionality to browse, read, take, and review examination questions and submit answers, as well as to give feedback for clarifications and regrading. It also has a proctoring system while the student is taking an exam. The figure below visually represents the functionality for each user:

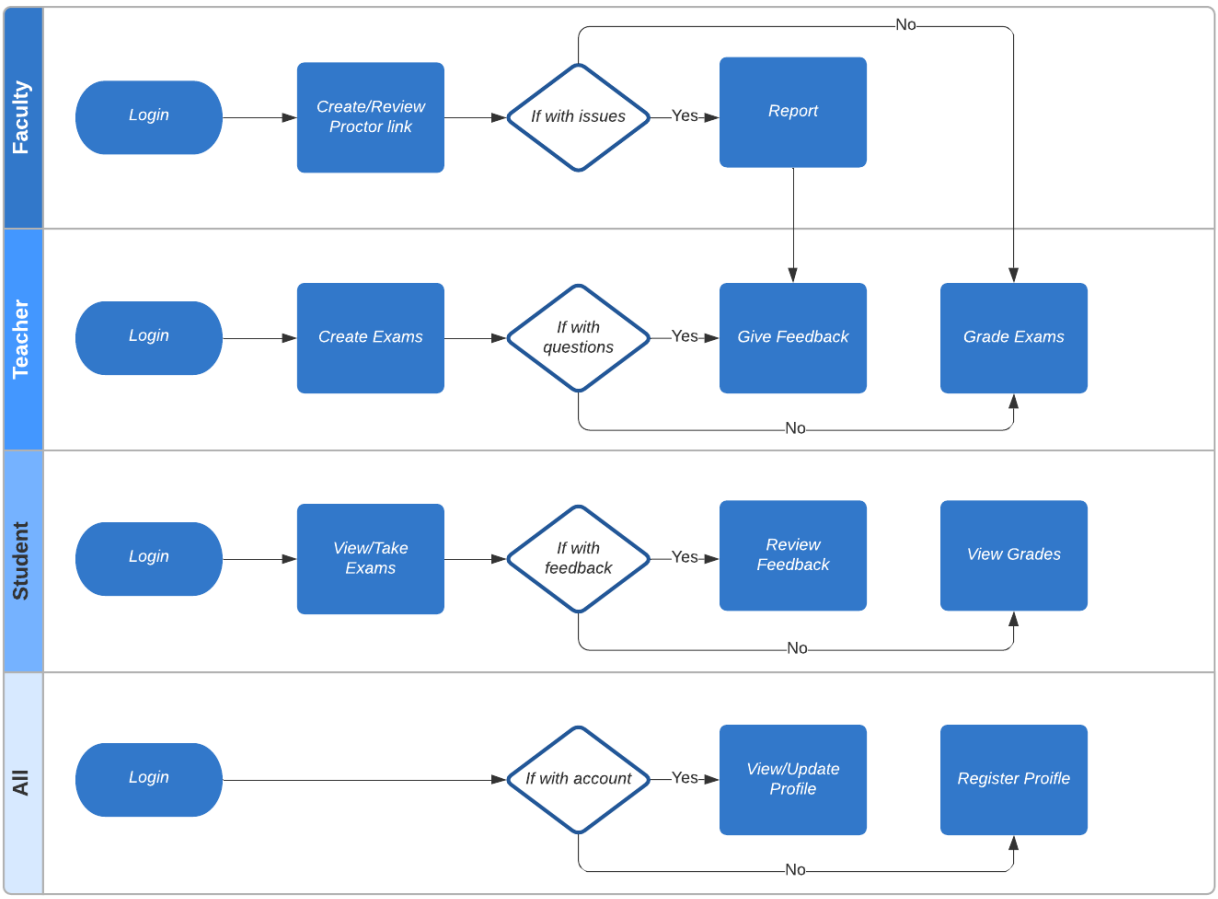

Figure 2. Process model

The key features of the online examination system are the following:

1. User Management
2. Exam Management
3. Exam Taking
4. Exam Feedback
5. Exam Proctoring

User Management is where users can register their accounts and update their profiles. Exam Management is where users can create and view their exams. Exam Taking is where users can take their exams. Exam Feedback is where users can be graded and view their feedback or questions about the exams. Exam Proctoring is where users can set up and review the video streams for proctoring during exams.

The stakeholders for the project are divided into the following:

1. Students
2. Teachers
3. Faculty
4. All users

Students can take exams, review their answers, submit exams, and review their grades. They can submit exam feedback or questions to their teacher. Teachers can create, view, modify, delete, and grade exams. They are also able to submit responses to any student feedback or questions, as well as re-grade exams as they see fit. Teachers or faculty members that are assigned to proctor students can create and view webcam streams of the students while taking exams. All users of the system can edit their profiles and change their passwords.

Methods

The methods used for development include a review of existing online examination systems. Literature on examination systems and the switch from offline to online examinations were studied. Looking up examples of online examination systems was included in the review. The review also checked for existing functionality similar to the proposed system.

There was a prototype made and the output presented to users for evaluation and testing. Assessment methods included the creation of a system usability survey, as well as questions for the users about the system. The survey was done to help evaluate the system's effectiveness.

The final report contains an analysis of the results from the usability survey. It also concludes with recommendations on any future modifications that can be done to further improve the system.

User Testing and Project Assessment

User acceptance testing was proposed for UPOU students. A system usability scale or SUS questionnaire was done to assess the usability of the project and to gather user feedback after testing. SUS scores were then computed, and an analysis done to check if the problem was addressed by the project.

There are several questions that were answered:

1. Is the examination system working as expected in the perspective of a student taking the exam?
2. Is the examination system working as expected in the perspective of a teacher managing and grading the exam?

3. Is the examination system working as expected in the perspective of a faculty member proctoring the exam?
4. What improvements could be made?

A five-point scale rating consisting of strongly disagree, disagree, neutral, agree, and strongly agree were used for the set of questions to identify the usability of the project. The questions for the usability survey were as follows:

1. I think that I would like to use TestTime frequently.
2. I found TestTime unnecessarily complex.
3. I thought TestTime was easy to use.
4. I think that I would need the support of a technical person to be able to use TestTime.
5. I found the various functions in TestTime were well integrated.
6. I thought there was too much inconsistency in TestTime.
7. I would imagine that most people would learn to use TestTime very quickly.
8. I found TestTime very cumbersome to use.
9. I felt very confident using TestTime.
10. I needed to learn a lot of things before I could get going with TestTime.

Security Testing

Security testing was done by running the online examination system through the free and open source OWASP Zed Attack Proxy or OWASP ZAP software, which can be downloaded at: https://www.zaproxy.org.

Chapter V

RESULTS AND DISCUSSION

The online examination system can be found at: https://drewramos.me/testtime. The user guide is uploaded at: https://drive.google.com/file/d/1NIAJ_Y824s8gK3-EOKg8X0TWAh_k0Vw9/view?usp=sharing. Users can register and login with their own accounts or use the test accounts alramos4+student@up.edu.ph for the Student Portal and alramos4+teacher@up.edu.ph for the Admin Portal. Both are set with the password: Testp@ss1.

The figure below shows the student registration page under the User Management feature. It uses the Parsley JS library to validate user input quickly without needing to reload the page:

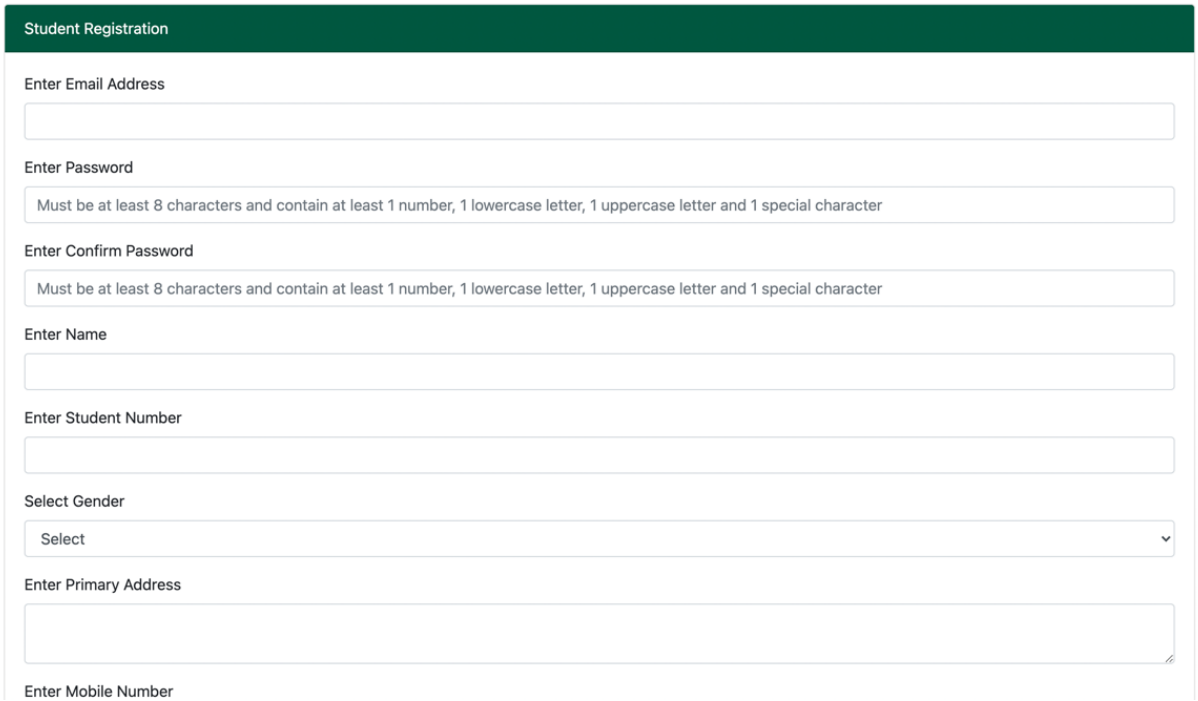

Figure 3. User Management

Once registered, the user can then login and access the Exam Management feature. The page provides a streamlined interface with only two sections: Create or Attend Exam and Exam List, as shown in the figure below:

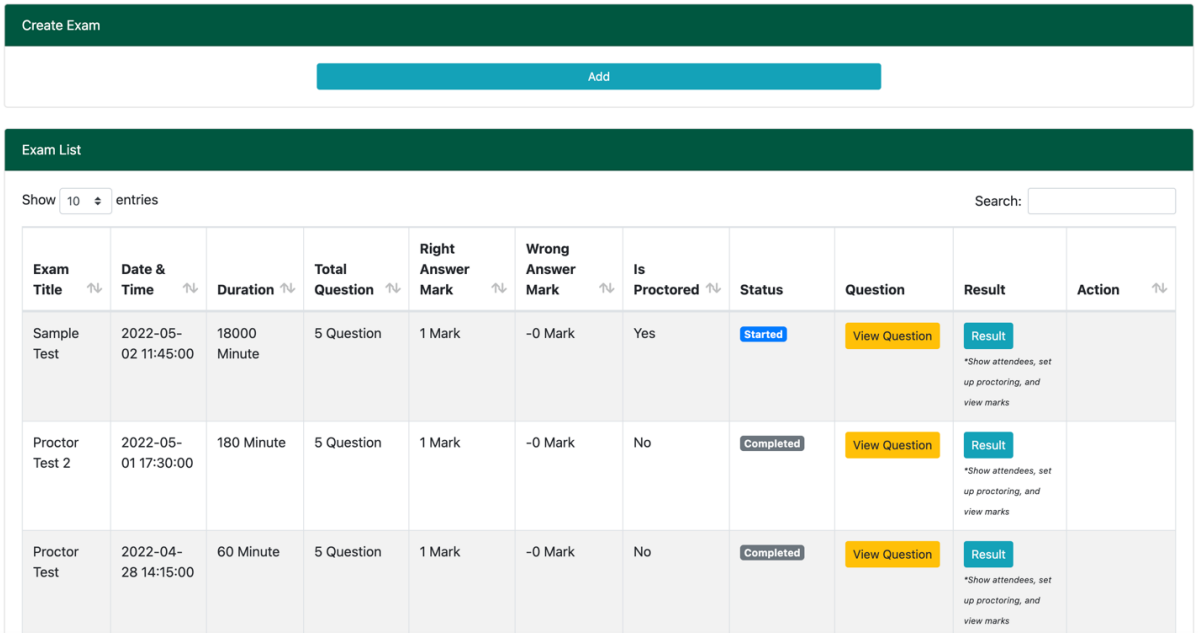

Figure 4. Exam Management

The page buttons show inline popups when clicked that allow the user to perform functions such as creating or attending exams, managing exam questions, viewing the exam attendees and results, as well as taking the exam:

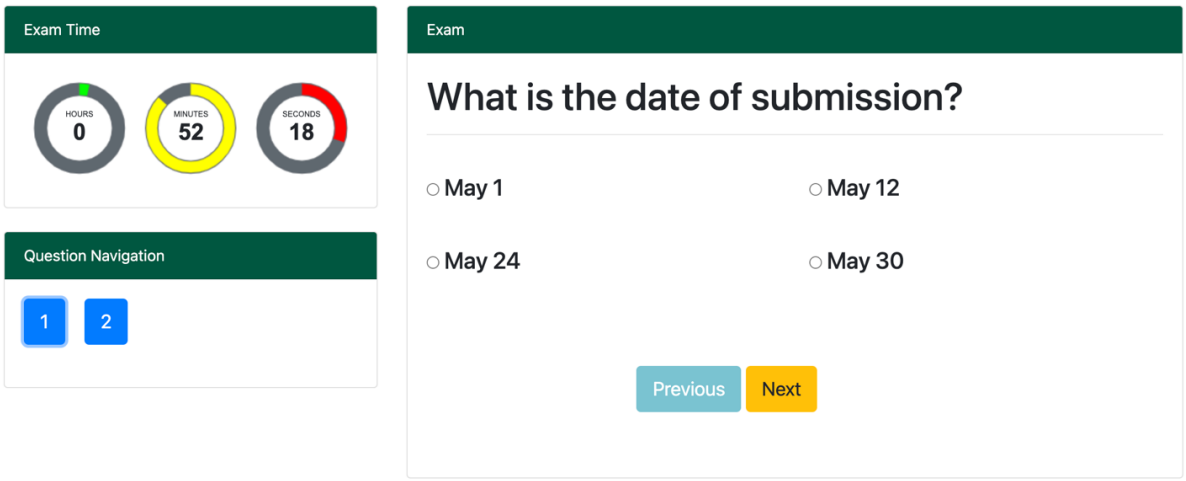

Figure 5. Exam Taking

Upon completion of the exam the user can view the results and, if the user is a student, has the option to submit feedback to the teacher for any question that needs clarification. The teacher can then easily respond to the feedback of the student as both input fields are on the same page, as shown in the figure below:

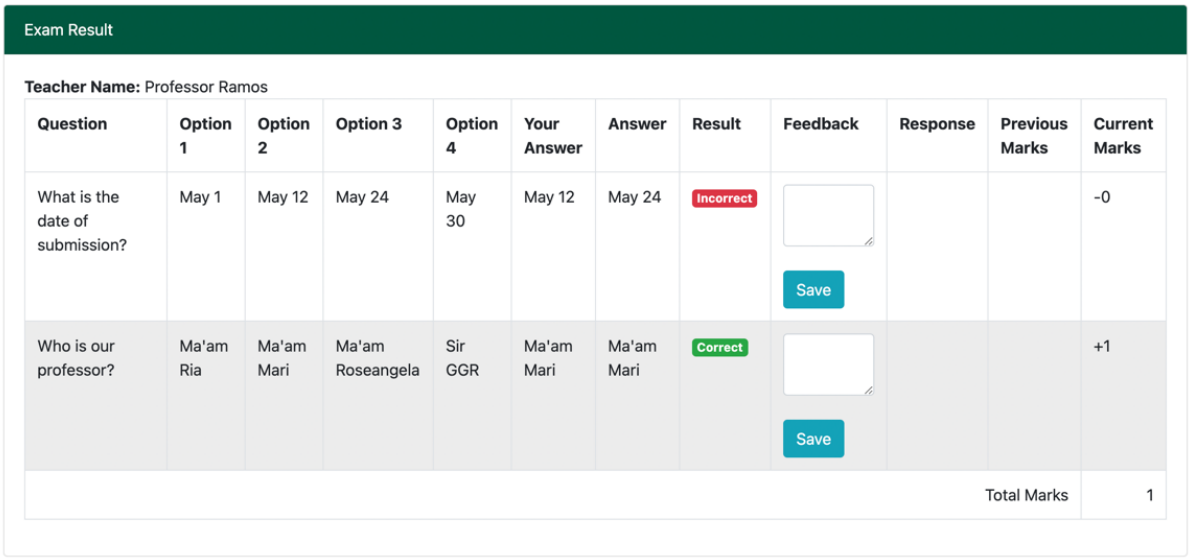

Figure 6. Exam Feedback

The system also has an Exam Proctoring feature using the PeerJS library. A proctor link is sent to the student's email address once the webcam is enabled. The student can also click on the Share Screen button to let the teacher monitor the screen:

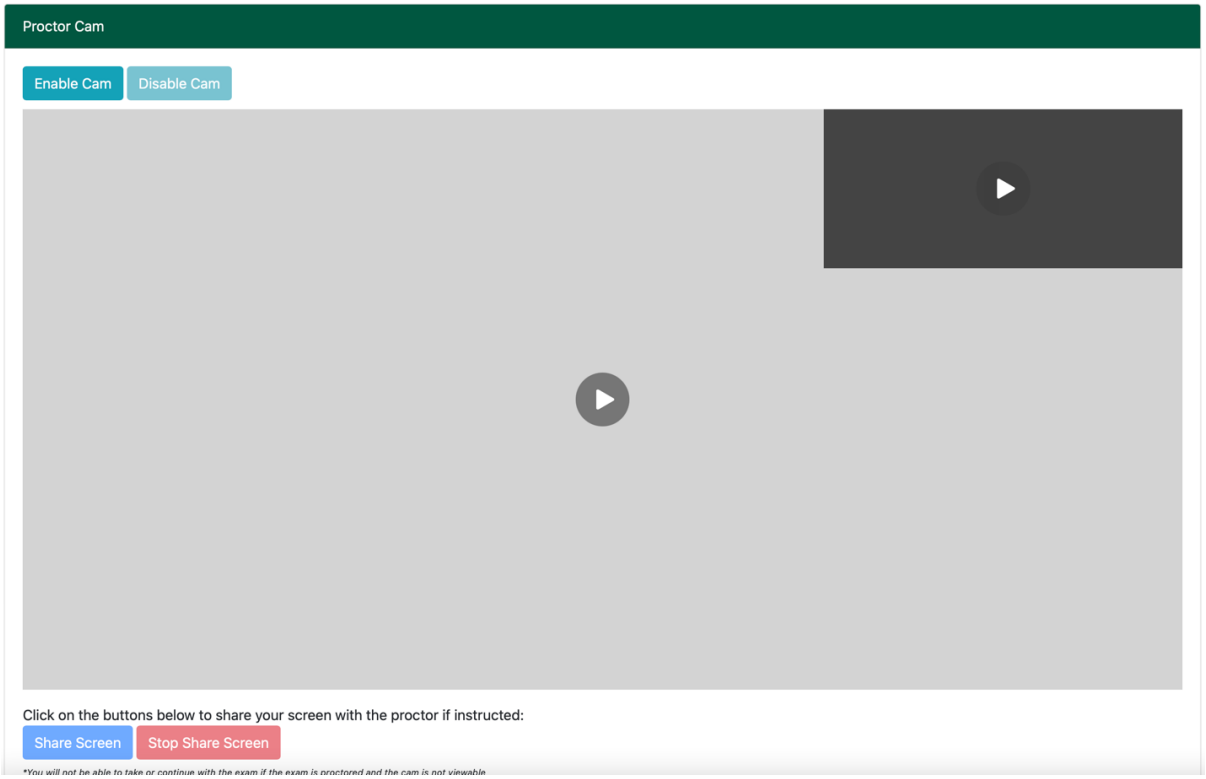

Figure 7. Exam Proctoring

The usability survey form can be found at the following Google Forms link: https://forms.gle/AKyBSZdrWLkariko6. Thirty students enrolled in IS 295 were sent invitations via UPOU MyPortal messaging to take part in the survey. A total of five students responded and gave their answers. The figure below shows the ratings given by each survey respondent as well as the SUS scores:

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
R1	3	2	5	1	3	3	5	1	4	1	80
R2	5	1	5	1	5	1	5	1	5	1	100
R3	4	2	4	1	4	2	3	1	3	3	72.5
R4	4	3	3	4	3	3	2	3	3	4	45
R5	5	5	5	1	4	4	5	1	5	1	80

Figure 8. SUS scores

A rating of 1 means strongly disagree, 2 means disagree, 3 means neutral, 4 means agree, and 5 means strongly agree for each question of the usability survey. The mean SUS score of the system was computed to be 75.5. In Bangor, et al. (2009),

a SUS score above 70 falls within the acceptable range with an adjective rating between good and excellent:

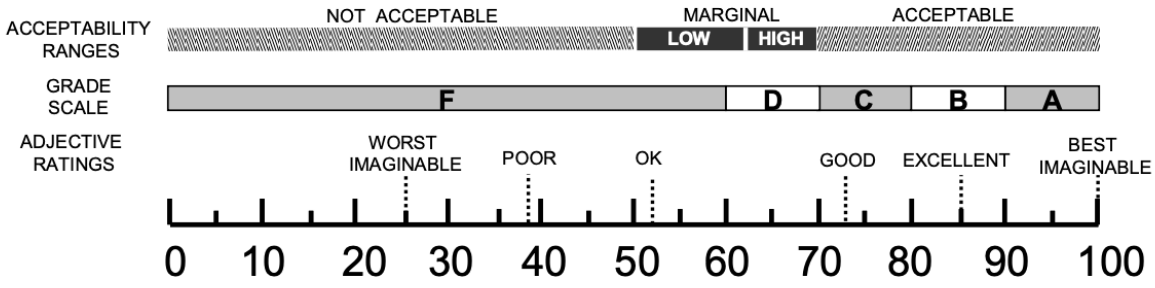

Figure 9. SUS ratings

The respondents were also asked for their feedback about the system and its proctoring functionality. Their comments are listed below:

1. I think there could be benefits for having the webcam internally supported within the same exam application.
2. Easy to use yet secured.
3. It saves time because I don't need to access external app like GMeet. It offers convenience since everything is available within the TestTime application alone.
4. I think it is good to integrate the remote proctoring via webcam since it lessens the preparation/installation time necessary when using external apps. It also gives the proctor control of the exam through the viewable and not viewable buttons unlike when using Google Meets.
5. This is better because you don't need to create or sign-in in multiple apps.

The system was also run through an automated scan using the OWASP ZAP software to look for any security vulnerabilities. The software classifies security risks as five levels: high, medium, low, and informational. The scan found no high-risk vulnerabilities present in the system:

		Confidence				
		User Confirmed	High	Medium	Low	Total
Risk	High	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Medium	0 (0.0%)	1 (8.3%)	2 (16.7%)	1 (8.3%)	4 (33.3%)
	Low	0 (0.0%)	0 (0.0%)	5 (41.7%)	1 (8.3%)	6 (50.0%)
	Informational	0 (0.0%)	0 (0.0%)	1 (8.3%)	1 (8.3%)	2 (16.7%)
	Total	0 (0.0%)	1 (8.3%)	8 (66.7%)	3 (25.0%)	12 (100%)

Figure 10. ZAP alerts by risk

The medium level risks found include recommendations for anti-CSRF tokens, Content Security Policy headers, directory browsing, and anti-clickjacking headers.

Chapter VI

CONCLUSIONS

TestTime is an online examination system that enables its users, the students and faculty of UPOU, to do the following:

1. Register and update their profiles and passwords
2. Easily manage and take exams
3. Quickly provide grading feedback to teachers
4. Give responses to feedback from students
5. And allow teachers to monitor their students remotely via webcam using the integrated proctoring functionality

These features address the enumerated gaps in the current UPOU online examination system. The research showed that convenience and user satisfaction increase the perceived benefits of taking exams online. Remote proctoring also promotes exam integrity. Offering exam features in a system that is easy to use, based on a survey of users, results in a better experience for students and teachers.

Chapter VII

RECOMMENDATIONS

Recommendations for future project development include adding support for non-text questions and answers in the form of images or videos, multiple proctor webcam streams to enable a double proctoring setup, and capturing user audio. Recording both the video and audio of a proctoring session for later review can be a useful addition to the system's Exam Proctoring feature. Natural language processing for grading of essay-type answers could also be an area of further research.

The maintenance plan of the system includes addressing the medium level risks found by the OWASP ZAP software, such as: using anti-CSRF or Cross-site request forgery packages like OWASP CSRFGuard, adding the Content-Security-Policy HTML meta-tag, disabling directory browsing by adding an index file to all directories, and configuring Apache for anti-clickjacking headers by editing the site configuration. To support more users, the virtual machine where the system is hosted should be upgraded in terms of disk space, memory, and bandwidth.

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Appendices

A. Deliverables and Milestones

The deliverables of the project were the proposal, online examination system, user guide, usability results, and manuscript. The milestones can be found below:

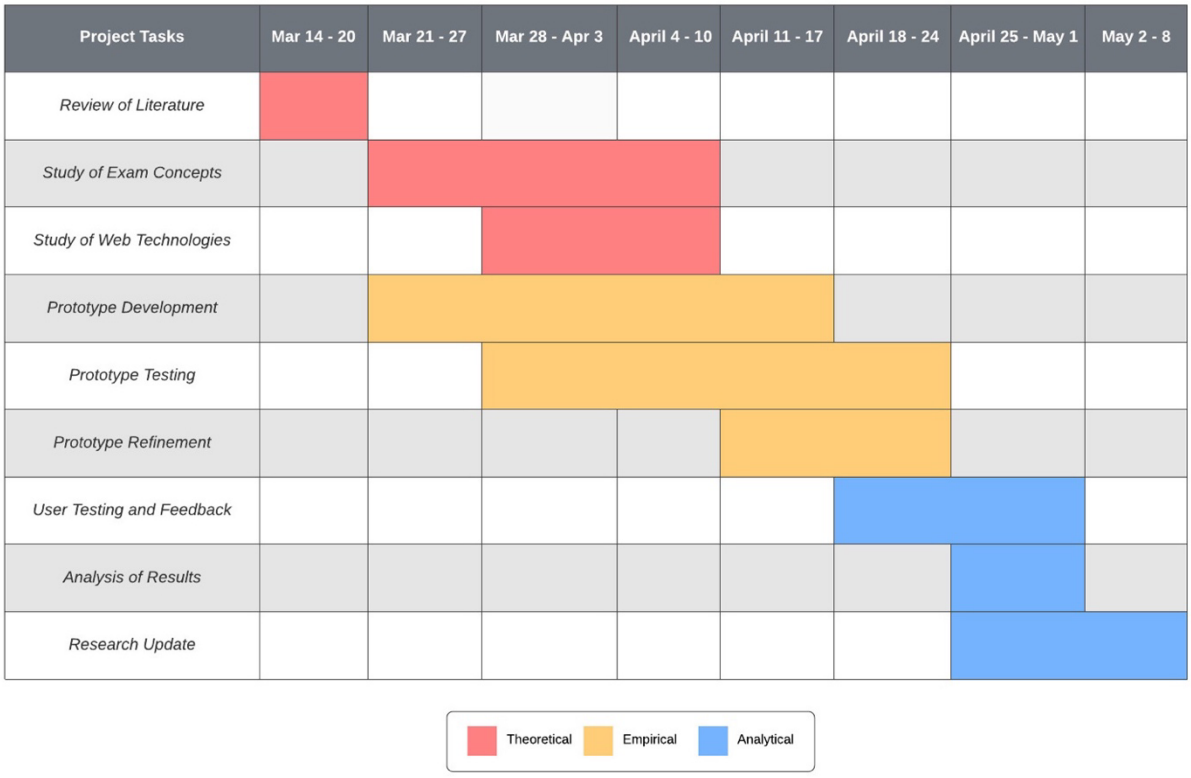


Figure 11. Gantt chart

B. Budget

The budget used up for the project was USD 9.15 for Amazon AWS hosting.

C. Qualifications

The author's qualifications include course work and professional experience in software development as well as a bachelor's degree in Computer Science. During the project, the author gained new knowledge on libraries related to web programming.

D. Additional Resources

The Github for the project can be found at: https://github.com/alramos4/testtime.

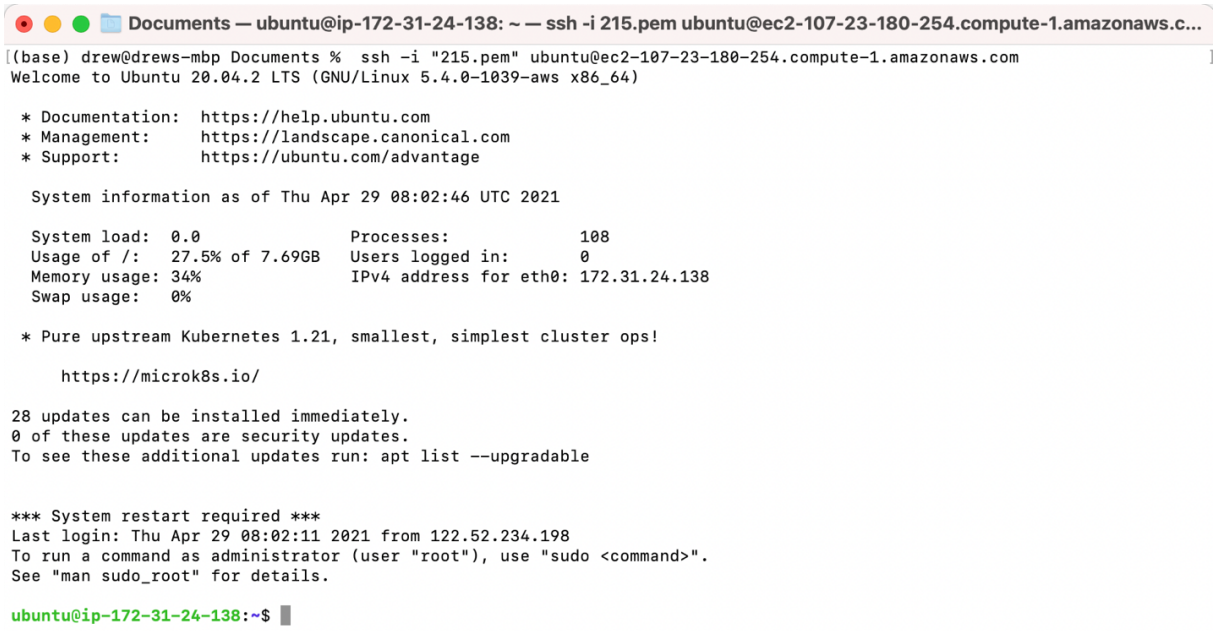
E. User Manual

The content below is from the user manual for TestTime and sent as part of the instructions for the survey respondents.

Site configuration

1. To configure the site, we will need to connect to our virtual machine instance on Amazon AWS. For reference we will follow the guides on the links below:
   https://phoenixnap.com/kb/ssh-to-connect-to-remote-server-linux-or-windows
   https://www.tecmint.com/initial-ubuntu-server-setup-guide/

2. First using the key pair created when we started our EC2 virtual machine instance we will login via SSH with the following command on the terminal:
   ssh -i "[key pair]" [user]@[ip address].compute-1.amazonaws.com

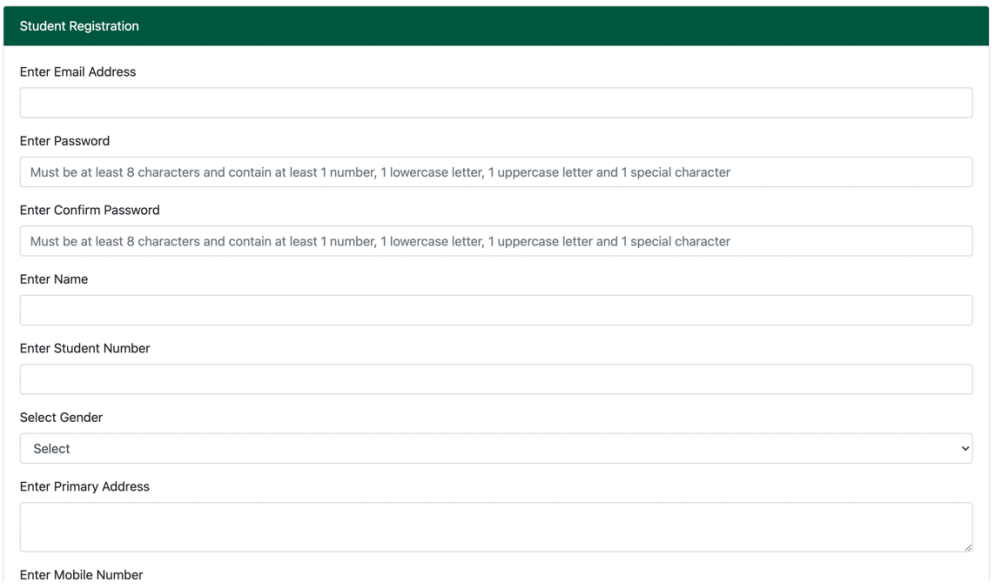


3. Once logged in, we can then configure the server and site by running specific commands such as the Ubuntu package installer update command below:
   sudo apt update

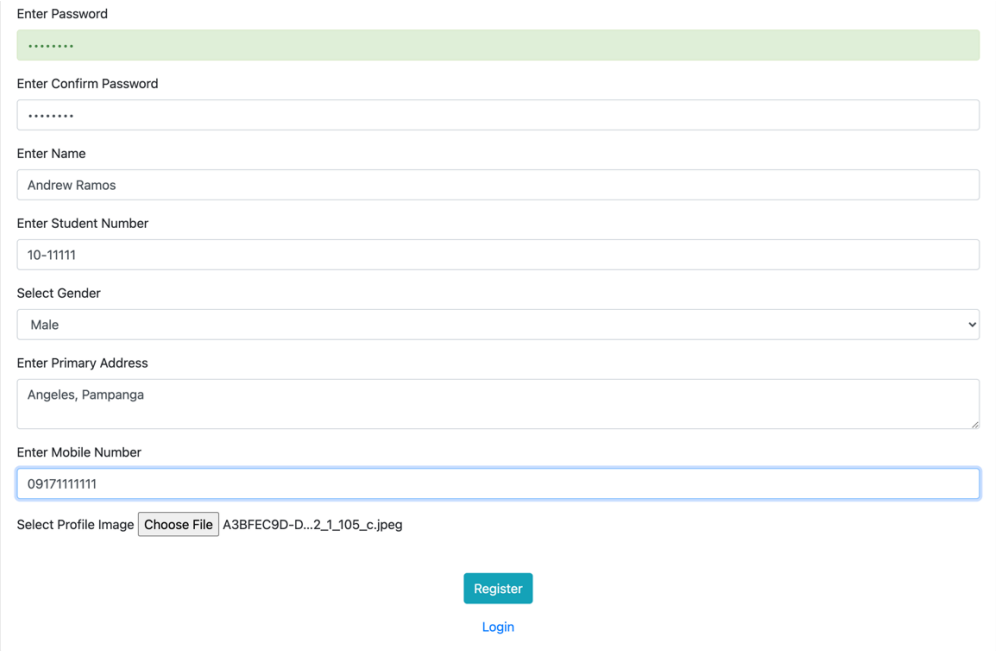
```
ubuntu@ip-172-31-24-138:~$ sudo apt update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-backports InRelease [101 kB]
Get:4 http://security.ubuntu.com/ubuntu focal-security InRelease [109 kB]
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [951 kB]
Get:6 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [765 kB]
Fetched 2040 kB in 1s (3058 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
37 packages can be upgraded. Run 'apt list --upgradable' to see them.
ubuntu@ip-172-31-24-138:~$
```

User registration

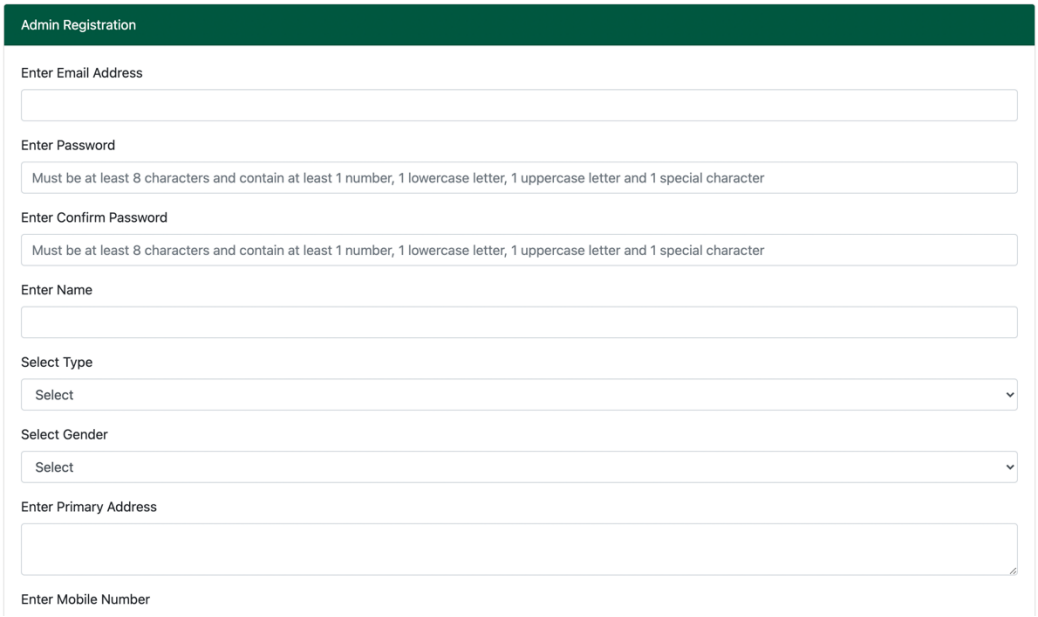
1. The Student Portal can be found at: https://drewramos.me/testtime. To register as a student, click on the Register link which will take you to the Student Registration page:



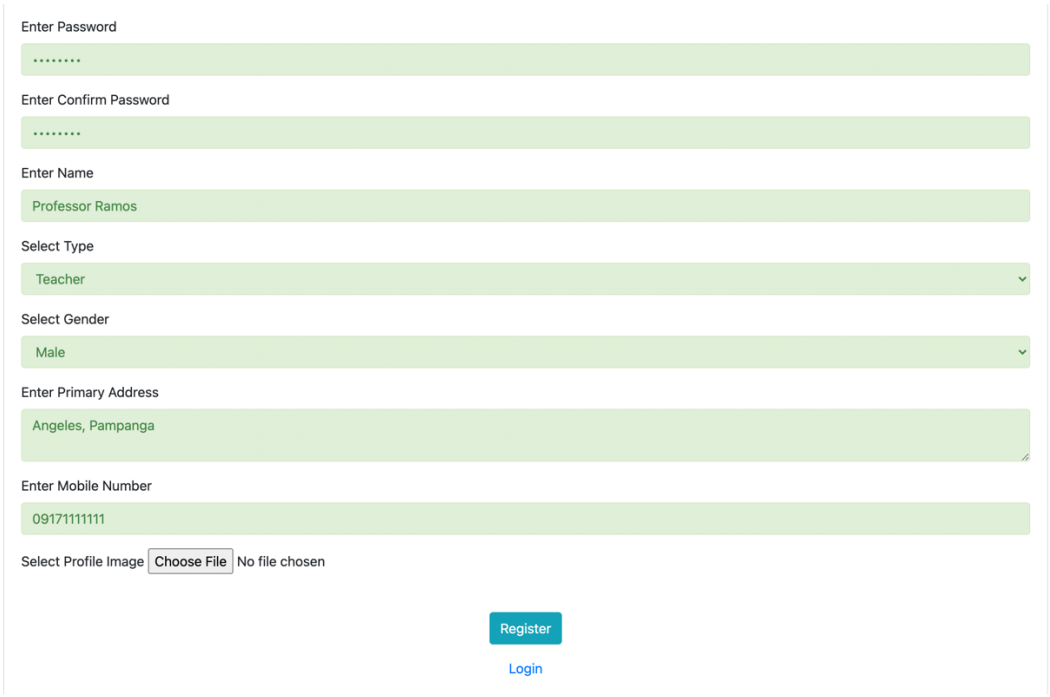
2. Enter your student details as required and you can also upload a photo, as shown below:



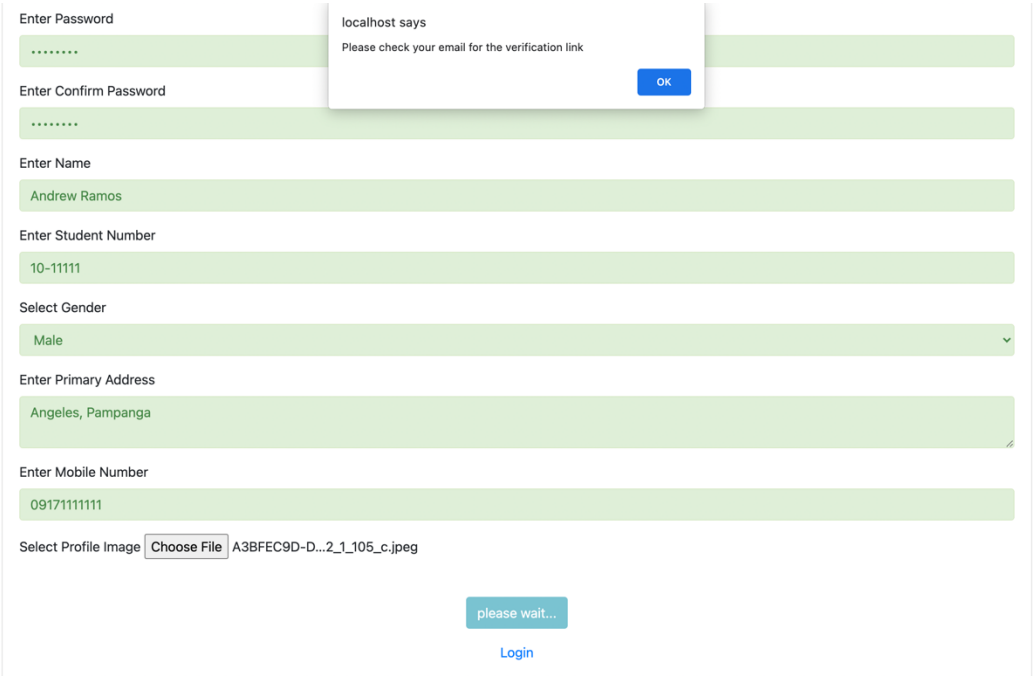
3. The Admin Portal can be found at: https://drewramos.me/testtime/admin. To register as a teacher, click on the Register link which will take you to the Admin Registration page:



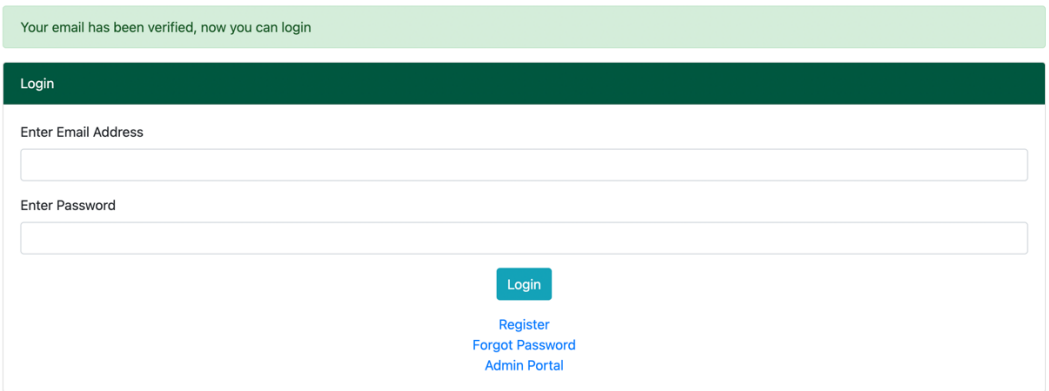
4. Enter your teacher details as required, make sure to select the user type as Teacher as shown below:



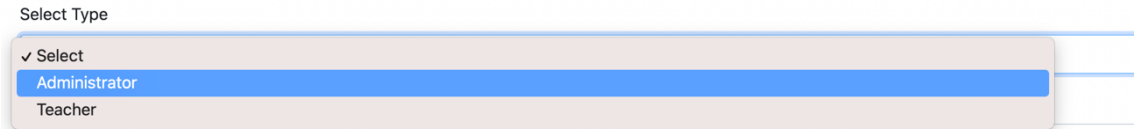
5. Once done, click on the Register button and it will let you know that a verification email has been sent:



6. Upon receiving the email, click on the link to verify your account and you can now login:

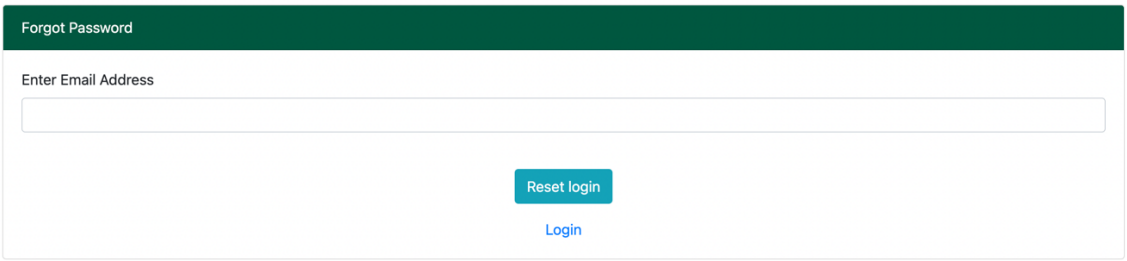


7. Note that you can also register as an administrator user by just selecting the Administrator type on the Admin Registration page and following the same steps above:

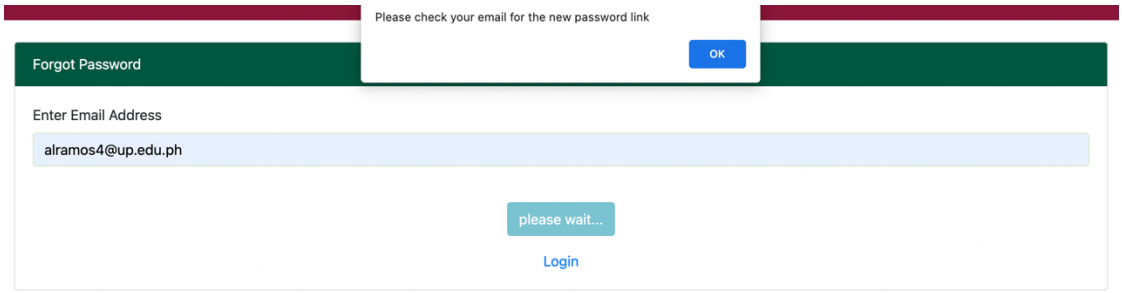


Password request

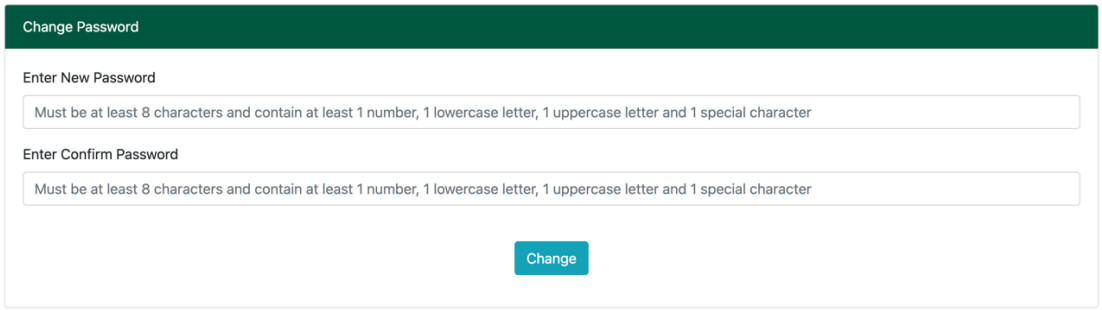
1. If you forgot your password, clicking on the Forgot Password link will take you to the page where you can enter the email address you used during registration:



2. Once you click the Reset login button it will let you know that an email has been sent:



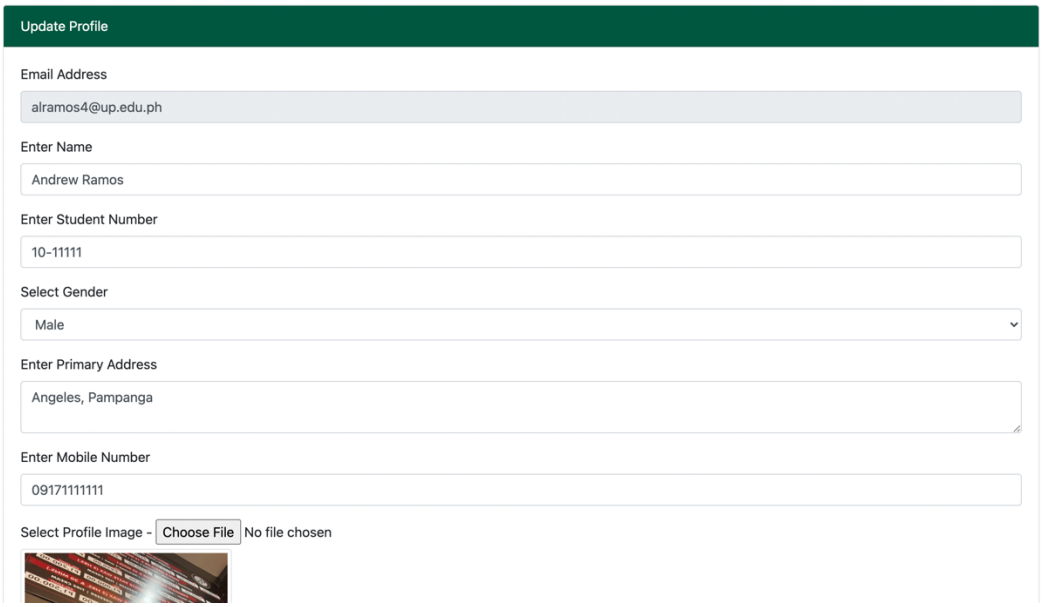
3. Upon receiving the email, click on the link to login to your account and you can now change your password:



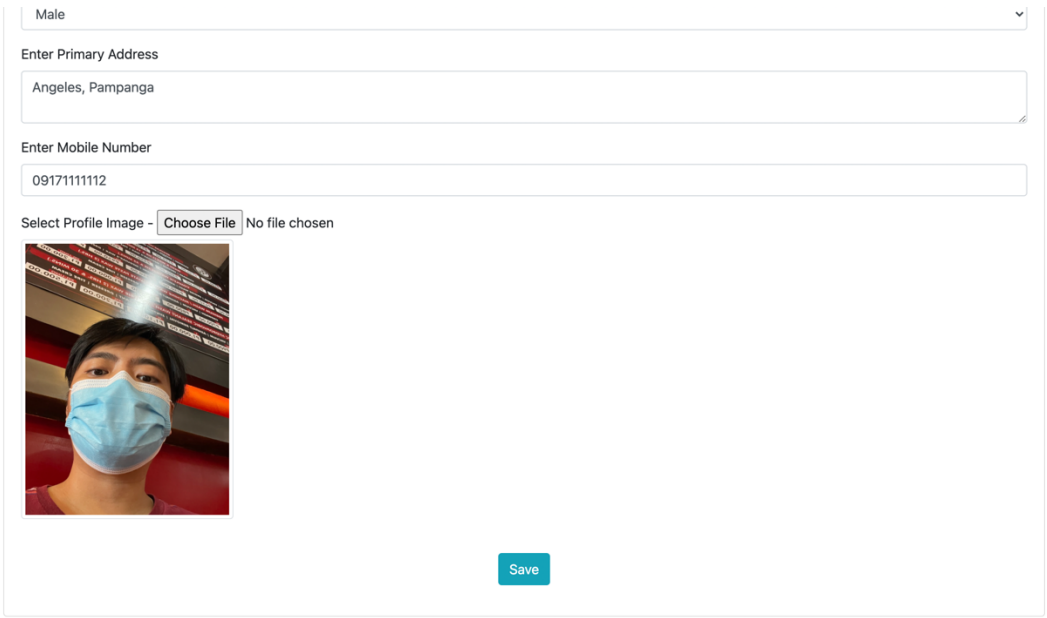
4. Note that if you choose not to change your password and you get logged out again, you will have to repeat the process if you still do not remember your password.

Edit user profile

1. When logged in on both the Student and Admin Portal, clicking on Update Profile link on the menu bar will take you to the Update Profile page:

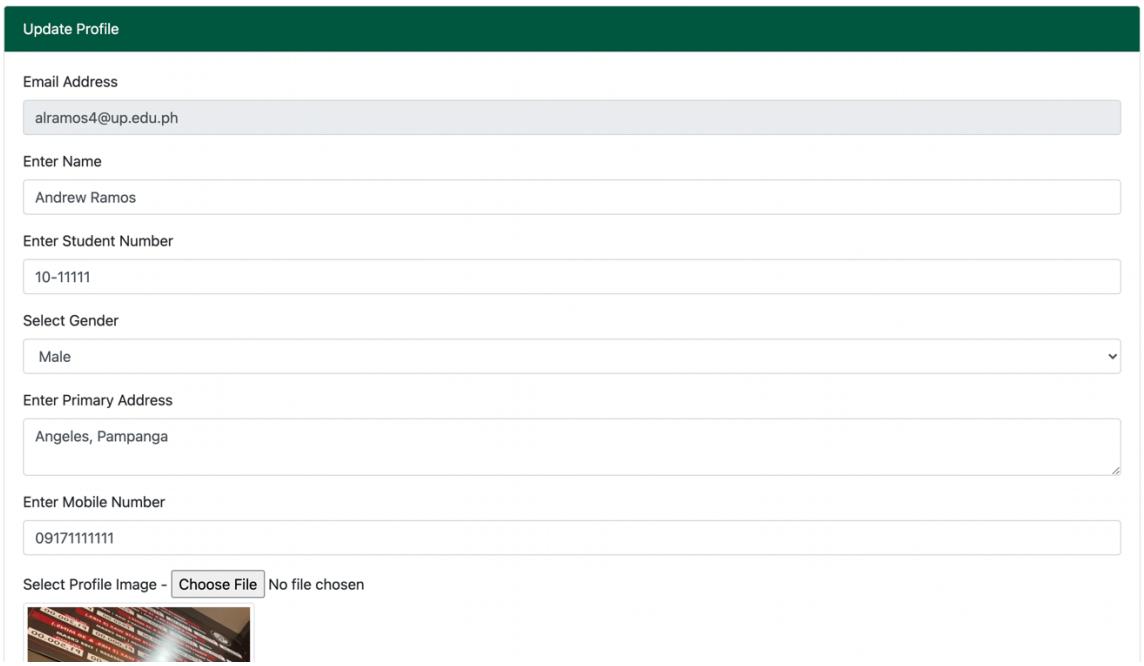


2. You can then modify all user profile fields (except for your email address) by clicking on the Save button, as shown below:



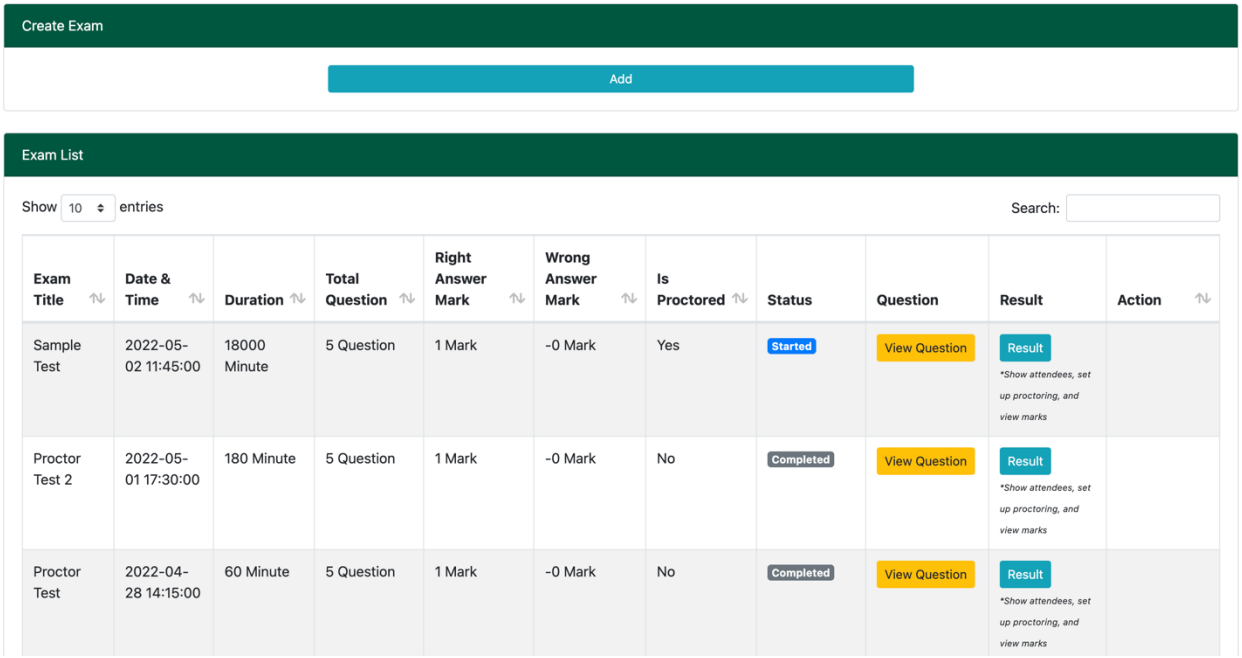
View user profile

1. To view your user profile, click on the Update Profile link on the menu bar which will take you to the Update Profile page:

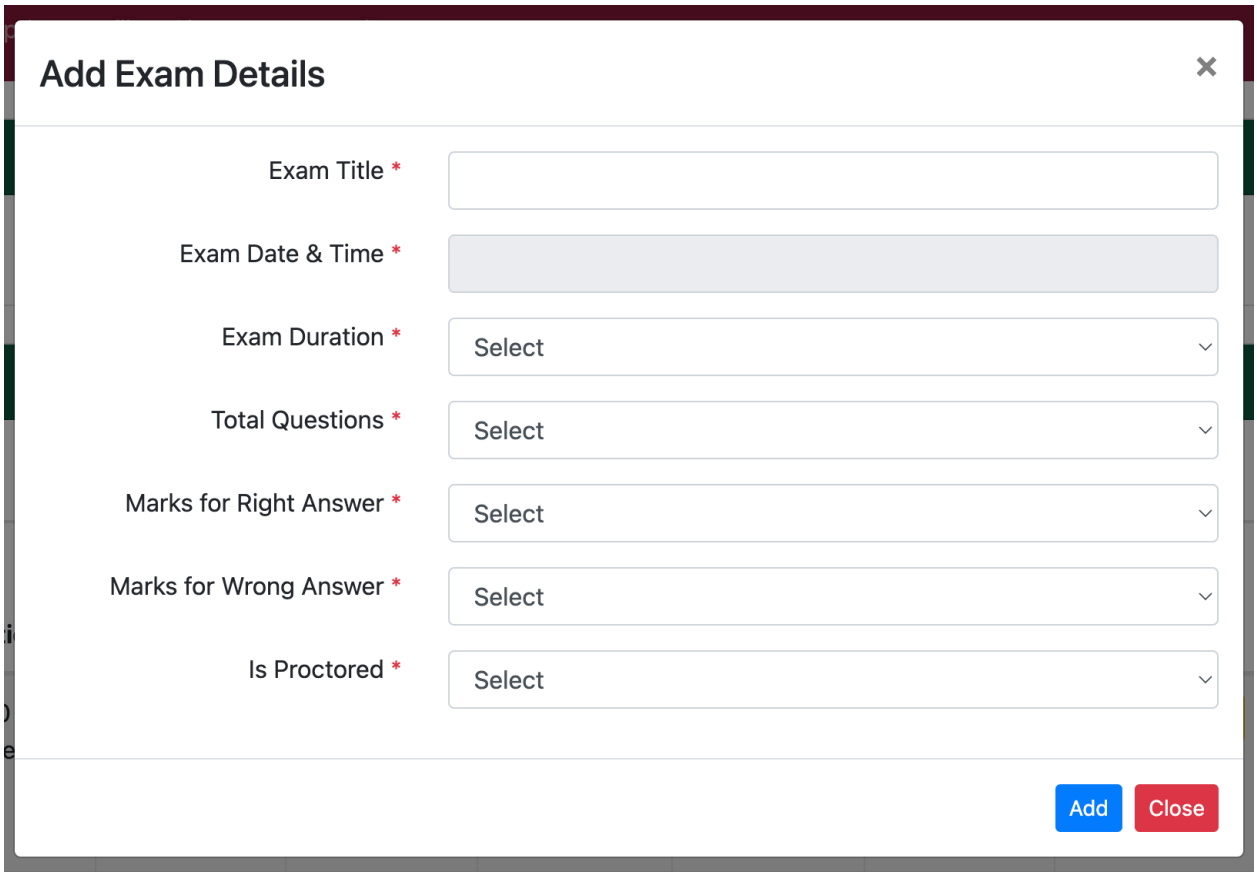


Create exam

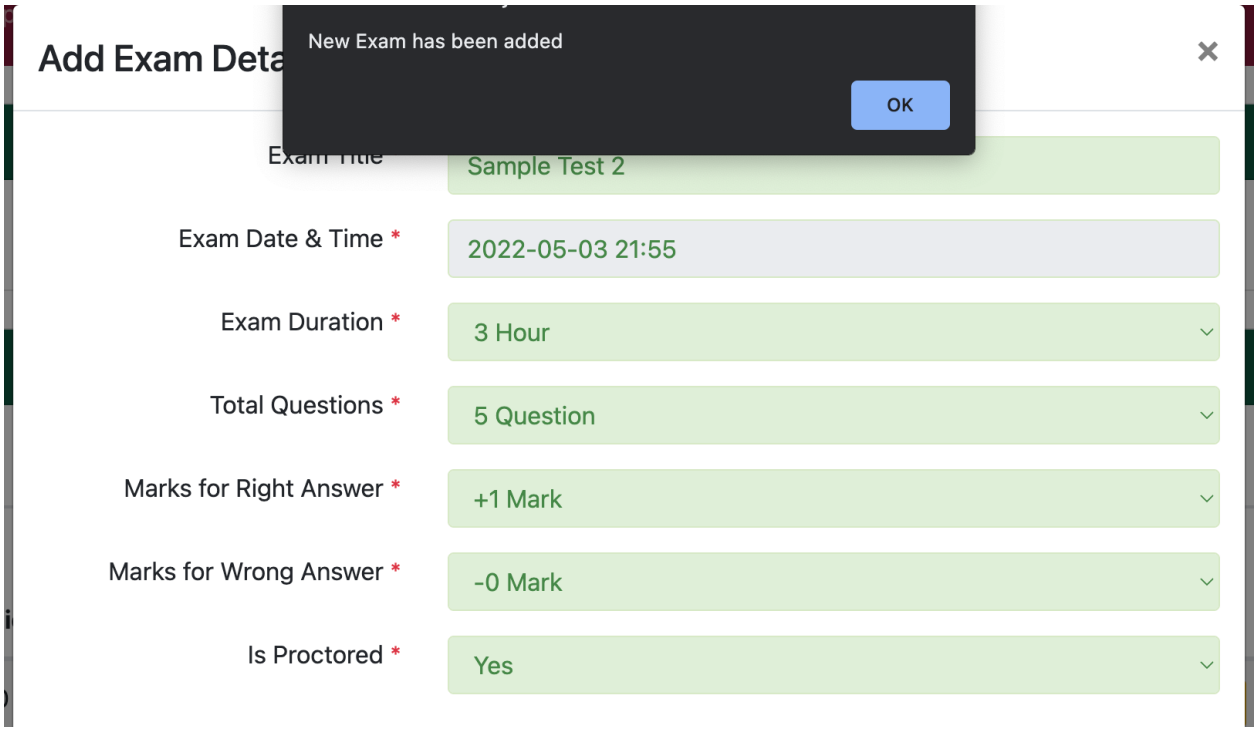
1. On the Admin Portal, once logged in as a teacher it will take you straight to the Manage Exams page:



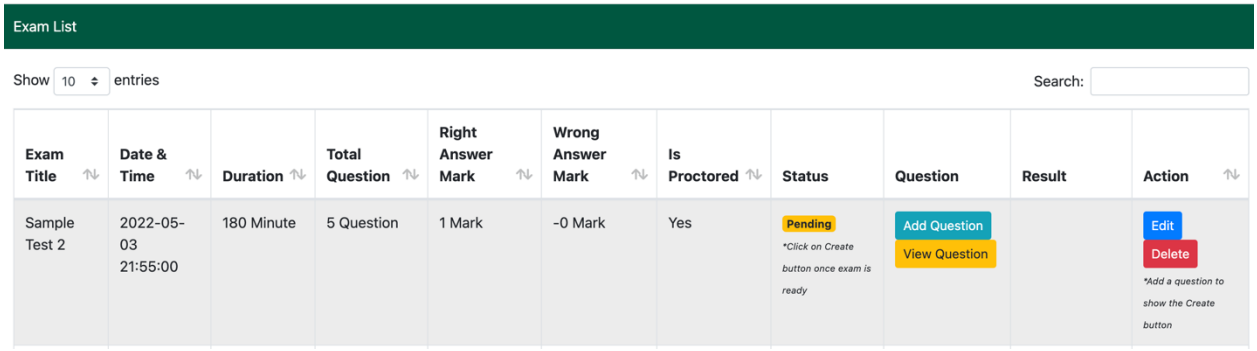
2. To create an exam, click on the Add button which will show the Add Exam Details dialog:



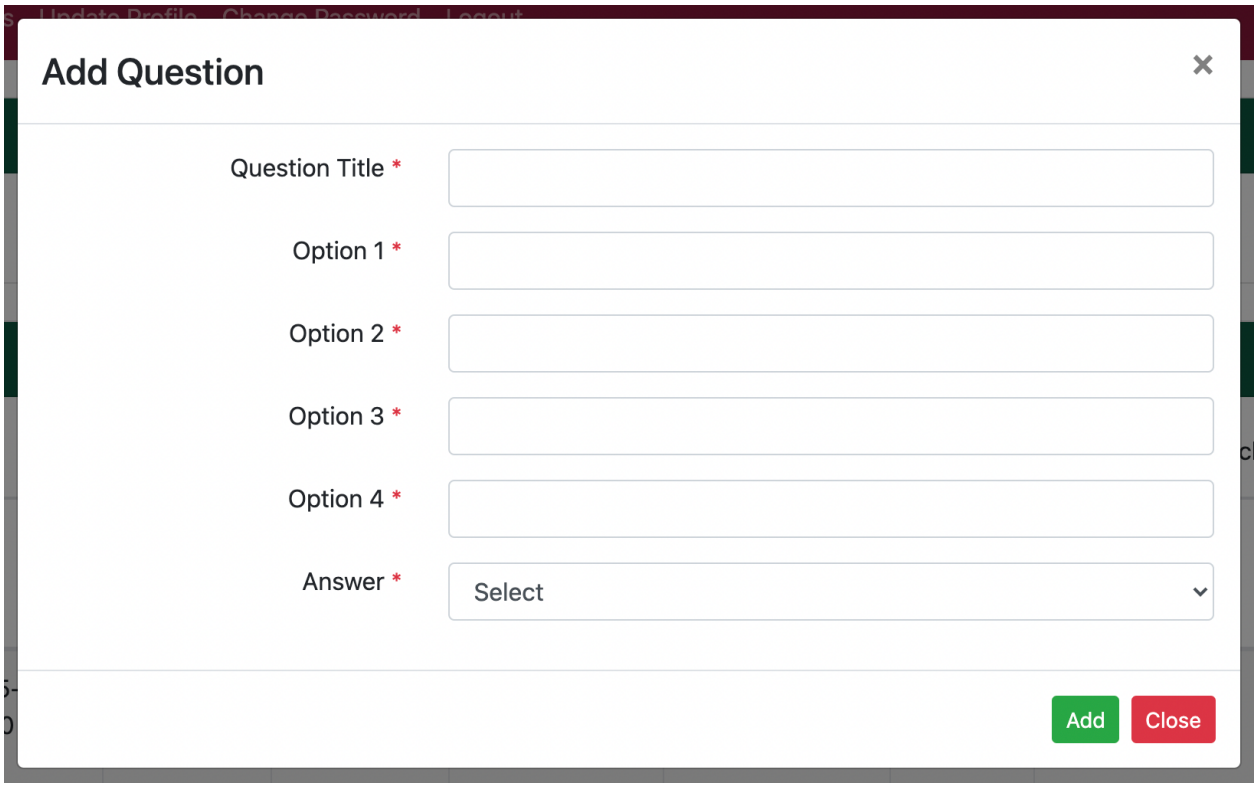
3. Once you have entered the required details, click on the Add button to save:



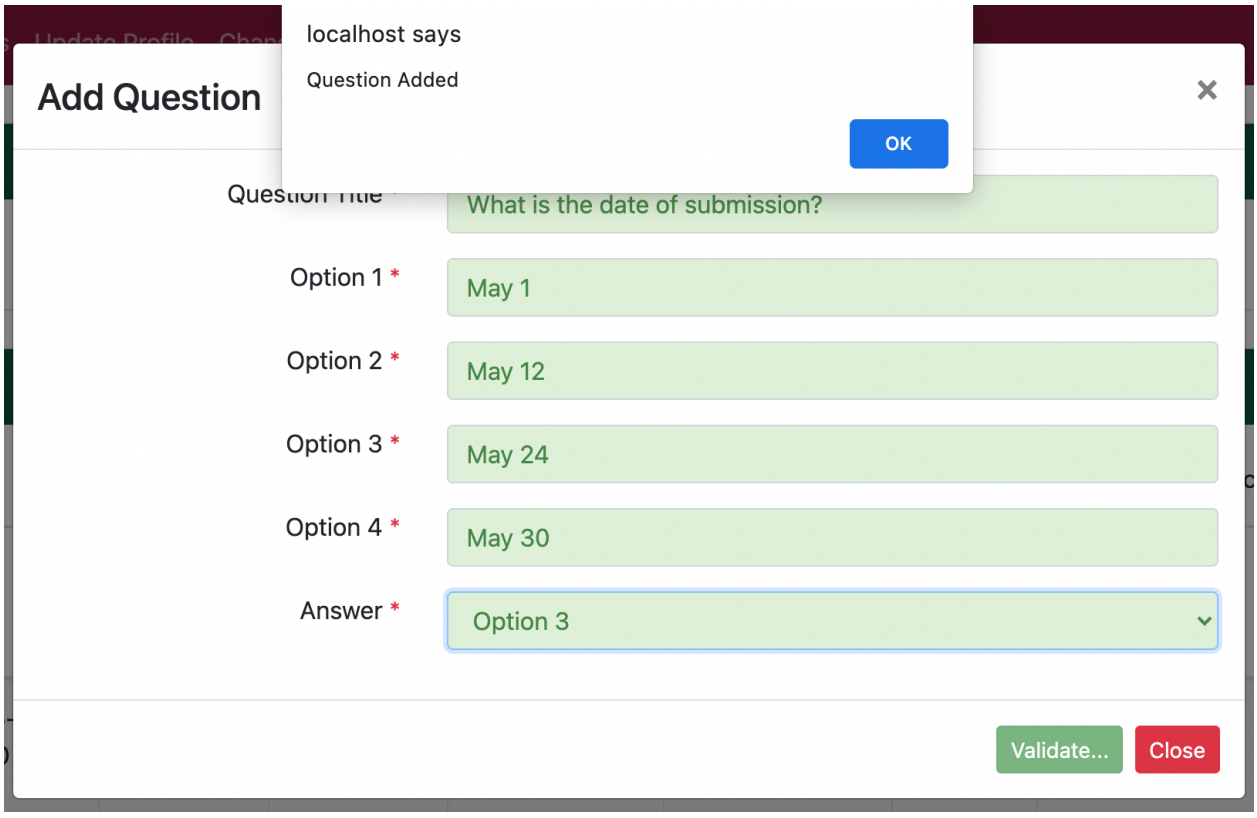
4. The created exam will then show under the Exam List section:



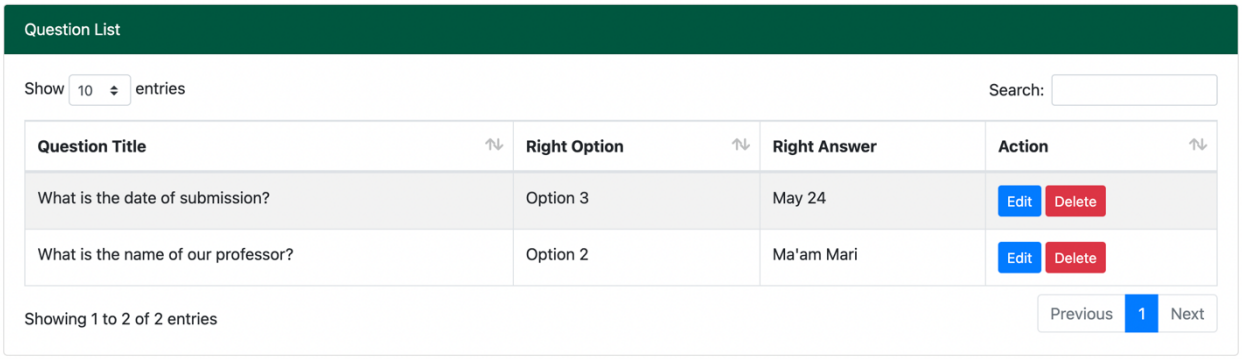
5. Your newly created exam will be on Pending status (which means it cannot be attended by any student). To change it to Created status (which means it can be attended by any student), you will have to add at least one question by clicking on the Add Question button which will show the Add Question dialog:



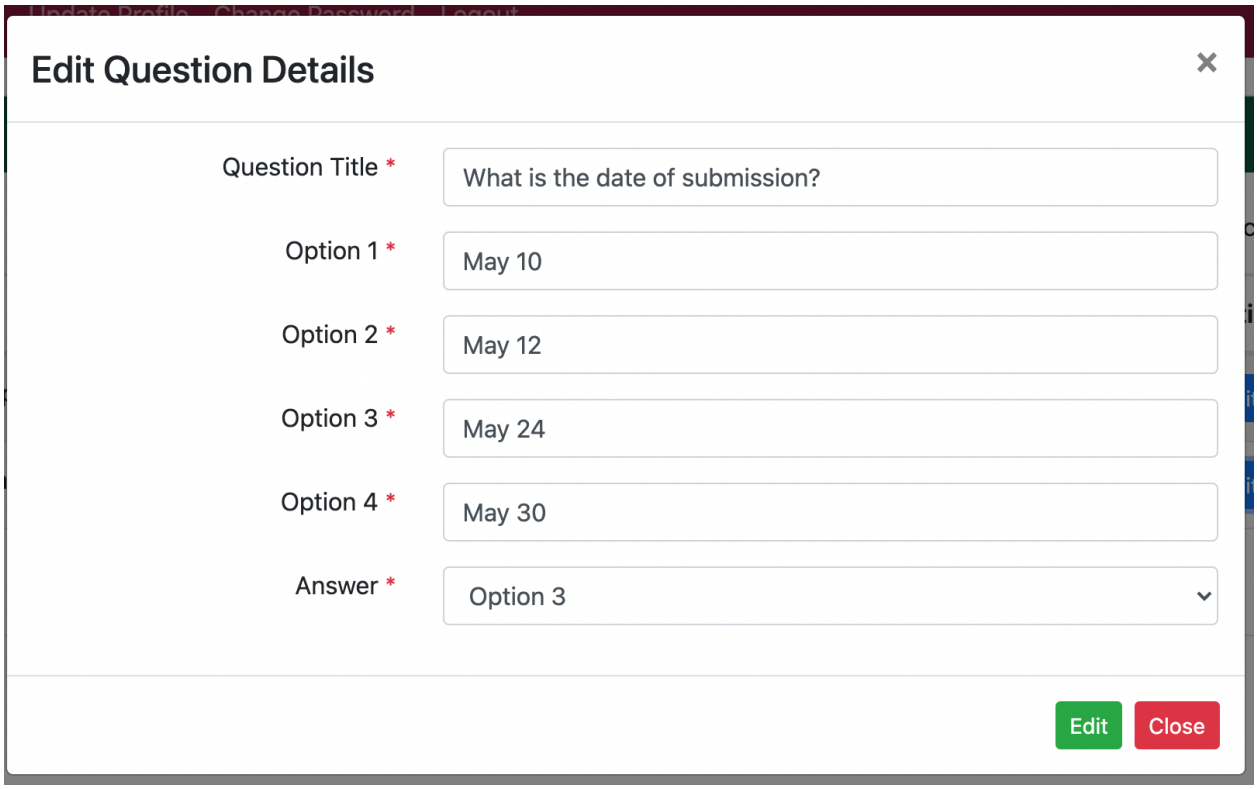
6. Once you have entered the required details, click on the Add button to save:



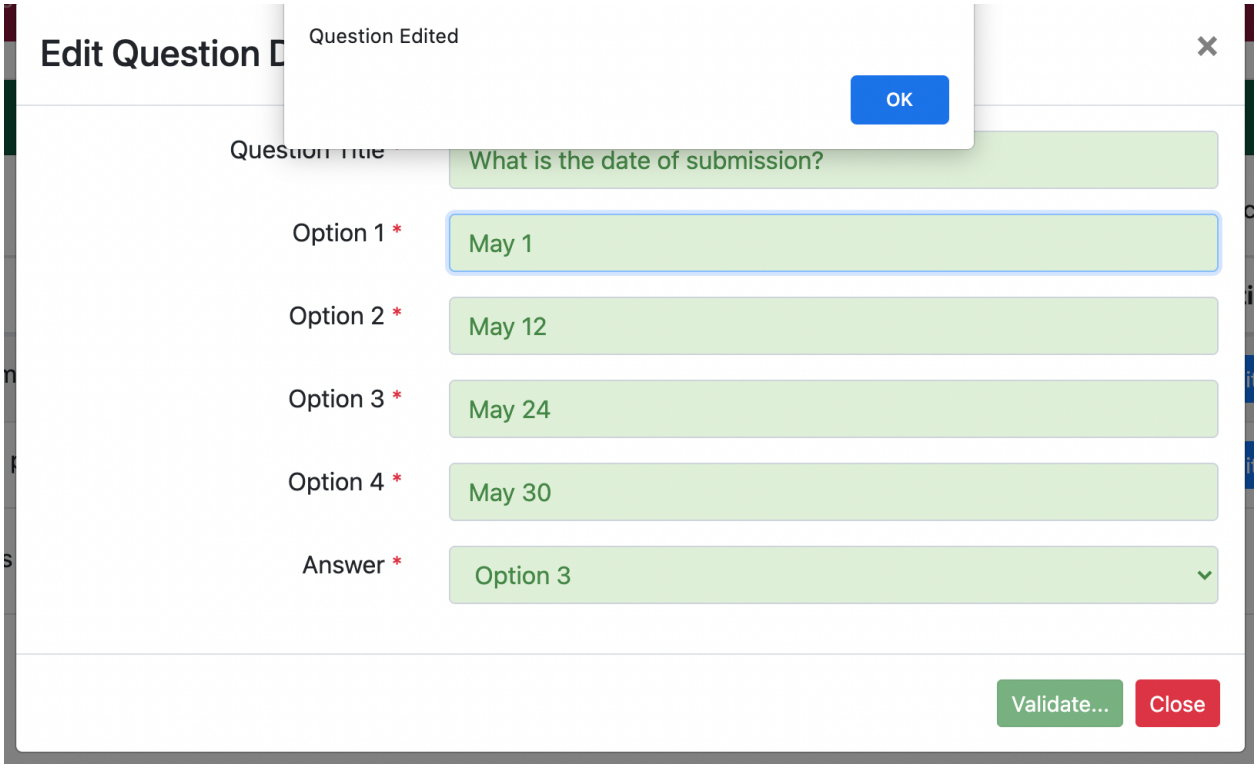
7. To view the list of questions and answers for a specific exam, click on the View Question button which will take you to the Question List page:



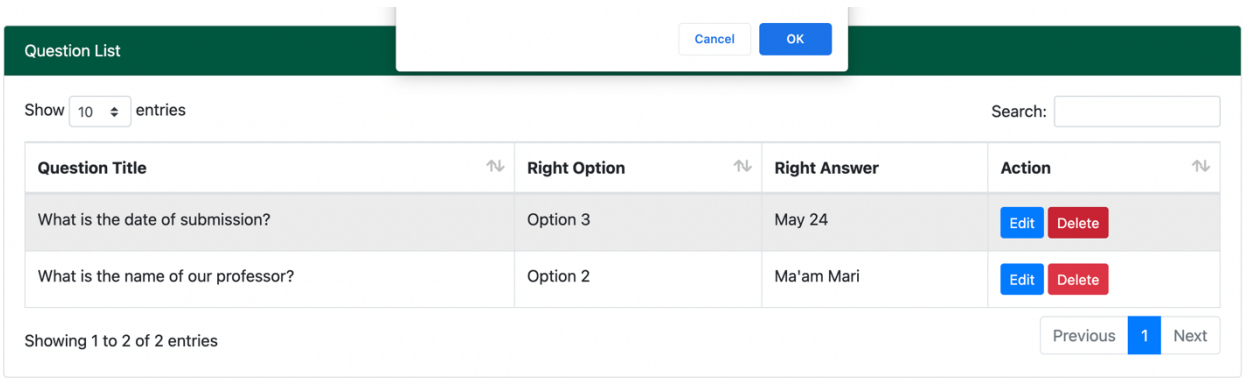
8. To edit a question, click on the Edit button which will show the Edit Question Details dialog box:



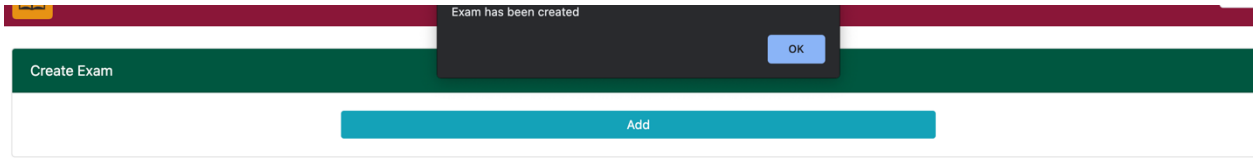
9. Once you have entered the required details, click on the Edit button to save:



10. To delete a question, click on the Delete button which will ask you to confirm before deleting the question:

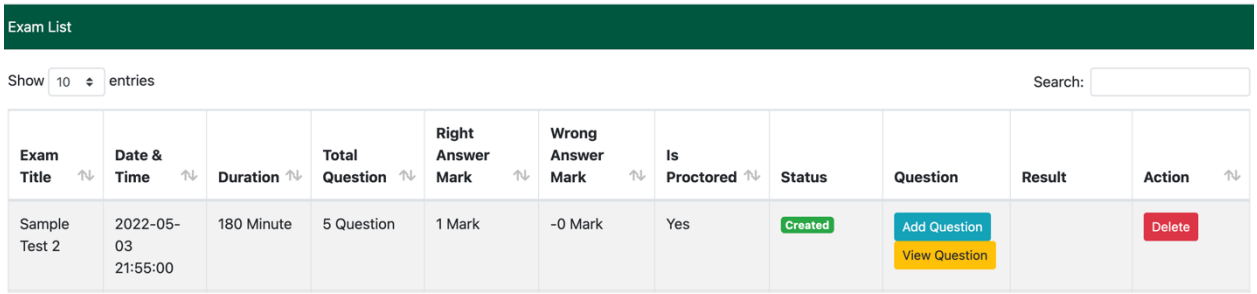


11. Finally, to change your exam status to Created, click on the Create button for the specific exam on the Manage Exams page, as shown below:



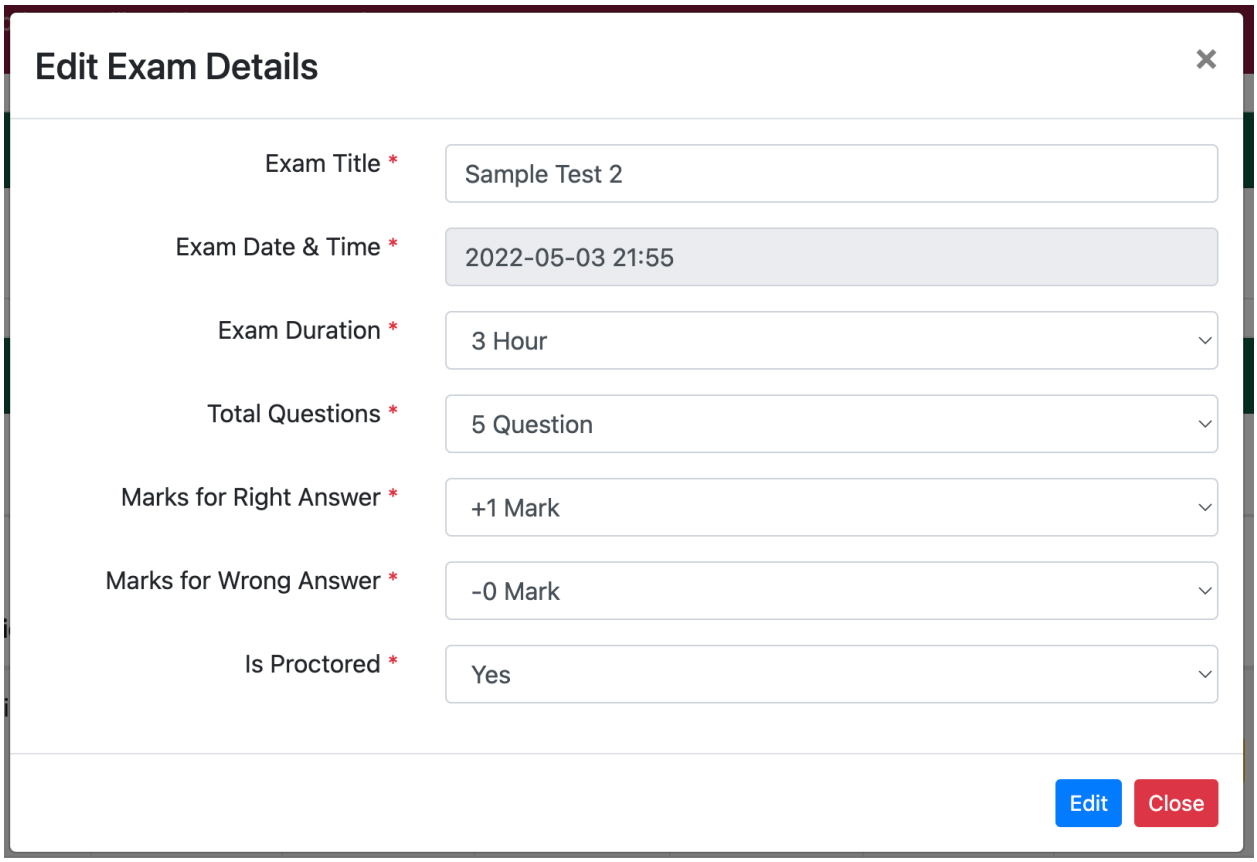
View exam

1. To view your created exams, click on Manage Exams link on the menu bar which will take you to the Manage Exams page:

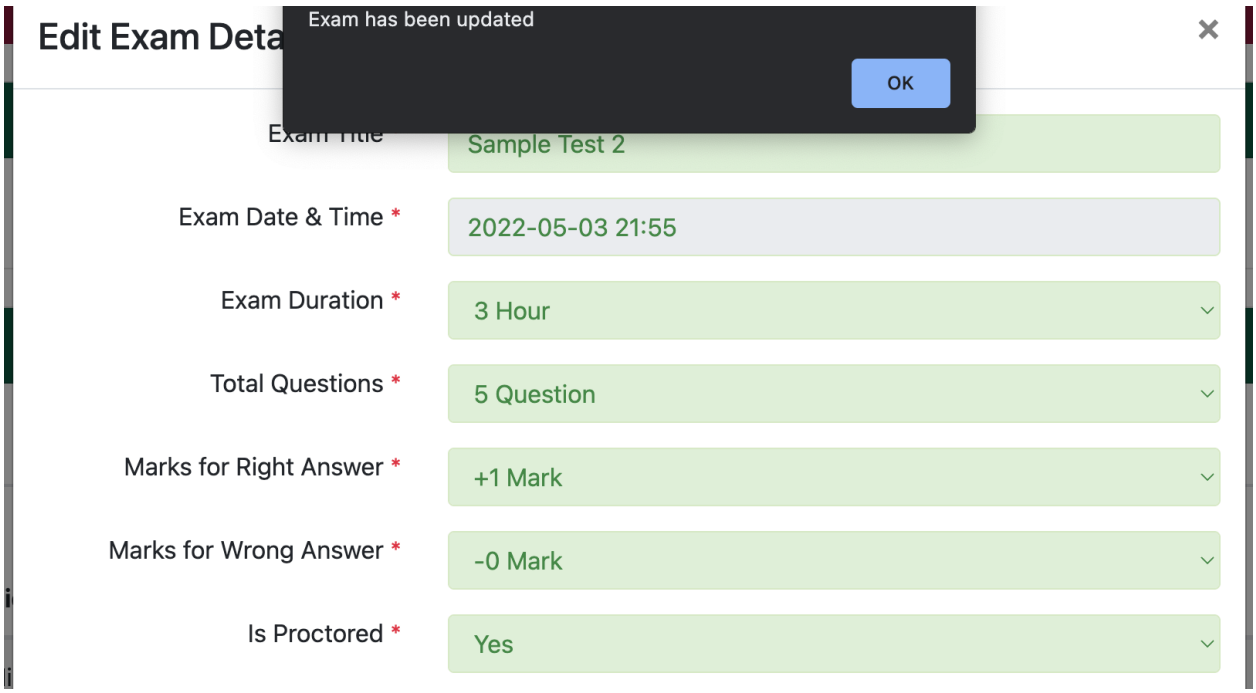


Modify exam

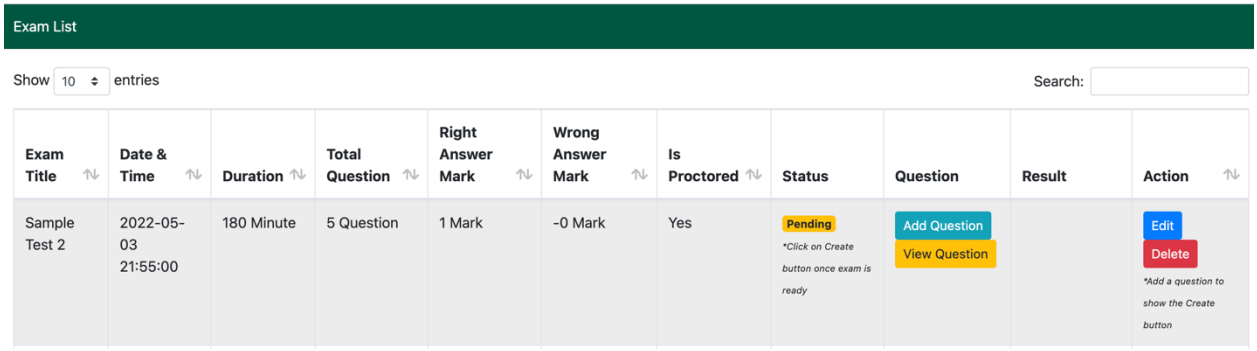
1. To edit an exam's details such as the date and start time, click on the Edit button which will show the Edit Exam Details dialog:



2. Once you have entered the required details, click on the Edit button to save:

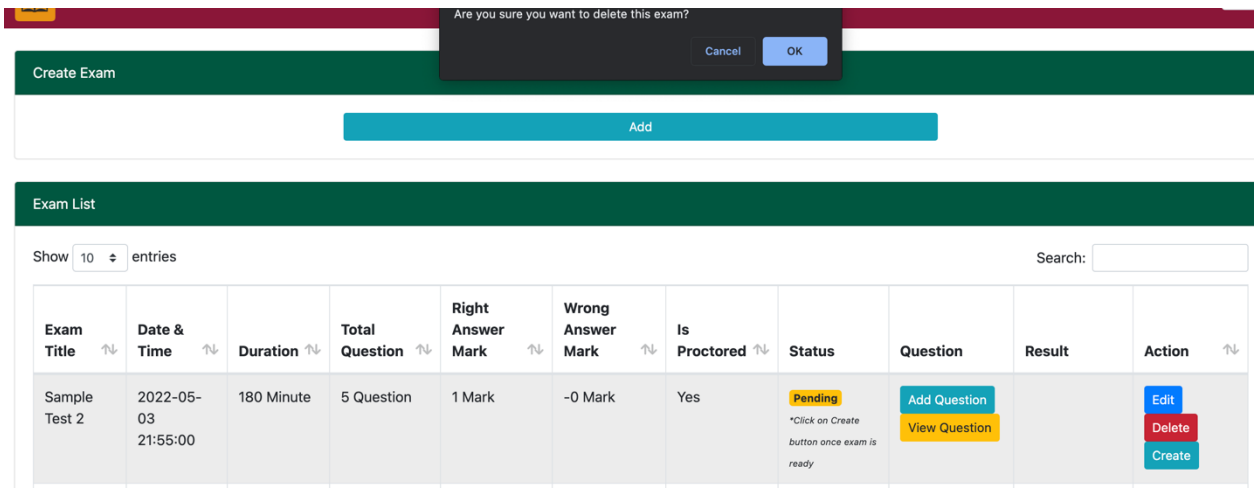


3. The modified exam will then show under the Exam List section:



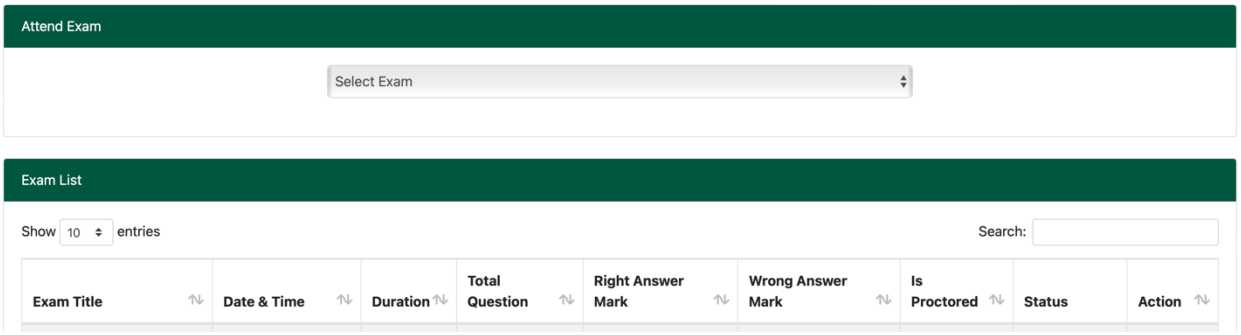
Delete exam

1. To delete an exam, click on the Delete button for the specific exam which will ask you to confirm before deleting the exam:



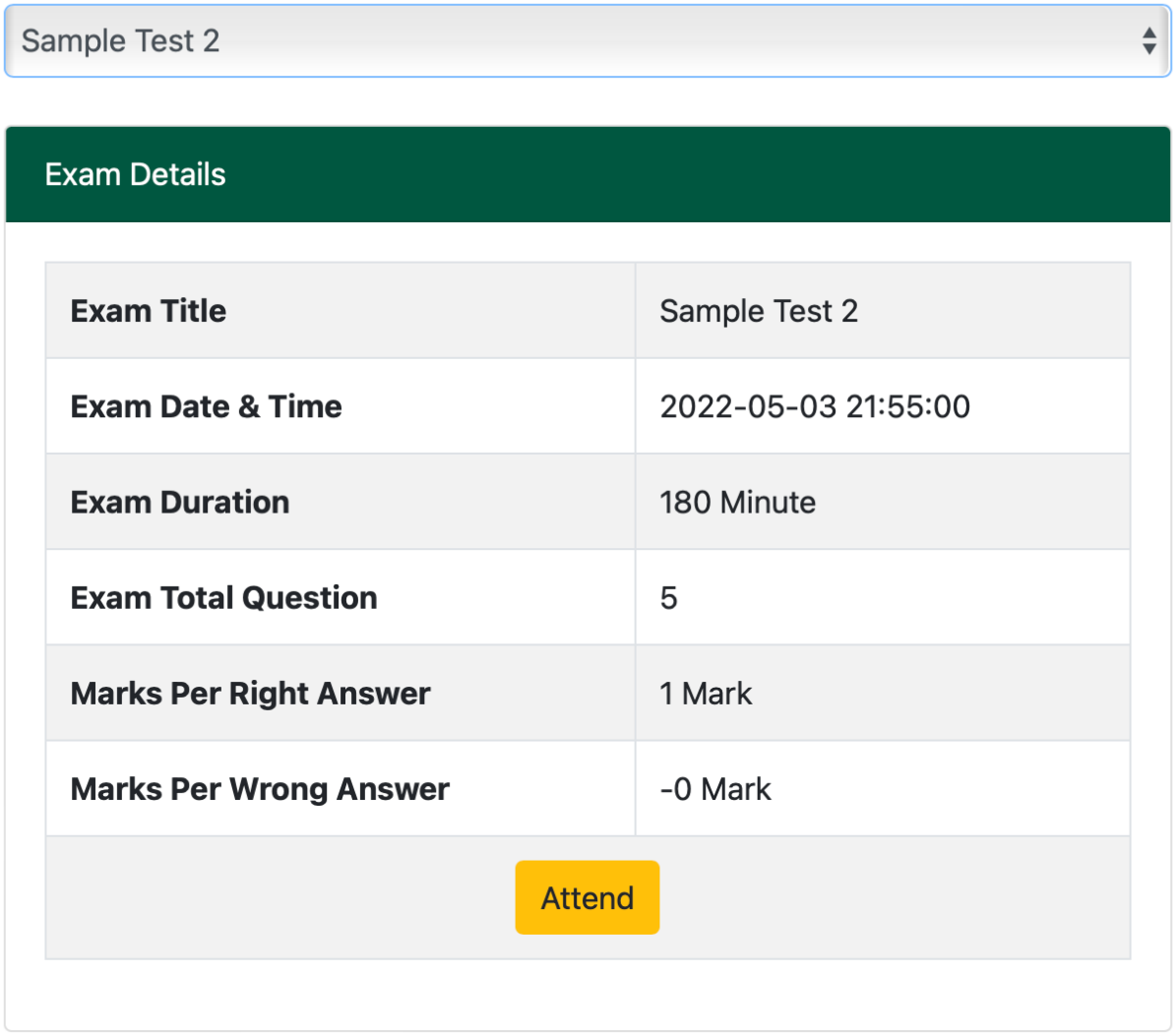
Take exam

1. On the Student Portal, once logged in it will take you straight to the Exams page:

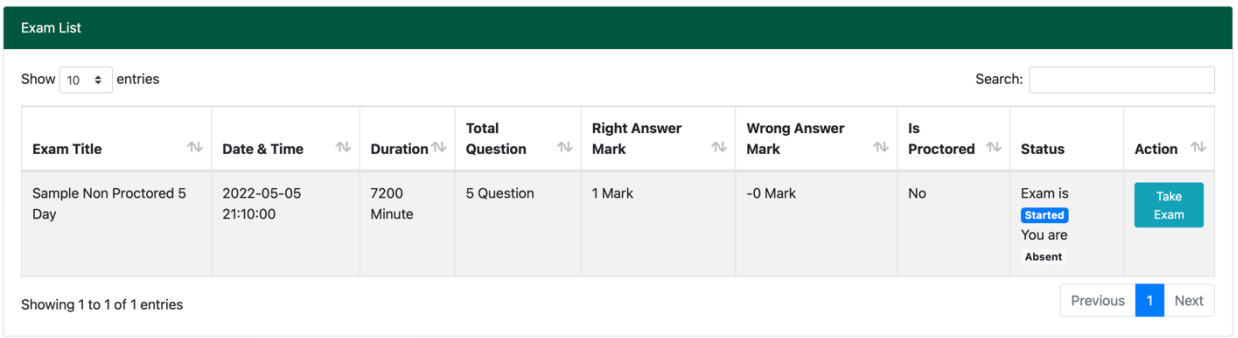


2. Under the Attend Exam section, select the available exam that you wish to take:

3. Once selected, click on the Attend button which will notify you once you have successfully attended:

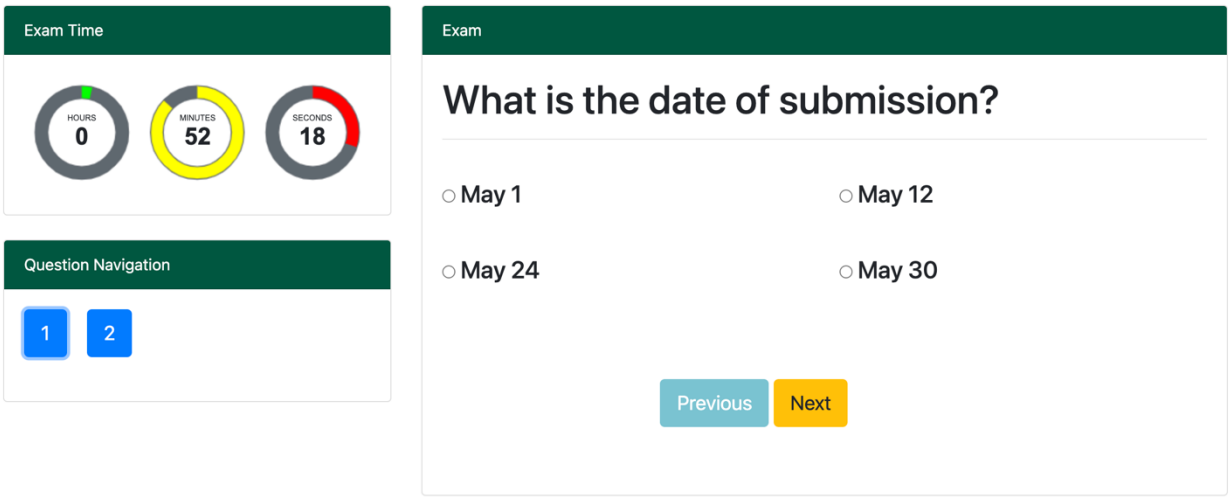


4. You will then see your attended exam under the Exam List section, as shown below:



5. Once the exam status has changed to Started (when the page is refreshed after the exam date start time has been reached), you can then click on the Take Exam button to take the exam.

6. The Take Exam page shows the remaining exam time on the Exam Time section as well as the exam questions and answers on the Exam Question section, as shown below:

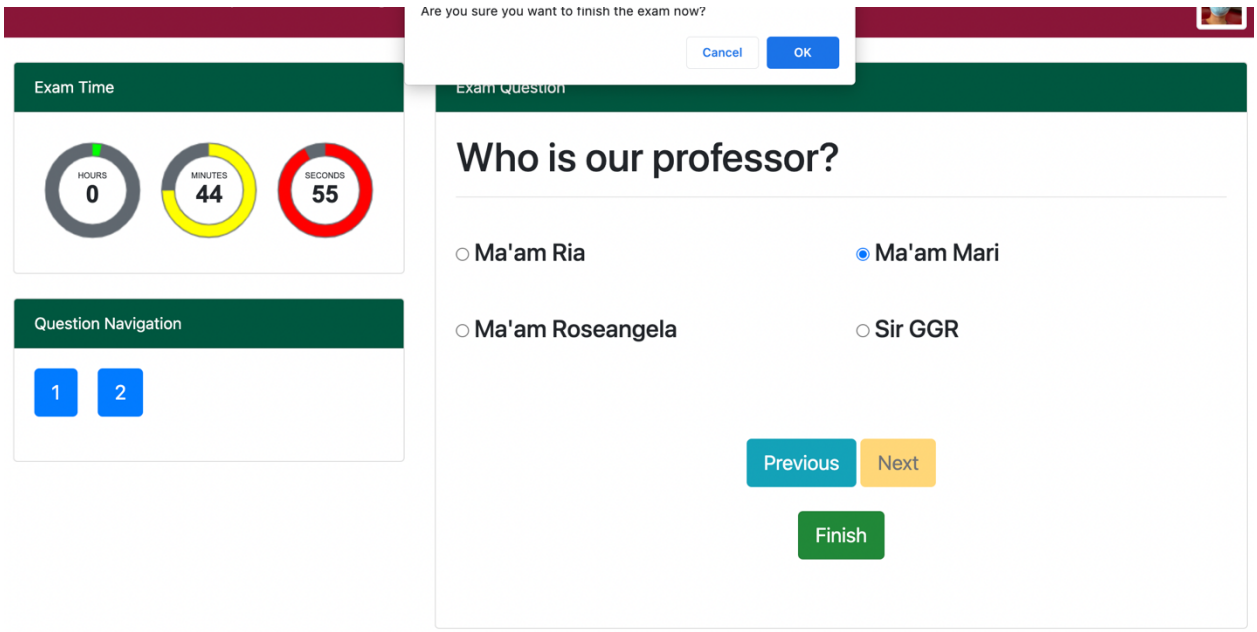


Review exam

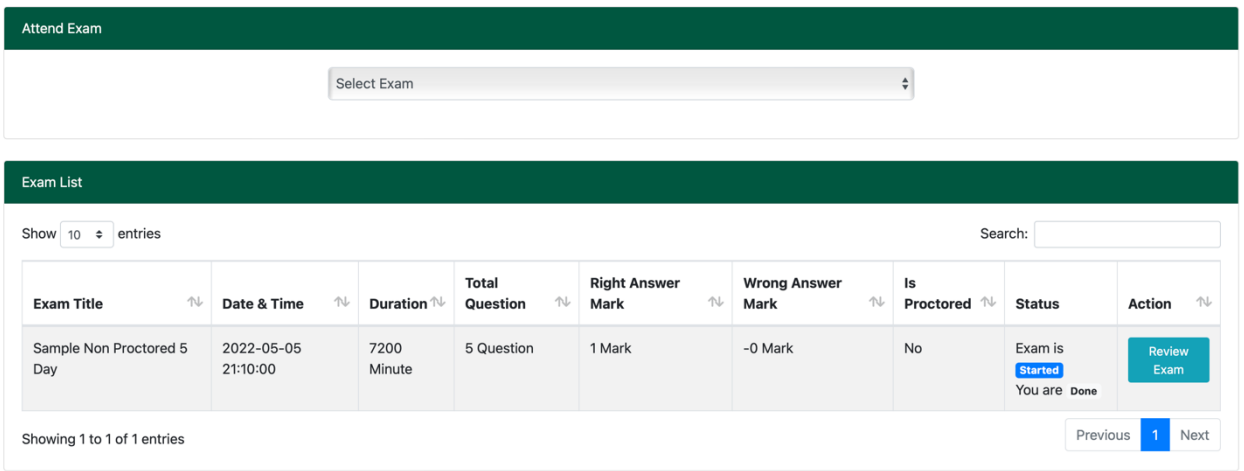
1. You can review your exam answers while the exam is still ongoing (Started status) by using the Previous and Next buttons to go through the questions or by clicking on the numbers found under the Question Navigation section on the Take Exam page.

Submit exam

1. Once you have answered all the questions, click on the Finish button to end the exam:



2. You will then be taken back to the Take Exams page as shown below:



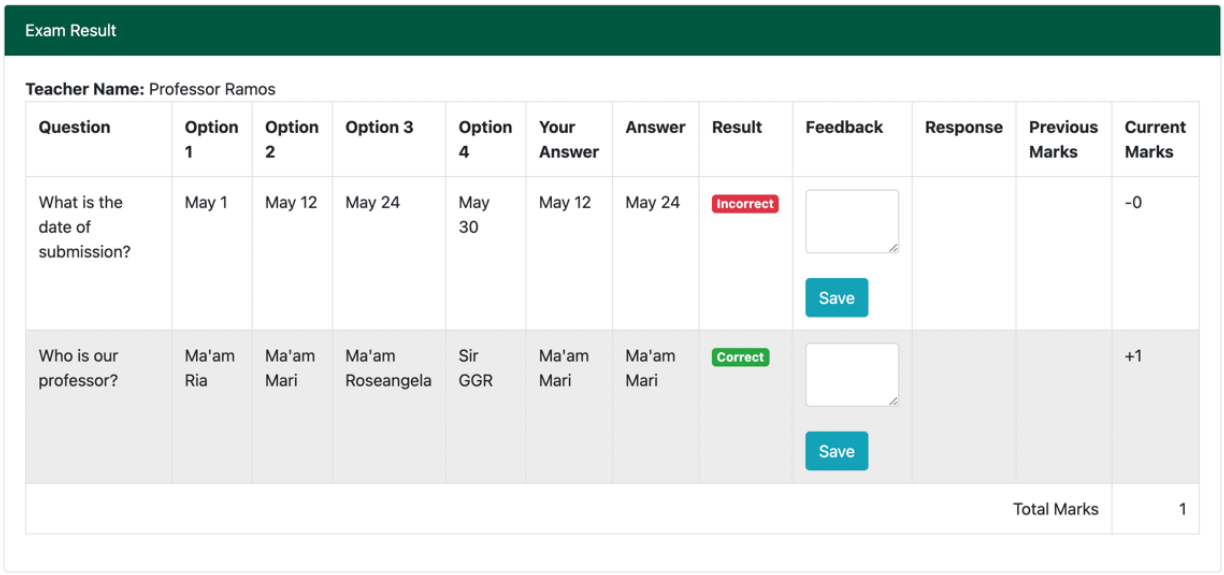
3. Note that if you do not click on the Finish button and the exam status has changed to Completed (when the page is refreshed after the exam date end time has been reached) your exam attendance status will still change from Present to Done indicating that you have finished the exam.

Grade exam

1. The exam is automatically graded once the student has finished the exam.

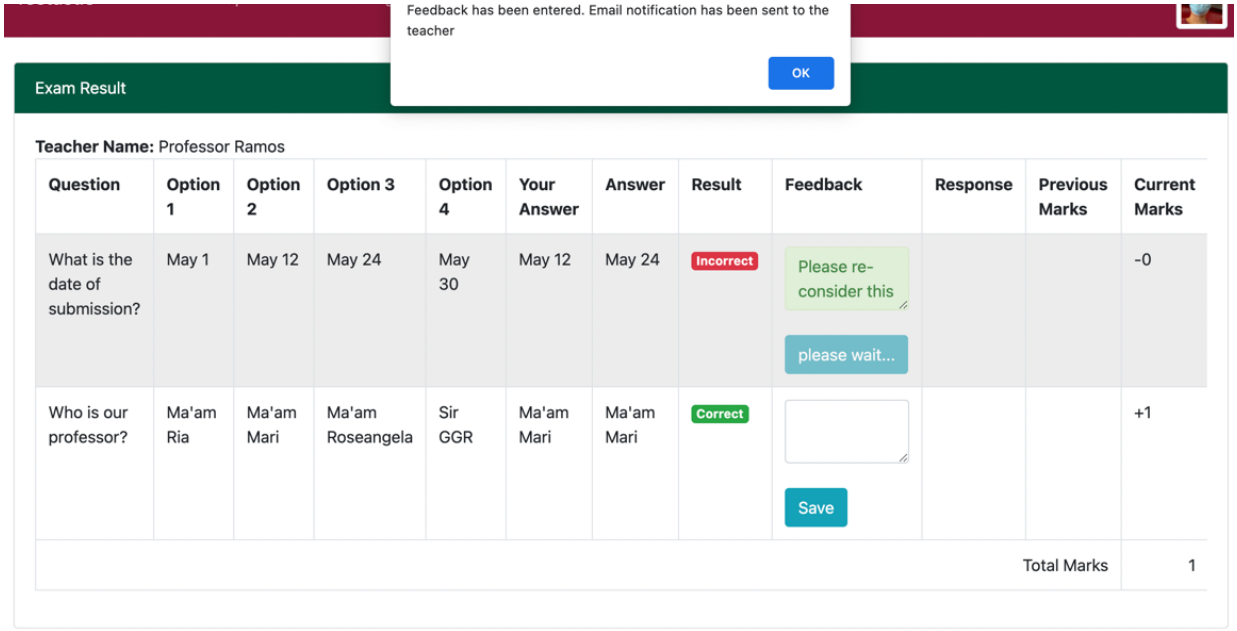
Review graded exam

1. On the Student Portal, go to the Take Exams page and click on the Review Exam button of the specific exam which will take you to the Exam Result page:



Submit exam feedback or questions

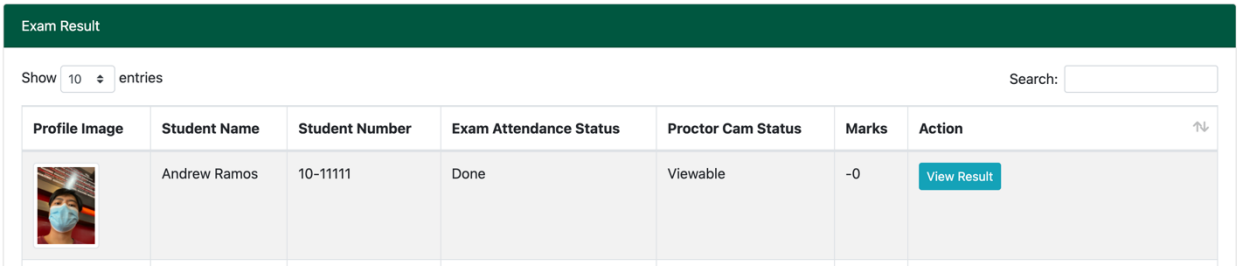
1. On the Exam Result page, you can enter your feedback on each graded question by writing on the text area and clicking on Save as shown below:



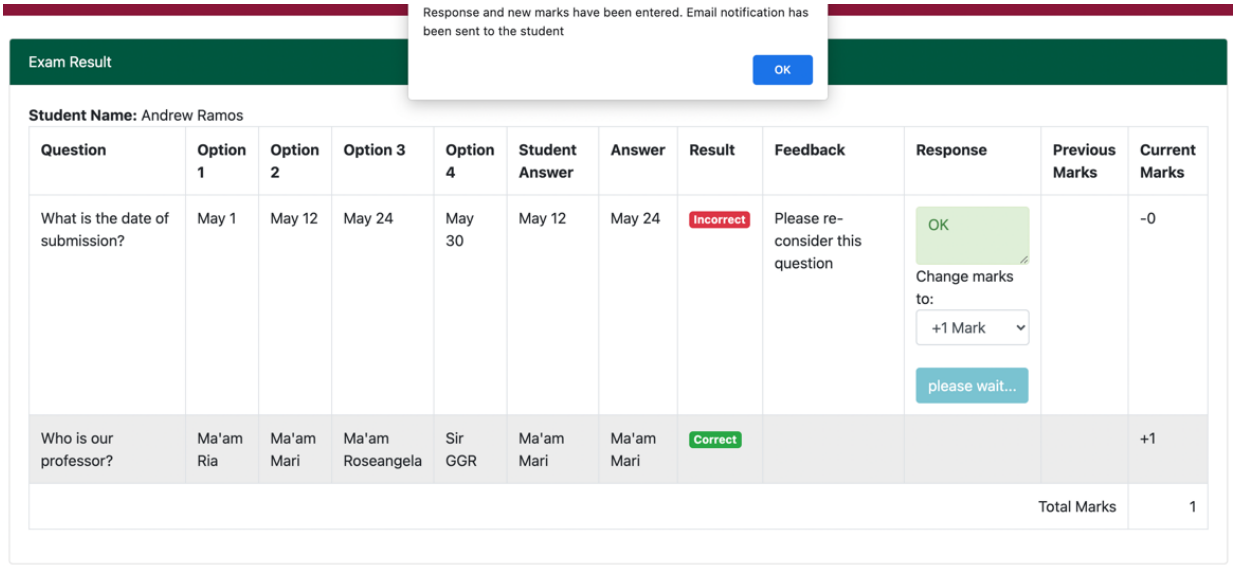
2. An email is sent to the teacher notifying them of the feedback or question.

Submit response to feedback or questions

1. On the Admin Portal, go to the Manage Exams page and click on the Result button of the specific exam which will take you to the Exam Result page:



2. On the Exam Result page, you can enter your response on each feedback by writing on the text area and change the marks by clicking on Save as shown below:



3. An email is sent to the student notifying them of the response.

Re-grade exam

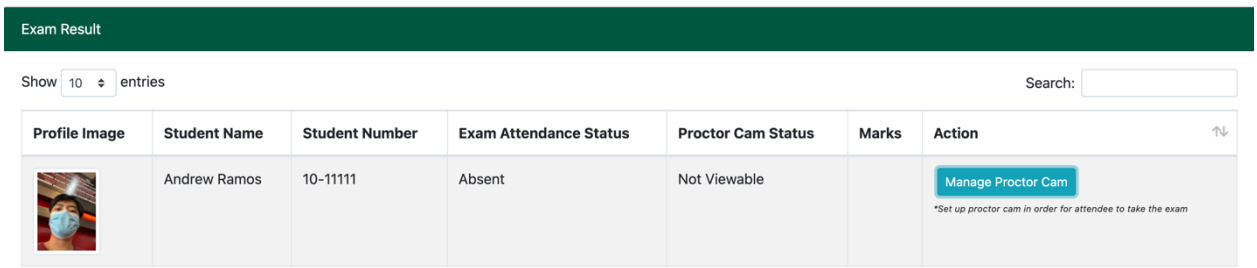
1. The exam is automatically re-graded based on the new marks given by the teacher:

Question	Option 1	Option 2	Option 3	Option 4	Student Answer	Answer	Result	Feedback	Response	Previous Marks	Current Marks
What is the date of submission?	May 1	May 12	May 24	May 30	May 12	May 24	Correct	Please re-consider this question	OK	-0	+1

Proctor exam

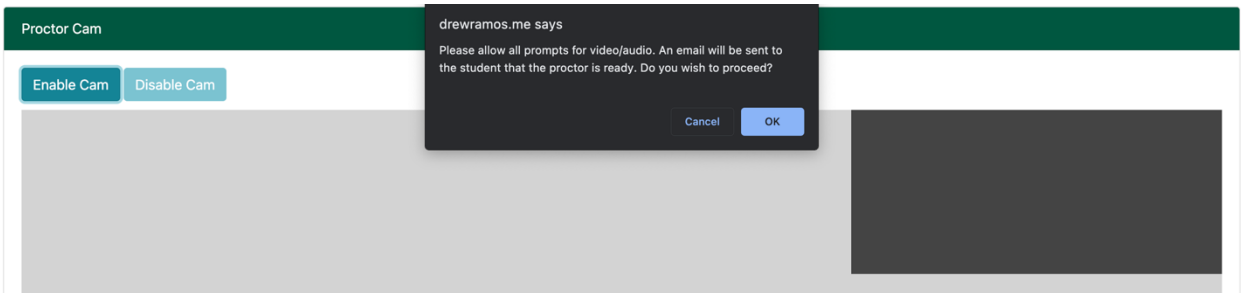
1. An exam that is proctored requires the student to have an enabled webcam and the teacher to mark the student as viewable for the student to take the exam.

2. On the Admin Portal, go to the Manage Exams page and click on the Result button, then select the proctor cam page of the specific student by clicking on the Manage Proctor Cam button:

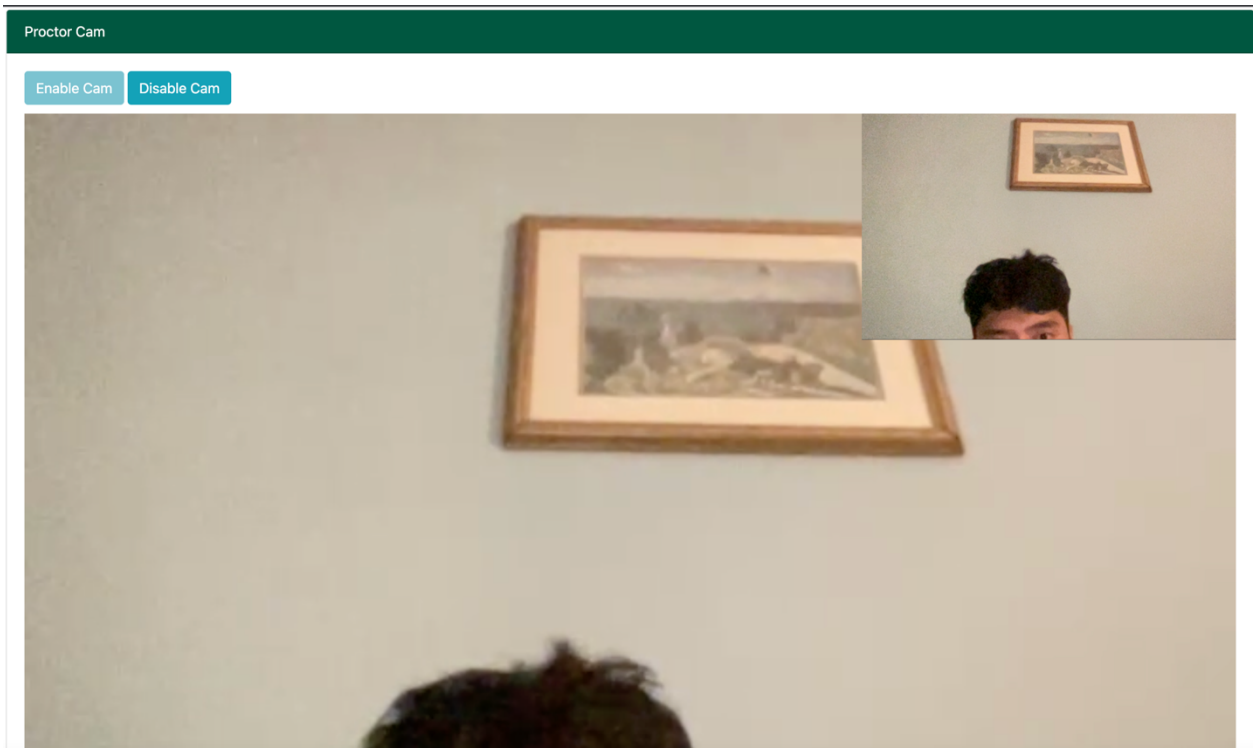


3. The Proctor Cam page will then show a view screen for two cameras: the local camera in dark gray background and the remote camera in light gray background, as shown below:

4. Once the Enable Cam button is clicked a prompt will appear to let the teacher/proctor know that the student will be informed that the proctoring session is ready:

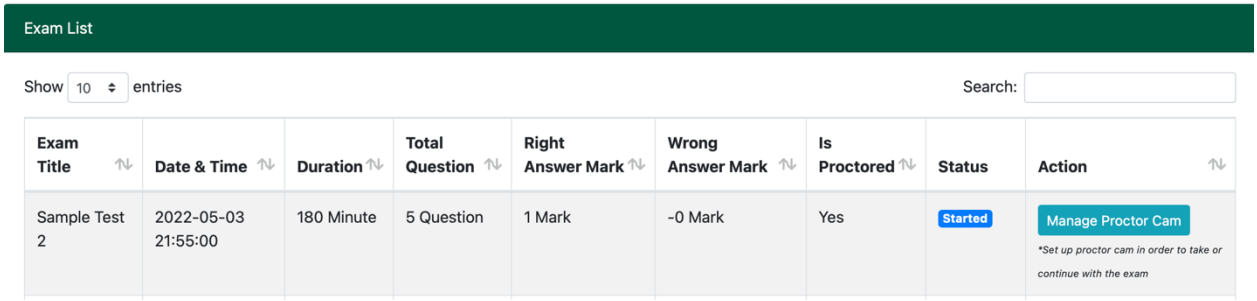


5. The cameras will then show the webcam feed for the local camera and remote camera (when the student has connected) as shown below:

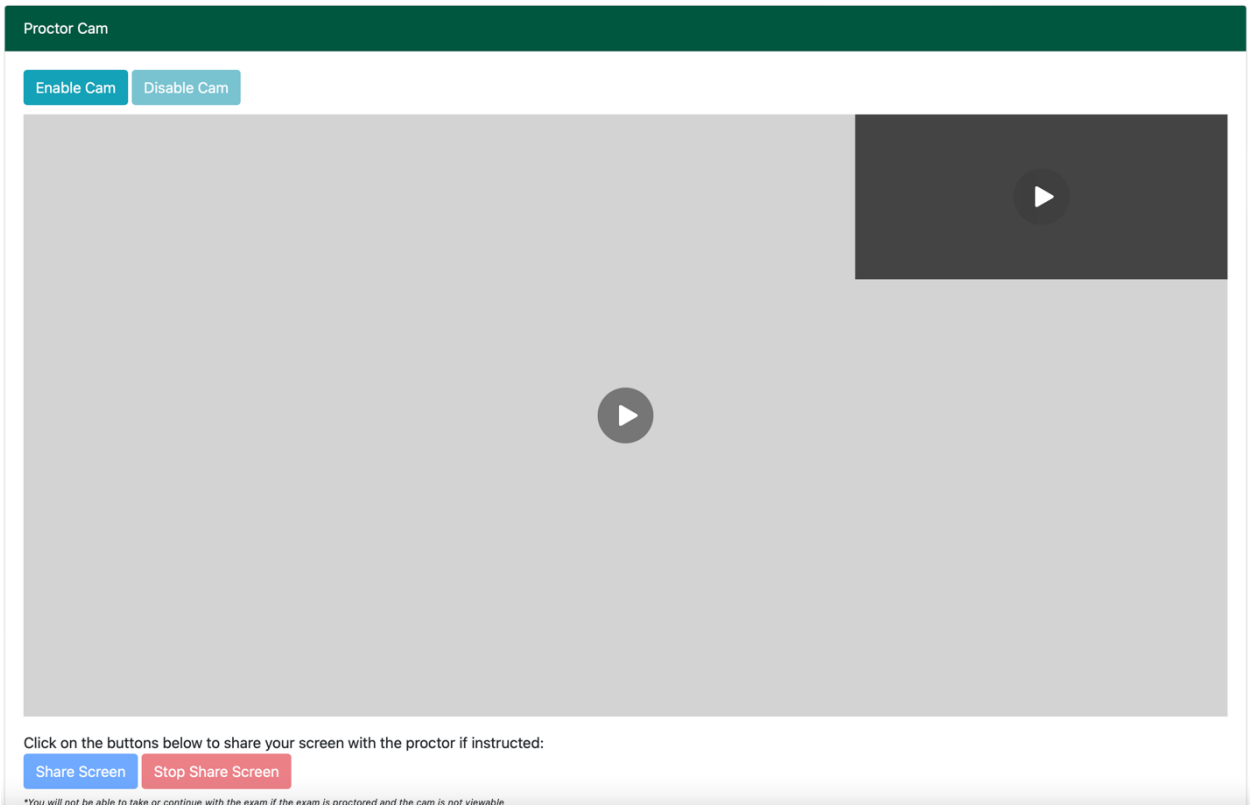


6. Once the teacher/proctor can confirm that the student is viewable then the Viewable button must be clicked at the bottom of the page so that the student can take the exam:

7. On the Student Portal, go to the Exams page and click on the Manage Proctor Cam button for the specific exam, as shown below:

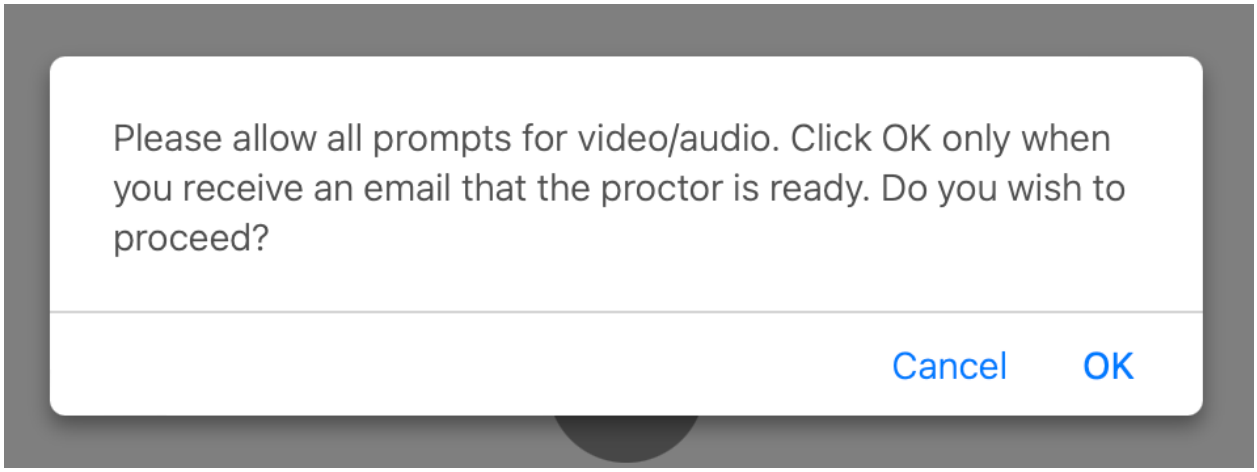


8. The Proctor Cam page will then show a view screen for two cameras: the local camera in dark gray background and the remote camera in light gray background, as shown below:

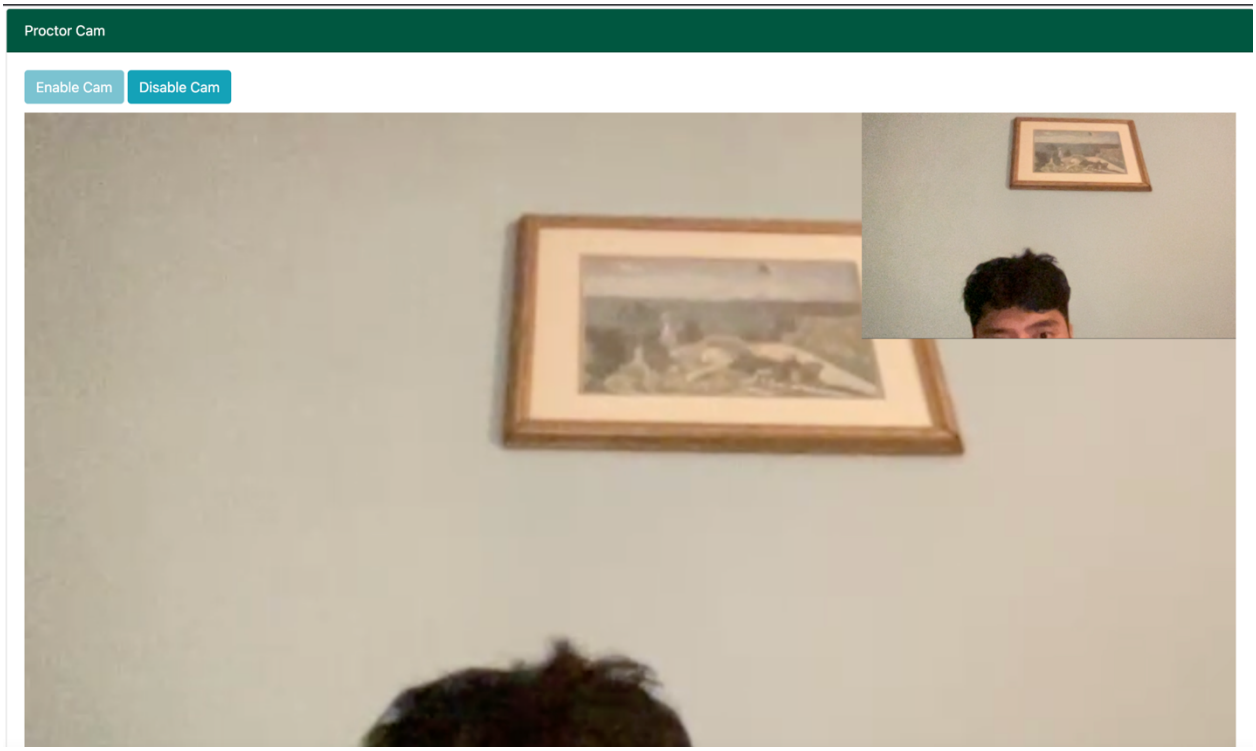


9. The student should also receive an email link directly to the proctor cam page once the teacher/proctor has started the proctoring session. When the Enable

Cam button is clicked a prompt will appear to remind the student to proceed only when the proctoring session is ready:

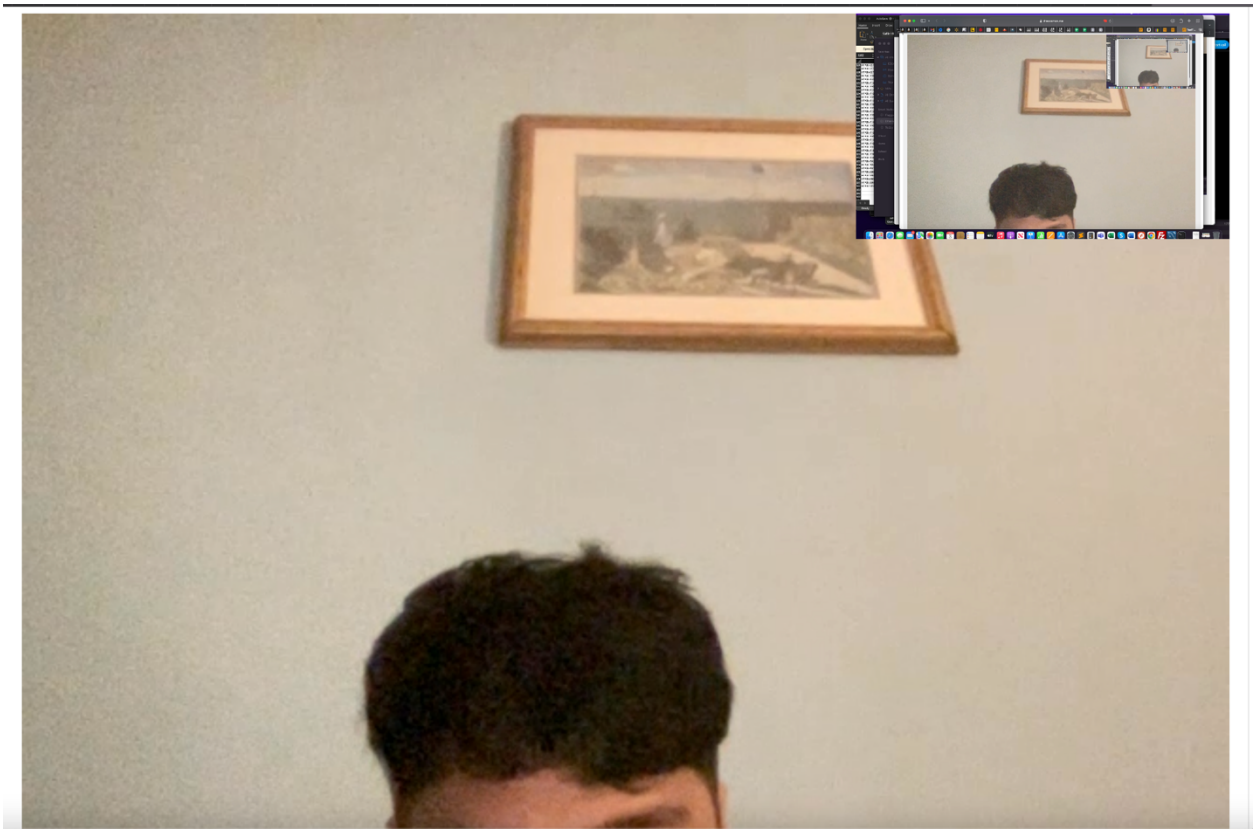


10. The cameras will then show the webcam feed for the local camera and remote camera (when the teacher/proctor has connected) as shown below:



11. On the bottom of the page, there are options to share the student's entire computer screen to the teacher/proctor (if required) by clicking on the Share Screen button, as shown below:

12. The local camera will then show the share screen feed instead of the webcam feed (the remote camera on the teacher/proctor view will also show the share screen feed) as shown below:



13. Clicking on the Stop Share Screen button will stop the share screen feed and bring it back to the webcam feed.

14. If at any point the student is not viewable by the teacher/proctor, then the Not Viewable button must be clicked at the bottom of the Manage Proctor Cam page in the Admin Portal.

15. The steps above will then be repeated for the proctoring session to resume so that the student can continue taking the exam.

F. Software Requirements Specifications

The content below is from the Software Requirements Specification document. It will be detailing out the use cases, functional and non-functional requirements, and environmental requirements necessary to properly develop the proposed modified examination system for UPOU.

The proposed online examination system will have the functionality to register and login users such as students and teachers. In the teacher's view, the system will have the functionality to add/edit/delete examinations as well as to add/edit/delete grades. In the student's view, the system will have the functionality to browse, read, take, and review examination questions and submit and review examination answers, as well as to submit answers for clarifications and regrading. In the faculty view, the system will have the functionality to proctor students taking their exams via video streaming from the user’s own webcam on their desktop and mobile devices, as well as have a facility to review the streams after each exam.

The system, called TestTime, will have a backend using the open-source web programming language of PHP and the open-source database engine of MySQL (latest versions). The frontend of the system will be built using a combination of HTML, CSS, and JS technologies that are supported on both desktop and mobile browsers.

TestTime will also use a PHP framework that supports test-driven development to speed up development and make testing a little bit easier. Documentation will also be done in the code as well as in word processing formats according to the course specifications.

Use Cases

Use cases detail the functional requirements of an information system from the perspective of the end user. It describes a sequence of events that will be followed by the users and those who will develop the system. A use case will include a main success scenario and might include alternative scenario extensions. It also has the following characteristics: organizes functional requirements, models the goals of system and actor interactions, records scenarios from initial events to goals, and describes one main success scenario and alternative scenario extensions, if any [1].

The Use Case Suite and Use Cases document details out the different uses of each aspect of our proposed system. These use cases are broken down into different categories like the functional area, stakeholders, priority and business object and anchor. The prerequisite for the proposed system is that users must be logged in to be able to access and use the system. Use cases may vary from user to user as they have certain access and limitations in the system in terms of account management, exam management, exam usage and exam feedback.

Details:

- The use case suite (Use Case Suite and Use Cases Document) lists all use cases in an organized way

Functional Requirements

Functional requirements are often presented through feature sets or a group of functions that are all the system capabilities that have been determined and planned for development and implementation [2].

The Feature Set and Feature Specification document details out the specific features that we'll be including in our proposed system as we've mentioned some of the features in our system proposal. These features are broken down into two parts namely the Features Set that summarizes the features and categorized by release and priority, release and risk, functional area and the Feature itself in which we describe each feature and specific details related to it.

Details:

- The feature set (Feature Set and Feature Specification Document) lists all features in an organized way

Non-Functional Requirements

Usability Requirements

For the usability requirements of the proposed system, we wanted to make sure that the system has a good balance of accessibility, learnability, productivity, user friendliness and performance. The criterion in the proposed system is what we deemed will blend in well with the overall flow, the customization and personalization,

and most importantly, the engagement factor that we wanted to achieve for the proposed system [3].

Details:

- The system is able and easy to access while implementing the necessary security features of the system in place.
- The system can be easily learned by all users (administrators, teachers, students) and be able to bring some familiarity to the system and not have to adjust to the system for a longer period
- With the useful features of the system (e.g., Exam Grading, Re-grading, and Exam Feedback) will be able to help the overall productivity of both the teachers and students.
- User-friendliness of the system means following the UI guidelines for the development and usage of the system (Call to action (CTA) buttons, menus, dialog boxes) whenever possible.
- In terms of performance, the system should be able to operate in a proper way with the given recommendations of the hardware and software requirements necessary to use the system properly.
- In terms of customization and personalization, users should be able to view and edit their profile along with their information (limited availability) to their liking, they are also able to ask questions and provide feedback regarding the exam and their grade.

Reliability and Uptime Requirements

The following requirements for reliability and uptime detail the system's goal in terms of being able to perform as expected and when required. It should be reliable in a sense of ensuring whatever is entered into the system is correctly entered and the outputs are correctly computed. It should be available in terms of being accessible when needed.

Details:

- The system should be able to save data accurately and reliably
- The system should be able to perform its functions as expected
- The system should be reliably accessible 24/7
- The system should be able to achieve 99% uptime

Safety Requirements

The following requirements for safety detail the conditions needed to ensure that the system will not be hazardous to the users while they are using the system as well as not cause undue harm.

Details:

- The system should be monitored for safety concerns such as any scenarios that will cause harm to users e.g., exposed passwords, data leaks, etc.
- The developers will assess any hazards that might occur when using the system

- The developers will do root cause analysis for any major issues that occur
- The risks of using the system should be minimized

Security Requirements

The security requirements detail access and protection of the system and the online examination data that is hosted on it. It is important to secure both the server and the actual examination system to prevent leakage of user data as well as to protect the integrity of the examination and student grades.

Details:

- The system will only be accessible to users with credentials, either server credentials for the administrators or user login credentials for other users such as students and teachers
- The server can only be accessed via SSH
- The website can be accessed via HTTP or HTTPS protocol
- The database where the student and examination data are located will not be publicly accessible

Performance and Scalability Requirements

The following requirements for performance and scalability of the proposed system are indicated here to ensure that the system runs smoothly with less errors and bottlenecks and serves as an opportunity for the system to grow and develop its capacity to meet the rising demands for the services offered [4].

Details:

- The system must perform with 99% uptime
- The system will be accessible online to the public via the given domain name
- The system will be hosted on a platform that can scale up the server requirements when required such as the memory and bandwidth allocation during periods of peak usage
- The system will use a database that can handle more connections through the set-up of replication databases in the future

Maintainability and Upgradability requirements

The following requirements for maintainability and upgradability are detailed out to ensure that the maintenance for the system is being followed, and if there are other tools, applications that will be need for the upgrade purposes in the future until the system can no longer be used and has reached the expected lifespan and could be potentially replaced by another system [5].

Details:

- The virtual machine will remain accessible to the administrators who can maintain and upgrade the server or software used
- The operating system will be updated periodically with software updates as provided by the source
- The software used will be maintained with security patches as needed

- Upgrades of the operating system and software can be done after the announcement of a scheduled downtime

Supportability and Operability requirements

The supportability and operability requirements detail the provided support needed during the lifecycle of the system as well as the key operating features required to keep the system running.

Details:

- Technical support will be provided on an ongoing and as needed basis when there are software issues to address
- Backups of the scripts and database will be automated via the use of scheduled tasks so that these will not be forgotten
- The server will be set up to record logs for access and script errors so these could be used for troubleshooting
- Uptime will be monitored via the host tools where the virtual machine is located

Business Life-Cycle Requirements

The business life cycle requirements detail out on how the proposed system can be used, developed, and be maintained in the 4 phases of the business life cycle, which is the launch phase, the growth/expansion phase, the shake-out phase all the way to the maturity phase. The 4 phases mentioned are detailed out to make sure the

proposed system can adapt and be able to be used for sustained periods of time until it reaches the expected lifespan [6].

Details:

- During the launch phase, the system will be under constant monitoring by administrators for any issues encountered
- During the growth/expansion phase, the system will be periodically updated depending on any additional business requirements
- During the shake-out phase, the system will be maintained with no new development done except for fixing any errors
- During the maturity phase, the system will be gradually retired with the data made available to be used for any new future systems developed

Environmental Requirements

System Hardware Requirements

The recommended system hardware requirements are described here to ensure that the hardware components to be used along with the software will be able to run the system smoothly and be able to use the system properly.

Details:

- Server with Intel/AMD 64-bit architecture
- CPU of 1 GHz or greater

- RAM of 1 GB or greater
- Storage space of 2.5 GB or greater

System Software Requirements

The recommended system software requirements are described here to ensure that the system will run given the specific software versions that are required to be installed given the hardware requirements above.

Details:

- Ubuntu 20.04 or greater
- Apache 2.0 or greater
- PHP 5.6 or greater
- MySQL 8.0 or greater

Application Program Interfaces (APIs) Requirements

The Application Program Interface (APIs) requirements are minimal as there are currently no plans to make examination data available for other systems in development. APIs are specifications that allow you to interact with other software components [7]. For our purpose there is no public data to expose via APIs, but this may change in the future if so required.

Details:

- The system has no public data to expose via APIs

- Development for APIs can be included in a future release if included as an additional requirement

Data Import and Export Requirements

The Data Import and Export requirements are minimal as there is not much user data that can be imported or exported for an examination system. The actual user and examination data is stored in an SQL database which can be configured in the future to be accessible to other servers and advanced users if they need to be exported into another system.

Details:

- The system will store data in an SQL database that can be accessed and queried by other systems in the future if so configured
- The system can support importing and exporting of examination data in a future release

References

[1] Brush, Kate. Use Case. https://searchsoftwarequality.techtarget.com/definition/use-case

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[4] Slele. 22 April 2008. Scalability Requirements. https://seilevel.com/requirements/scalability-requirements

[5] Alexandrian Rafael. 09 September 2019. Non Functional Requirements: Maintainability, https://seilevel.com/requirements/non-functional-requirements-maintainability

[6] DP, Taylor. 16 June 2020. The 4 Key Stages of the Business Life Cycle. https://www.fool.com/the-blueprint/business-life-cycle/

[7] Freeman, Jonathan. 8 August 2019. What is an API? Application programming interfaces explained. https://www.infoworld.com/article/3269878/what-is-an-api-application-programming-interfaces-explained.html