BENG (HONS) SOFTWARE ENGINEERING

SEC6201

UNDERGRADUATE PROJECT

PROJECT TITLE: EXAMIQ

SUBMITTED BY: LES PAUL RANALAN

SUPERVISED BY: DR. REHNA KALAM

2024 – 2025

ABSTRACT

This report examines the development and implementation of a proctoring solution with the use of artificial intelligence (AI), that is designed to address the challenges of remote examination integrity. This study focuses on how artificial intelligence (AI) can be used to enhance efficiency, accuracy, and fairness of online assessments. Whilst also addressing privacy and accessibility concerns.

The proposed solution integrates an algorithm to monitor test-takers in real-time by utilizing facial recognition, and behavior analysis to detect potential instances of academic dishonesty or cheating. The research included surveys and interview questions for both students and proctors or teachers. The findings reveal that students are less likely to be comfortable taking tests with artificial intelligence as it can perform a false-positive. Whilst for proctors or teachers, are more pro towards the idea.

ACKNOWLEDGEMENT

I extend my deepest gratitude to those who contributed to the successful completion of this project.

Firstly, I would like to thank University of Greater Manchester, for providing the resources and support needed to conduct this project. Special thanks go to Renuka Nyayadhish and Dr. Rehna Kalam, whose guidance and insights were invaluable throughout the entire project.

Secondly, I would like to thank my friends and family for always there in supporting me in my journey. Specifically, my mother: Susie Flores Ranalan, my father: Anthon Martinez Ranalan, and my girlfriend: Justine Kyle Garcia. Your feedback and moral support are of utmost importance.

This project is the result of collective efforts, and I deeply appreciate everyone indirectly contributed to its success.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TERMS & ABBREVIATIONS

Iterative Model – a software development methodology that breaks down the process of building a system into smaller iterations.

Artificial Intelligence (AI) – it refers to the simulation of human intelligence processed by computers.

Computer Vision – it is a field in artificial intelligence that enables computers to interpret and make decisions based on visual data.

Facial Recognition – it is the use of artificial intelligence to identify a person's face.

AI-Powered Proctoring – it is the use of artificial intelligence to monitor exam environments, ensuring that the students do not cheat.

NextJS – it is a React framework that helps build fast and modern web applications with built-in features such as server-side rendering, authentication, static site generation, etc.

WebGazerJS – it is a JavaScript library that utilizes a computer's webcam to perform real-time eye tracking without the need for hardware. It is powered through WebRTC and Canvas APIs.

Supabase – it is an open-source backend-as-a-service that helps with building scalable web and mobile applications by providing databases, authentication, etc.

INTRODUCTION

This chapter outlines the overview of the project, beginning with its background, which discusses the motivation behind this research and the growing need for artificial intelligence in schools and educational institutions. Whilst also stating the problem statement wherein it identifies the key challenges associated with remote examination security, such as academic dishonesty, privacy concerns, and false positives. Additionally, it provides the aims and objectives which outlines the goals of this project.

PROJECT BACKGROUND

The topic of AI-powered proctoring was selected as a way for educational institutions to transition from paper examination to digital or online examination. Transitioning would benefit both the student and educational institutions as it offers flexibility, convenience, and efficiency **(Hill, 2020)**. Additionally, this lets teachers create unique assessments that potentially motivates students to succeed.

Online examination has become especially prevalent during the years of the pandemic where schools enforced online assessments at home, where students are placed in an online meeting and are being proctored by a teacher or professor. Even today, it has become the norm as the College Board in the United States mentioned that they are transitioning their 12 out of 28 exams to fully digital starting May 2025 **(Packer, 2024)**. This includes courses such as Computer Science and Computer Science Principles.

In this current age, AI has become prevalent as well with 71% of businesses adopting AI for at least one business function **(Haan, 2024)**. As a way of improving online examinations, AI-powered proctoring was created as a way of mitigating academic dishonesty and evaluating students with efficiency. This is done by various techniques such as eye-tracking, predictive typing by sound, and detection of generative AI content.

Academic dishonesty or cheating is what keeps educational intuitions away from online examination. However, research shows that students, in general, do NOT cheat on online

tests more than on face-to-face ones **(Domínguez-Figaredo, et al., 2022)**. This means that evidence is inconclusive and that students WILL cheat eventually on both online and on paper, with studies saying that 35% of undergraduate business students admitted to cheating during the pandemic (Rosalyn, 2023).

PROBLEM STATEMENT

The increasing use of online examination has brought increased challenges in maintaining academic integrity and fairness. Traditional methods, such as manual supervision via video conferencing, are labor-intensive but also prone to inaccuracies and inefficiencies **(Holden, et al., 2021)**. Additionally, the growing adoption of artificial intelligence has increased the potential for academic dishonesty or cheating with the use of generative content.

While these tools have emerged, it raises issues such as false positives, privacy breaches, and lack of accessibility for the disabled **(Holden, et al., 2021)**. These issues can hinder the potential of converting from traditional to AI-powered proctoring, with traditional maintaining the reliable and more ethical way.

AIMS & OBJECTIVES

The aim of this project is to implement an online examination system, called Examiq, for enhancing examination integrity through AI-powered proctoring.

Below are the objectives:

1. To conduct literature review of articles or case studies focusing on best practices for online exam systems.
2. To organize feedback sessions from students and instructors.
3. To develop a prototype of the system and conduct a usability test.
4. To research and implement security measures such as anti-cheating system and identity verification
5. To evaluate the system by collecting feedback and measure effectiveness.

LITERATURE REVIEW

This chapter outlines the critical evaluation of existing technologies and systems relevant to the development to Examiq. It helps identify gaps in the current solution and provides a solid foundation, in terms of requirements, for the system's design and implementation.

STABLESIGHT

It is an AI-driven exam proctoring platform created by a company named Rosalyne. It uses advanced AI techniques to monitor and detect cheating during online examination, especially with the use of AI tools such as ChatGPT. It features gaze tracking (eye tracking) to identify if a student is using a secondary screen, a keyboard correlation model to detect concealed devices based on sounds of typing, and a system to review AI flags **(Rosalyn, 2023)**. Additionally, it features authentication based on facial recognition and ID verification. StableSight is currently being used by over 500,000 exams for institutions such as the United States Department of Defense, Coursera, Stripe, and Nexford University **(Rosalyn, 2023)**.

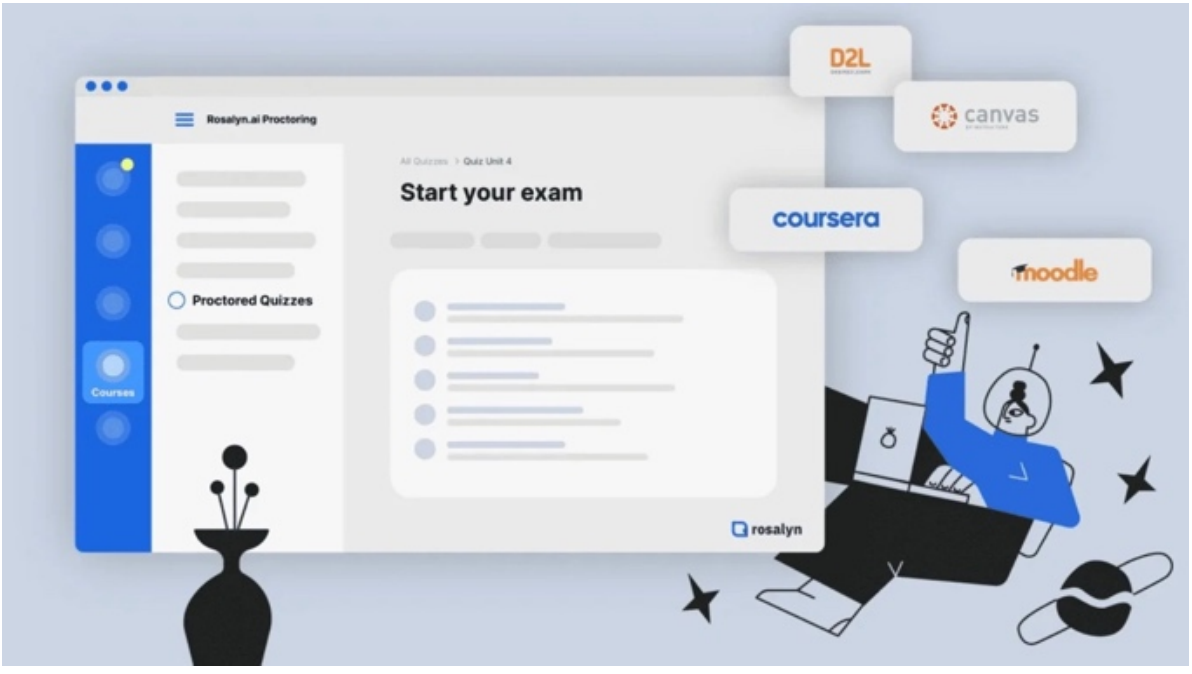


Figure 1: StableSight application

Advantages:

- Facial recognition and ID verification.
- AI tool usage prevention.
- Face, gaze, and typing tracking.
- Trust certified.
- Full-fledged application.

Disadvantages:

- Huge cost of delivery.
- Not open source.

HONORLOCK

It is an AI-driven exam proctoring platform created by two students at Florida Atlantic University (Honorlock, 2020). It combines live proctoring with AI to monitor the student's behavior, such as phone usage, blocking AI tools such as ChatGPT, lock down browsers to prevent searching in another tab, voice detection to prevent mobile assistant such as "Hey Siri" and "Hey Google", and video monitoring for live interventions of proctors. Additionally, it has authentication based on facial recognition and ID verification. Honorlock is used by over 3,000 exams in higher education institutions such as the University of Wisconsin-Madison **(O'Brien, 2020)**.

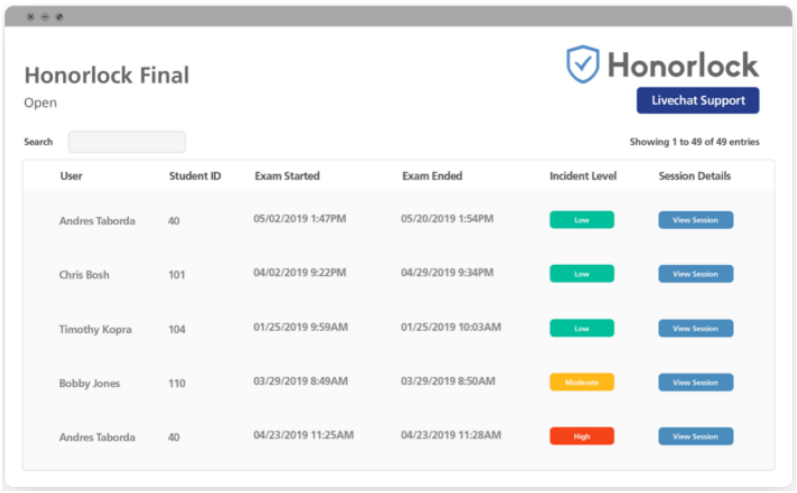


Figure 2: Honorlock application

Advantages:

- Face and voice tracking.
- Facial recognition & ID verification.
- Browser lockdown.
- Disability friendly.
- AI tool usage prevention.
- Protects student privacy via FERPA (Family Educational Rights and Privacy Act).

Disadvantages:

- Not open source.
- False flags may occur.
- Web application.

EXAMITY

It is an AI-drive exam proctoring platform initially founded by Michael London **(Hofherr, 2018)**, now acquired by Meazure Learning. It features AI techniques to analyze video feeds whether students are moving their heads or looking away from the screen, flagging unusual activities such as opening other websites, unexpected noise or unexpected movement. It also offers additional authentication to students such as fingerprint scene, voice match, and facial recognition. Examity is used by over 400 clients, including Boston University, Yale University, and Pennsylvania State University **(Hofherr, 2018)**.

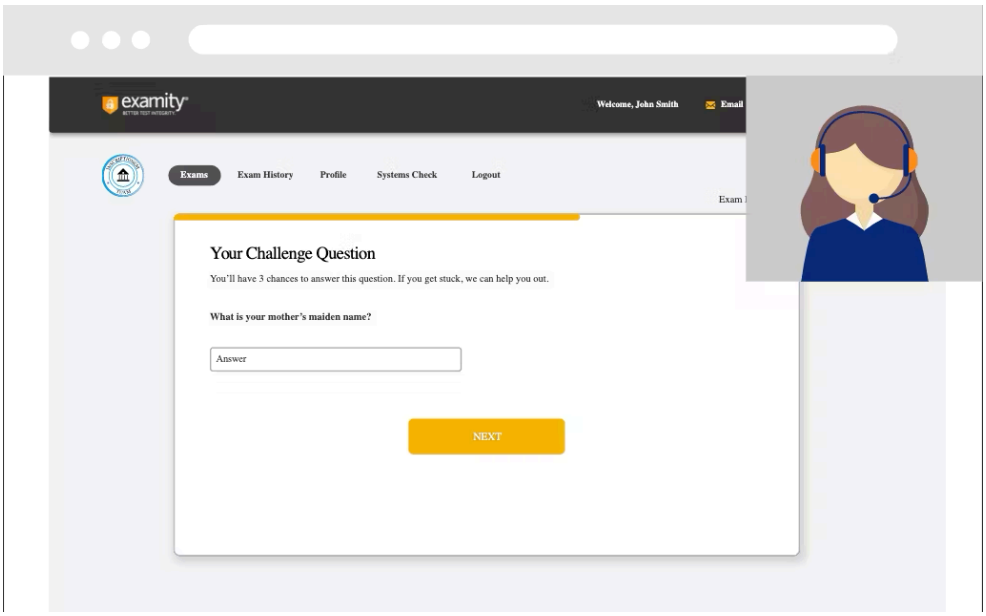


Figure 3: Examity application

Advantages:

- Face and sound tracking.
- AI tool usage prevention.
- Secure identity verification.

Disadvantages:

- Not open source.
- Huge cost of delivery.
- Data privacy concerns.
- Web application.

RESEARCH METHODOLOGY

This chapter outlines the research methodology employed to investigate the development and implementation of Examiq. It discusses data collection methods, data analysis techniques, and other considerations.

This study adopts a mixed-methods approach wherein it combines data from interviews and data from surveys to ensure a comprehensive understanding of the pros and cons of AI-powered proctoring solutions. This also highlights the opinion and perspective of a teacher and students.

SOFTWARE DEVELOPMENT LIFE CYCLE (SDLC) MODEL

Iterative Model will be used for this project. It is a software development process where a system is built in small sections or iterations **(Institute of Data, 2023)**. Each iteration contains its own planning, designing, coding, and testing. After each iteration, it is refined based on user feedback or research.

Through this, the system is built on continuous improvement and incremental development. It is flexible as more testing is required especially when dealing face tracking. It also makes risk management easier as detecting problems from the get-go can easily be mitigated.

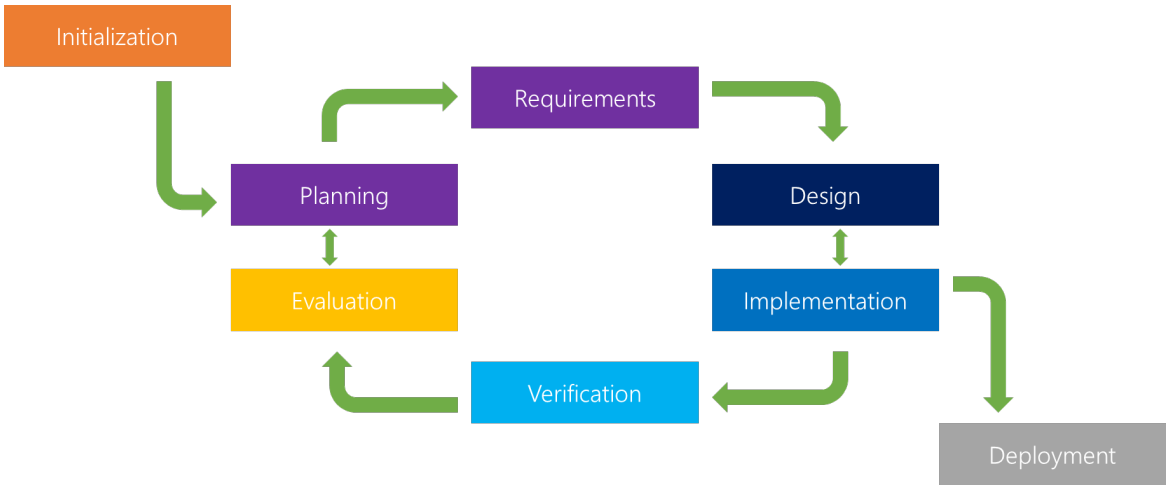


Figure 4: Iterative model

DATA COLLECTION

This chapter outlines the strategies, tools, and methods used to collect data before the development of the system. The goal is to understand user needs, current systems in use, feasibility in technology, and the context in which the system will operate. This will then serve as a guide in the designing and implementation phases.

PRIMARY DATA

This type of data is collected first-hand specifically for this project. It is original and collected directly from the source **(West Virginia University, 2023)**.

Primary data was collected through structured survey and was distributed to 20 students, coming from various schools and universities. Additionally, an interview was conducted to 1 instructor from a private school. This is to gain insights into their perception, and through that, it is easier to lay out all the requirements of the system.

SECONDARY DATA

This type of data is collected by someone else for another purpose and is relevant to this project, thus it's being referenced in this project **(West Virginia University, 2023)**.

Secondary data was collected through existing systems, research papers, and research articles. This can be seen through the literature review wherein it discusses the use of AI in online proctoring and its advantages and disadvantages of existing systems. Through this, each system's gap can be revealed, which can lay out requirements of Examiq.

DATA ANALYSIS

This chapter outlines the analysis of data collected from students and instructors regarding their experiences and perceptions of AI-powered proctoring. The data was gathered through surveys and interviews.

SURVEY

The survey was conducted via Google Forms. Below is the result summary, together with key findings of each question.

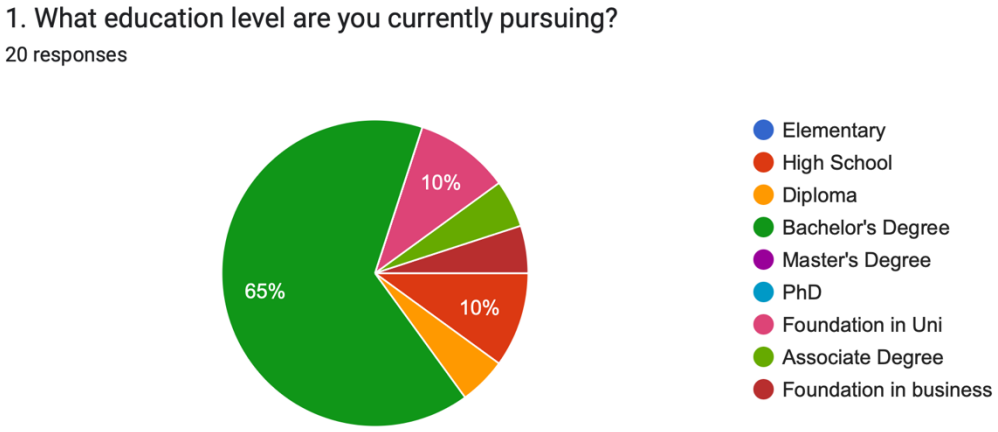


Figure 5: Survey question 1

Key findings: Majority of participants are currently taking bachelor's degree. While minority of participants are taking foundation level.

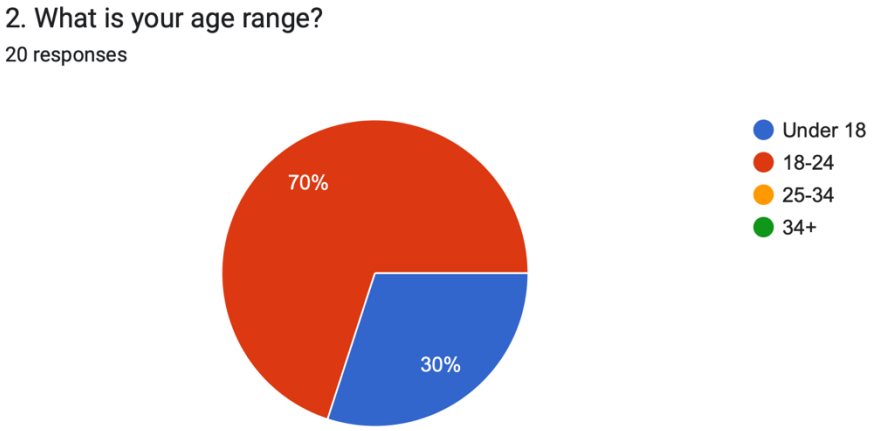


Figure 6: Survey question 2

Key findings: Majority of participants are above the age of 18. While minority of participants are aged below 18.

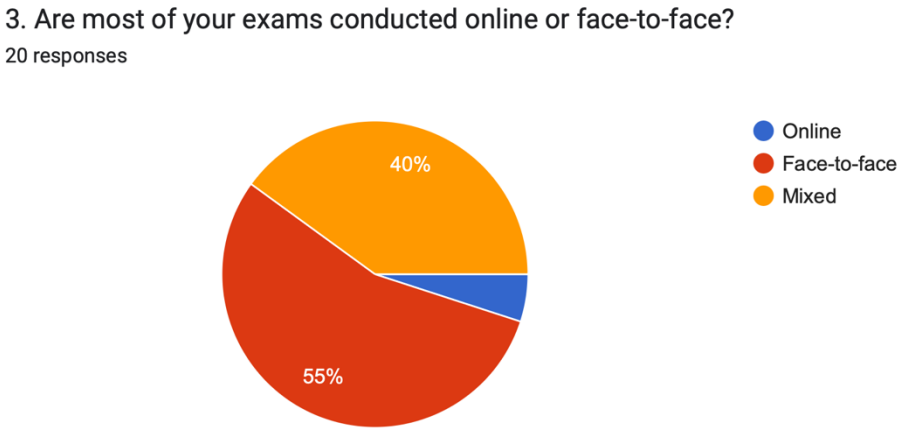


Figure 7: Survey question 3

Key findings: Majority of participants are more experienced towards face-to-face examinations. While 40% are mixed, and a minority with online examination.

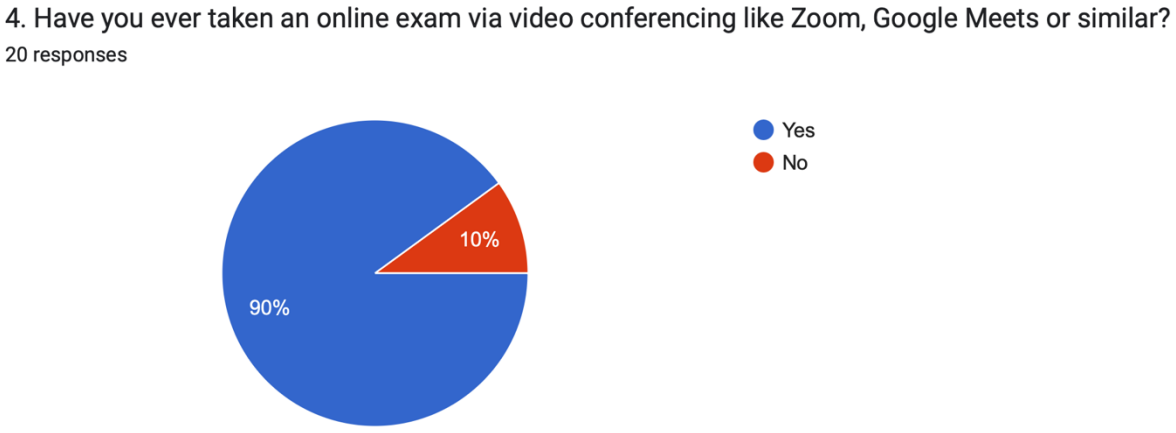


Figure 8: Survey question 4

Key findings: Majority of participants have experienced an online examination via Zoom in the past. While minority of participants have not experienced online examination.

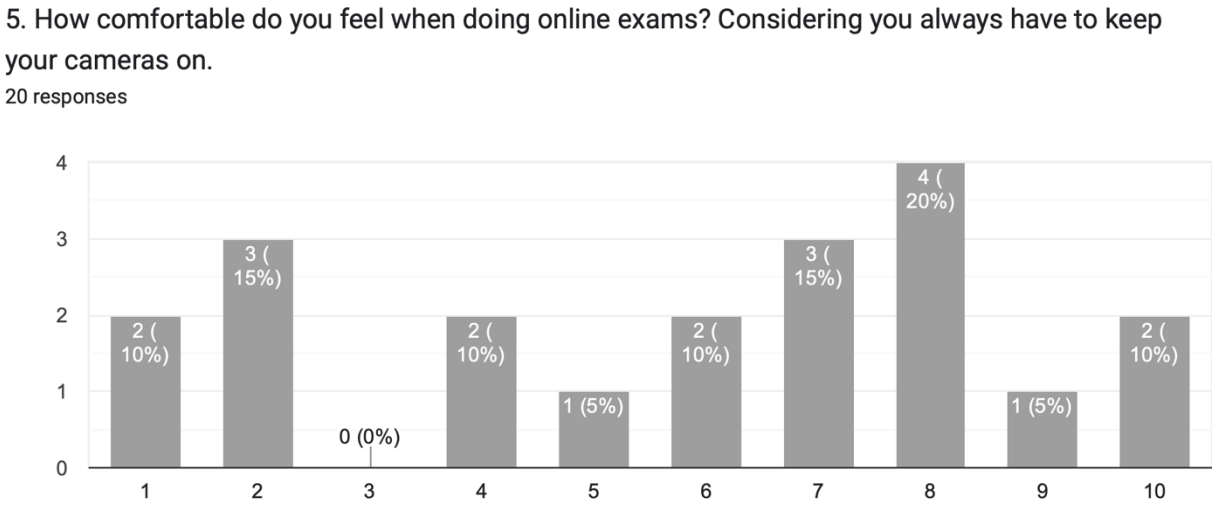


Figure 9: Survey question 5

Key findings: Majority of participants are more likely to be comfortable when in an online exam, with cameras turned on. While some minorities are not comfortable.

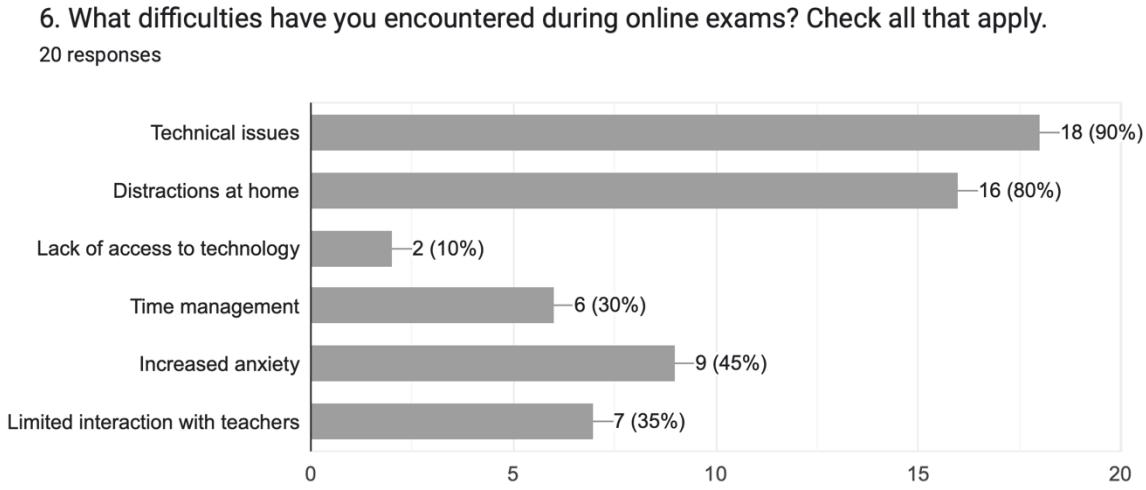


Figure 10: Survey question 6

Key findings: Majority of participants have experienced difficulties based on technical issues and distractions at home. While some minorities are experiencing increased anxiety when taking an online examination.

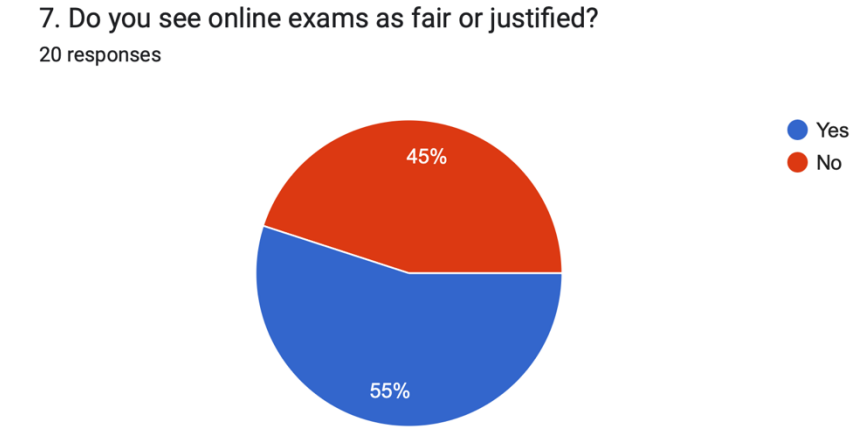


Figure 11: Survey question 7

Key findings: Majority of participants see online exams as unfair. However, this is a case-to-case basis. The data is considered as a tie between yes and no.

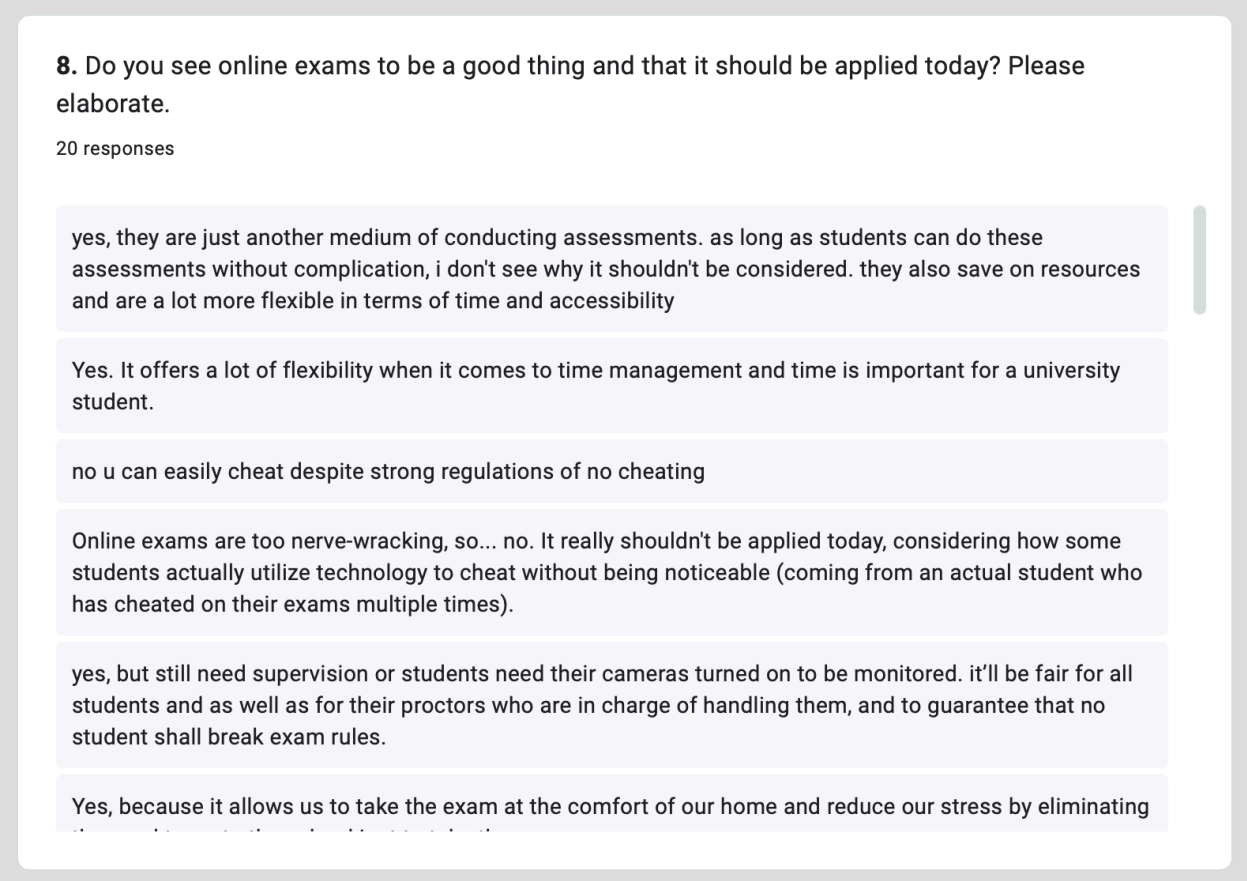


Figure 12: Survey question 8

Key findings: Majority of participants stated that online examination is a good thing that offers convenience and accessibility in cases of students unable to attend in person. However, majority of participants also stated that there are cons to it such as it offers more chances of academic dishonesty and the additional need of supervision. While minority of participants stated that is not a good thing because it is "nerve-wracking" due to the cameras always turned on, and more changes of cheating.

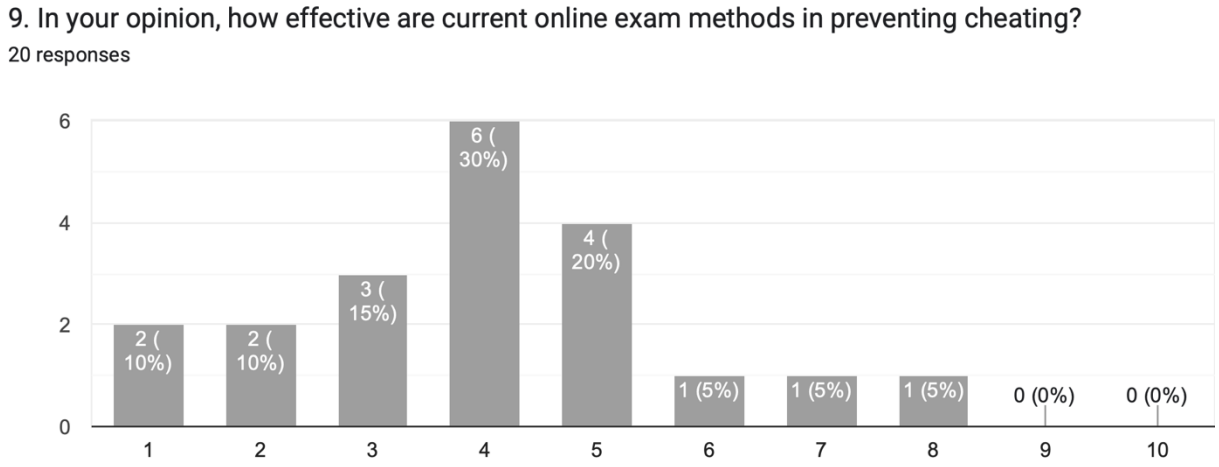


Figure 13: Survey question 9

Key findings: Majority of participants stated that current exam methods, such as online exam through Zoom, are not efficient in preventing academic dishonesty as most participants answered below the number 5 scale.

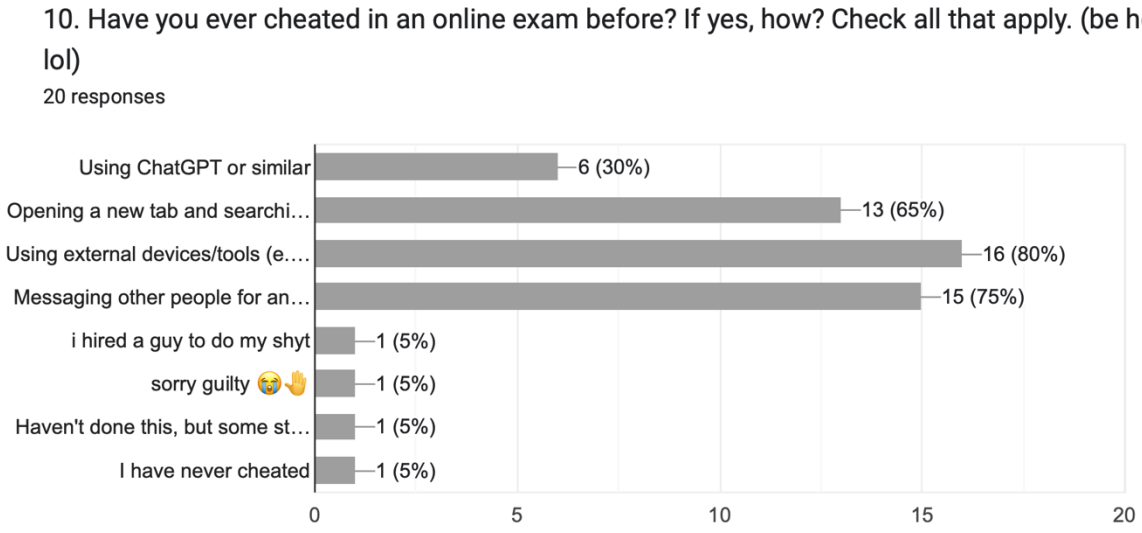


Figure 14: Survey question 10

Key findings: Majority of participants stated that they committed academic dishonesty, with commonly used method of having external devices off the camera, messaging other people, and using the web browser in the background.

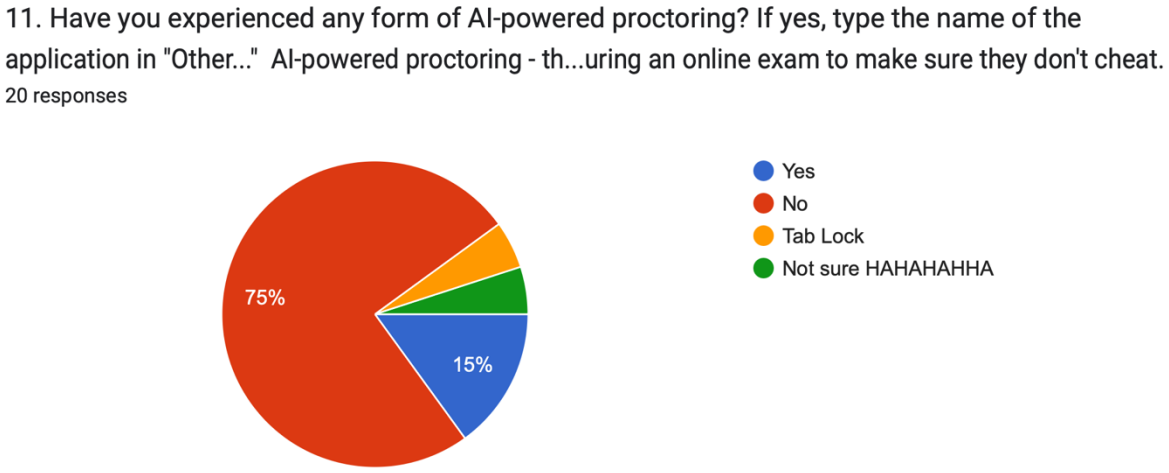


Figure 15: Survey question 11

Key findings: Majority of participants have not experienced AI-powered proctoring solution. While minority of participants do have experience in such systems.

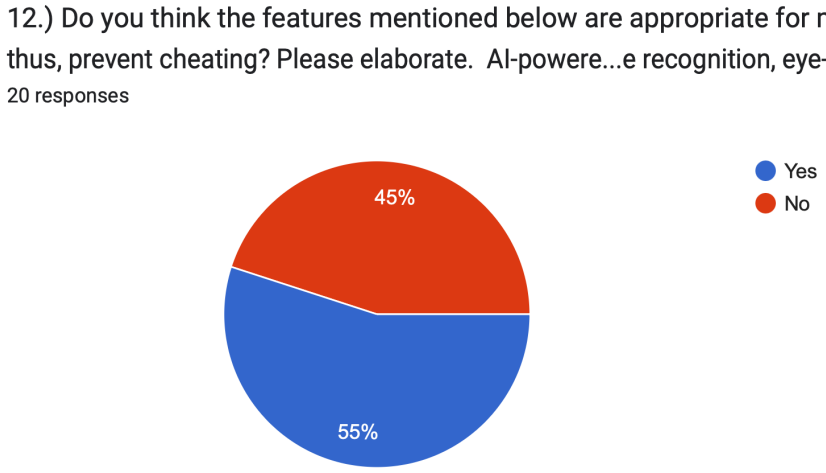


Figure 16: Survey question 12

Key findings: Majority of participants agreed that all the features above, such as face recognition, eye-tracking, and behavior analysis, are appropriate when it comes to AI-powered proctoring solution. Though the ratio has more answers towards "yes", this data is considered a tie between a yes and no.

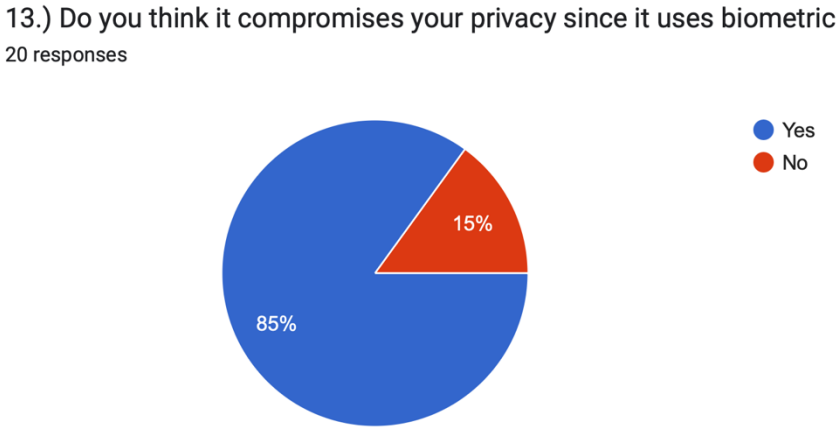


Figure 17: Survey question 13

Key findings: Majority of participants agree that privacy is a compromise when it comes to using biometric data for tracking. While minority of participants disagree.

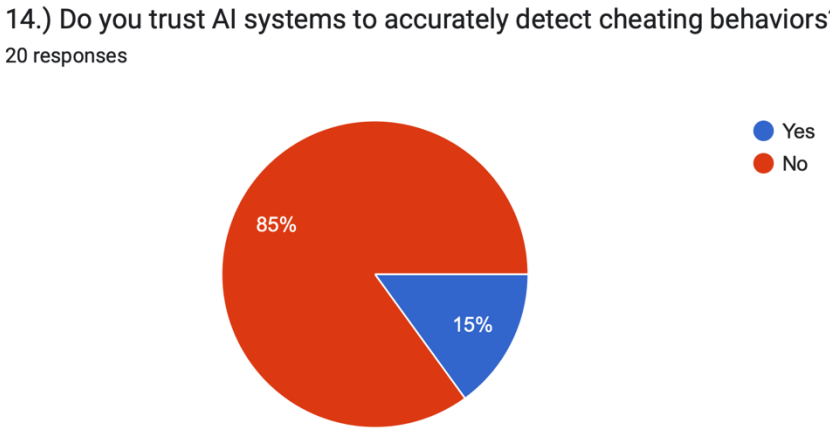


Figure 18: Survey question 14

Key findings: Majority of participants disagree that AI systems can accurately detect cheating behaviors. While minority of participants agree.

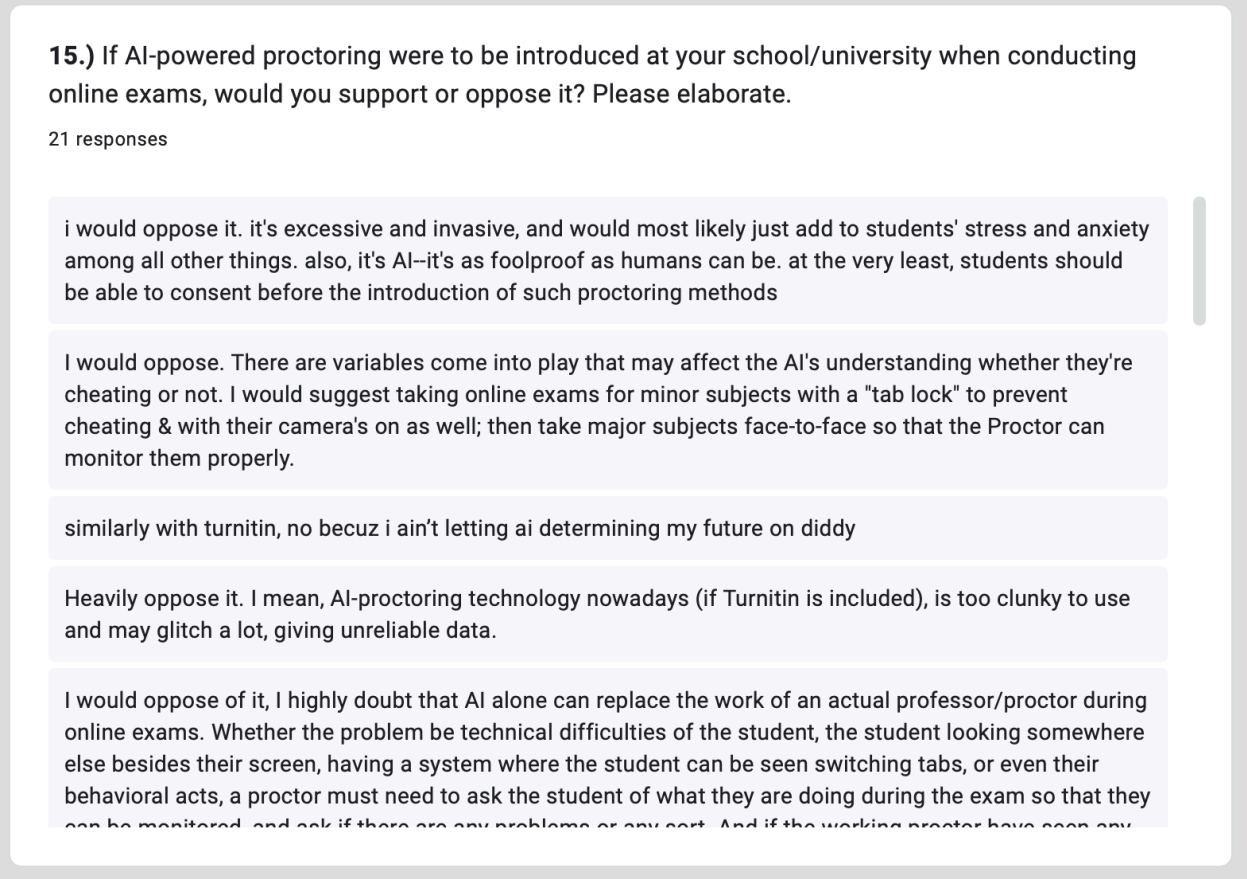


Figure 19: Survey question 15

Key findings: The data shows that this data is a tie between support and oppose. Some participants oppose the idea of AI-powered proctoring due to biometric data being used which results as a privacy risk, and the increased chances of false-positives when it comes to flagging behaviors. Nonetheless, there are participants who agreed to support the idea, which makes exams more efficient, fast, and easier to manage, but remains cautious about it and will only support it if the system is improved upon and made more accurate.

INTERVIEW

The interview was conducted via Zoom. Below is the transcript that contains the questions and responses:

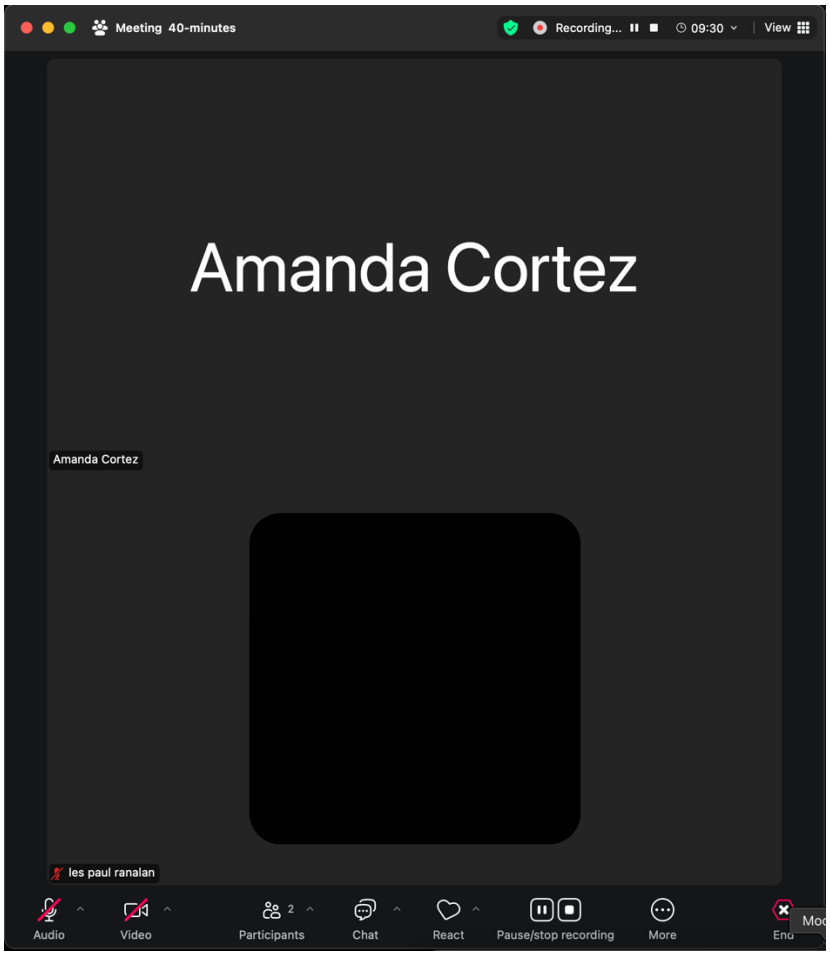


Figure 20: Interview session

1. How do you currently conduct exams?

   "Typically, I create the exam questions and hand out printed copies to the students. They complete the exams in class under my supervision."

2. What are the challenges you face in ensuring exam integrity, and what strategies do you use to ensure that?
   "Some challenges include preventing cheating or ensuring students don't share answers. To maintain integrity, I walk around the classroom, monitor students closely, and sometimes use different versions of the exam to minimize copying."

3. Do you think online exams are fair and justified?
   "Online exams can be fair if they're well-designed and students have equal access to technology. It's important to ensure that all students have a fair chance to succeed, whether exams are online or in person."

4. Do you think online exams are as effective as traditional exams?
   "Online exams can be effective if they are thoughtfully structured and cover the same material. They also offer flexibility, but they require reliable internet and technology access."

5. What are your thoughts on utilizing AI for monitoring exams?
   "Using AI for monitoring exams could help detect unusual behavior and reduce cheating. However, it's important to balance monitoring with students' privacy and ensure the system is fair."

6. Are you familiar with any AI-powered proctoring solutions? If yes, can you mention one or two?
   "Yes, I've heard of AI-powered proctoring tools like ProctorU and ExamSoft. These platforms use AI to monitor students during online exams."

7. What benefits or features do you expect when using AI-powered proctoring in comparison to traditional methods?
   "AI proctoring can offer more consistent monitoring and flag suspicious behavior automatically. It can also be used for remote exams, providing flexibility for students who can't attend in person. This can save time and resources compared to traditional proctoring methods."

8. What concerns do you have regarding the use of AI for proctoring?
   "I'm concerned about privacy and data security for students being monitored. Additionally, there's a risk of false positives or bias in AI systems that could unfairly impact students. Ensuring transparency and fairness is crucial."

9. What is the best way to introduce an AI-powered proctoring system to students?
   "The best way is to clearly explain how the system works, its benefits, and how it ensures fairness. Be transparent about what data is collected and how privacy is protected. Encourage questions to address any concerns they might have."

10. In the future, will you be open to AI-powered proctoring if it ever comes to your school/university?
    "If AI proctoring is implemented thoughtfully and ethically, I'd be open to exploring how it could benefit students and improve exam integrity. It's crucial to involve teachers and students in the decision-making process to ensure everyone's concerns are addressed."

FUNCTIONAL REQUIREMENTS

It is a type of requirement wherein it describes what the system should do, this is more focused on features, functions, and behaviors **(Jama Software, 2023)**. These requirements are closely tied to the business logic of the system.

Based on the analyzed data from the survey, below are the functional requirements made to improve upon the proposed AI-proctoring solution:

- **Course & instructor management**
  - Instructors can create and manage courses.
  - Instructors can create and manage exams within courses.
  - Instructors can enroll and remove students from courses.
  - Students can take the exam within their enrolled course.
- **User authentication**
  - Student account with password.
  - Instructor account with password.
  - Admin account with password.
- **Real-time proctoring & monitoring**
  - Live video feed with face tracking.
  - Behavior analysis to flag unusual activities.
- **Privacy & data security**
  - Encrypted video and behavior logs.
- **Automated reporting**
  - Automated checking and scoring via AI.
- **Exam flexibility**
  - Support for different types of exams (code, multiple choice, essays, fill in the blanks).

NON-FUNCTIONAL REQUIREMENTS

It is a type of requirement wherein it describes how the system should perform; this is mostly focused on quality attributes or constraints of the system **(Jama Software, 2023)**. These requirements are implemented to improve user experience and system reliability.

Based on the analyzed data from the survey, below are the functional requirements made to improve upon proposed AI-proctoring solution:

- **Performance & scalability**
    - Able to support many concurrent users without crashing.
    - Should function efficiently with different internet speeds.
- **User experience**
    - Easy-to-use interface for students and instructors.
    - Minimal distractions during exam periods.
- **Legal & ethical compliance**
    - Transparent on data collection.
    - System must be open source.

SYSTEM DESIGN

This chapter outlines the planning and structuring of how Examiq will function, both technically and logically. It talks about the overall architecture, the technologies used, how it's implemented. This includes the frontend, backend, different API components as well as diagrams.

FRONTEND

NextJS via React was used to create the frontend of Examiq wherein it utilizes components, which are building blocks of a website as this includes buttons, forms, cards, etc. Components are then reused to create different views for each user or create a whole new view entirely. Through components, it is used as a bridge between the backend, with inputs for user authentication and for displaying data from the database. Additionally, the frontend extends to providing a way to manipulate records in the database.

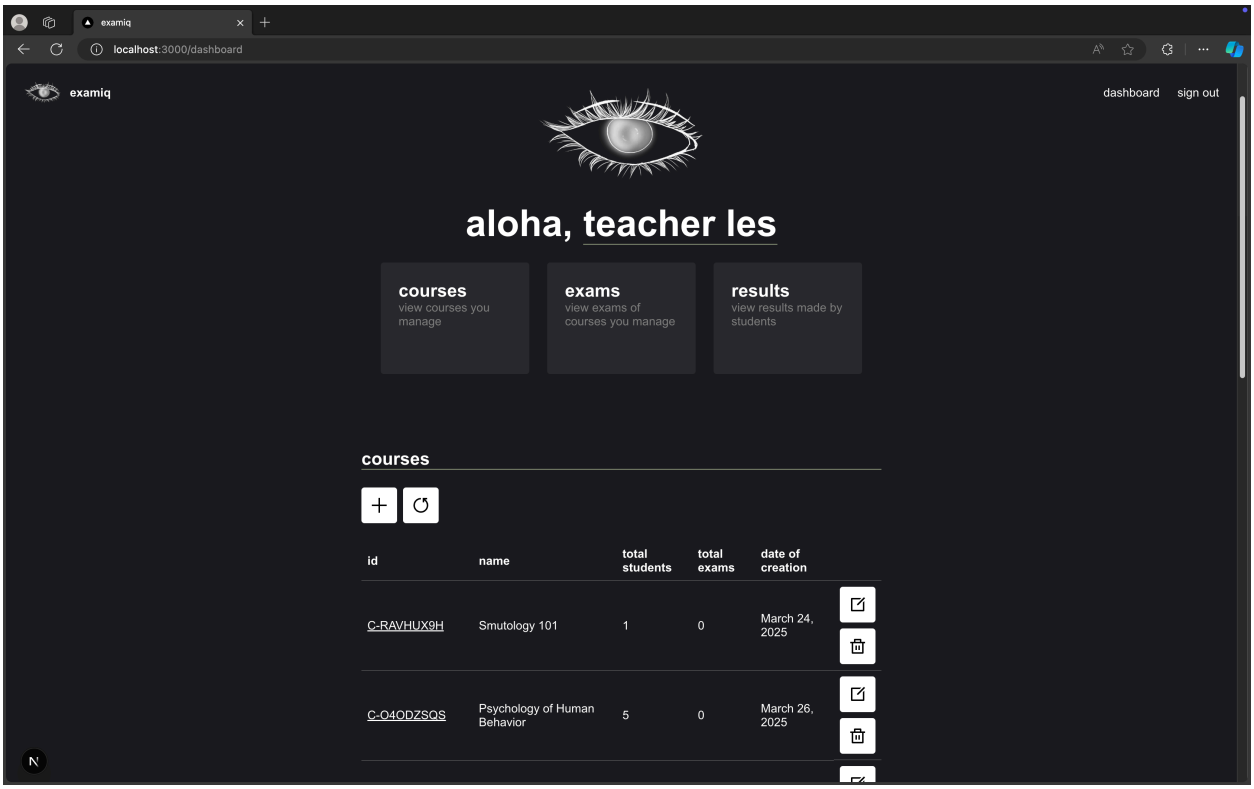


Figure 21: Frontend of Examiq

The main design and point of the frontend should be that it is simplistic and minimal. It should be easy-to-use and distraction-free. There should be no flashy colors and thus should remain as monochrome with black being the background color and white being the text color. This is intentional to reduce the reflection of the eyes to make the gaze-tracking more accurate. Additionally, there should be no distractions, this means no flashy components and no animations whatsoever.

BACKEND

Both NextJS and Supabase is used to create the backend of Examiq wherein it utilizes NextJS's feature of having server-side rendering to lessen the load on the client-side and thus improving performance. Supabase, on the other hand, handles all the user authentication and database interaction. Both user authentication and database all come pre-built within Supabase.

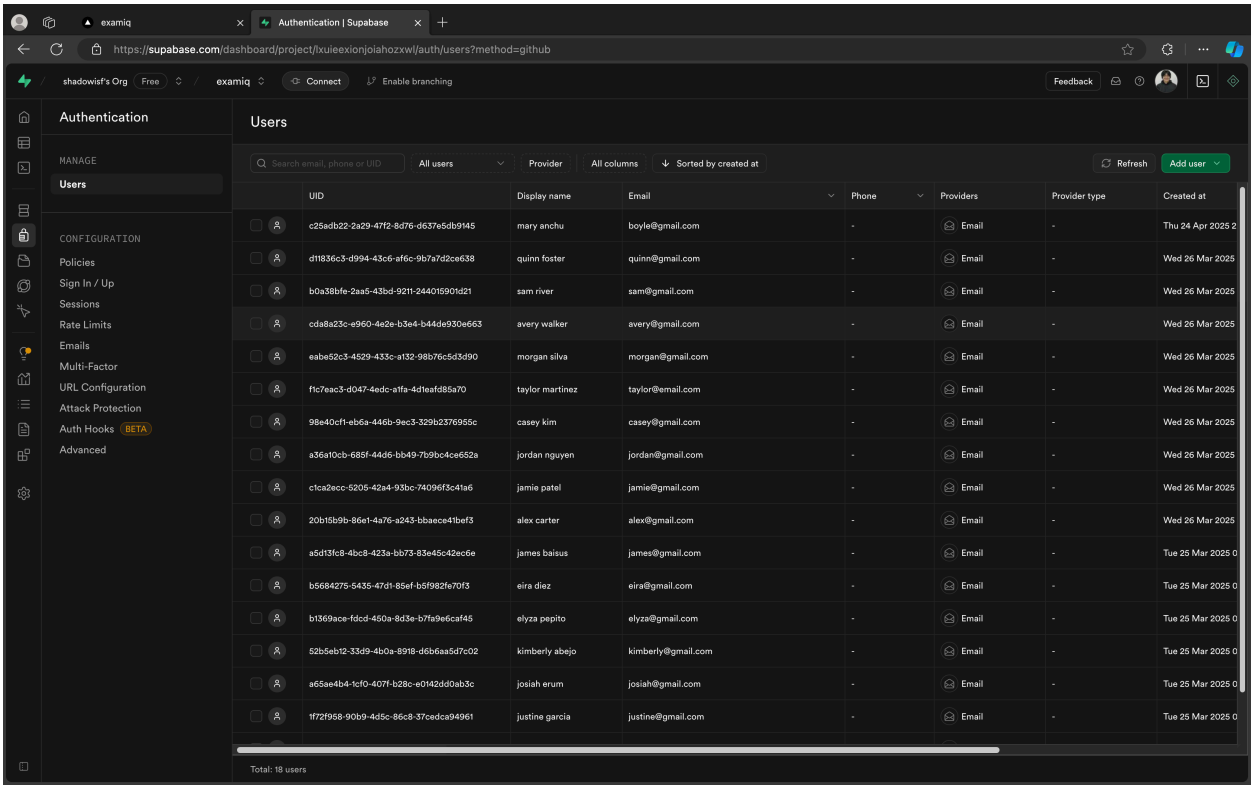


Figure 22: Backend of Examiq

In the database, each record has a primary and foreign key that links to other records of other tables. This makes it more efficient when filtering through exams within courses, students enrolled in courses, results within exams, etc. With the foreign key, if the parent record is deleted, all the referenced records would also be deleted via cascading. Using cascading would be beneficial as it prevents invalid records displaying onto the application.

ARTIFICIAL INTELLIGENCE (AI)

WebGazerJS is used to execute the eye-tracking component, while DeepSeek V3 is used for checking student answers automatically. With eye-tracking, there are hotspots on all sides of the webpage wherein if triggered, it will add a number to the location counter where the user looked whether that's top, right, left, and bottom. This forces the student to always look at the center where the exam content is located, preventing them from looking elsewhere.

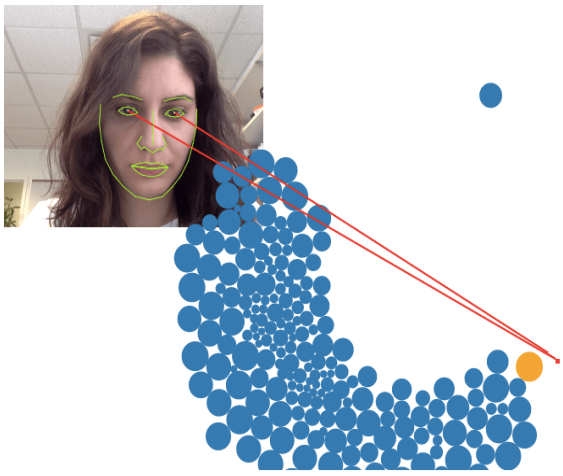


Figure 23: WebGazerJS's ball collision game via gaze-tracking

As for DeepSeek V3, it utilizes an API wherein it sends the request which is a question, and the system receives a response from the DeepSeek model. This is especially useful with unique exam items, such as paragraph questions or coding questions, where there is no specific right answer to the question. This gives the instructor efficiency where it cuts the entire checking time for unique exam items.

UNIFIED MODELING LANGUAGE (UML) DIAGRAMS

To better understand the system architecture, unified modeling language (UML) diagrams were used to visualize how different components of the system interact and how data flows between them. In this project, entity-relationship diagram (ERD) and data-flow diagram (DFD) were both used. Below are the diagrams and its explanation.

Data-flow diagram (DFD) is a visual representation that shows how data moves through a system, helping break down a system into many components based on how data is processed, stored, or travel **(Lucidchart, 2023)**.

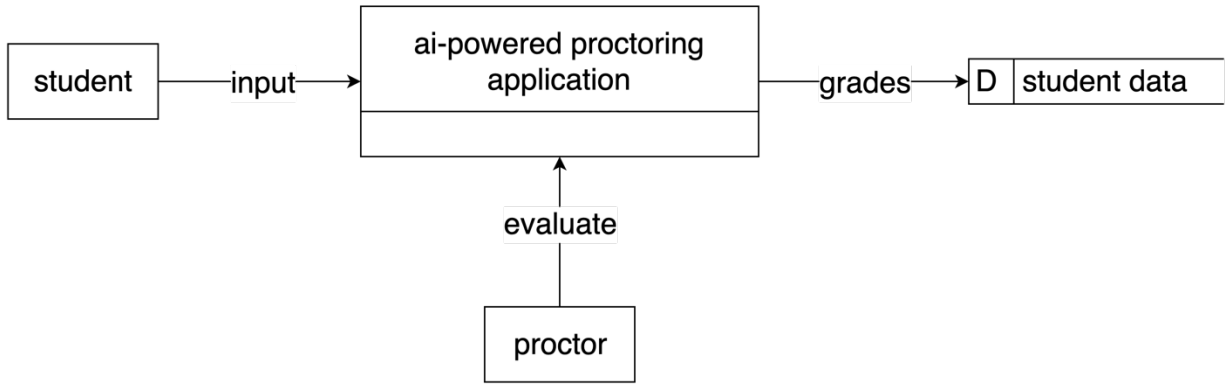


Figure 24: Level 0 data-flow diagram

Level 0 is also known as context diagram, and it just gives the simplified overview of the entire system. In the diagram above, it just shows the entities and their action and presents the system as a single process, with its output to a database.

The main key point here is to show the system interacting with external entities and show non-technical people understand the basic concept of the system at one glance.

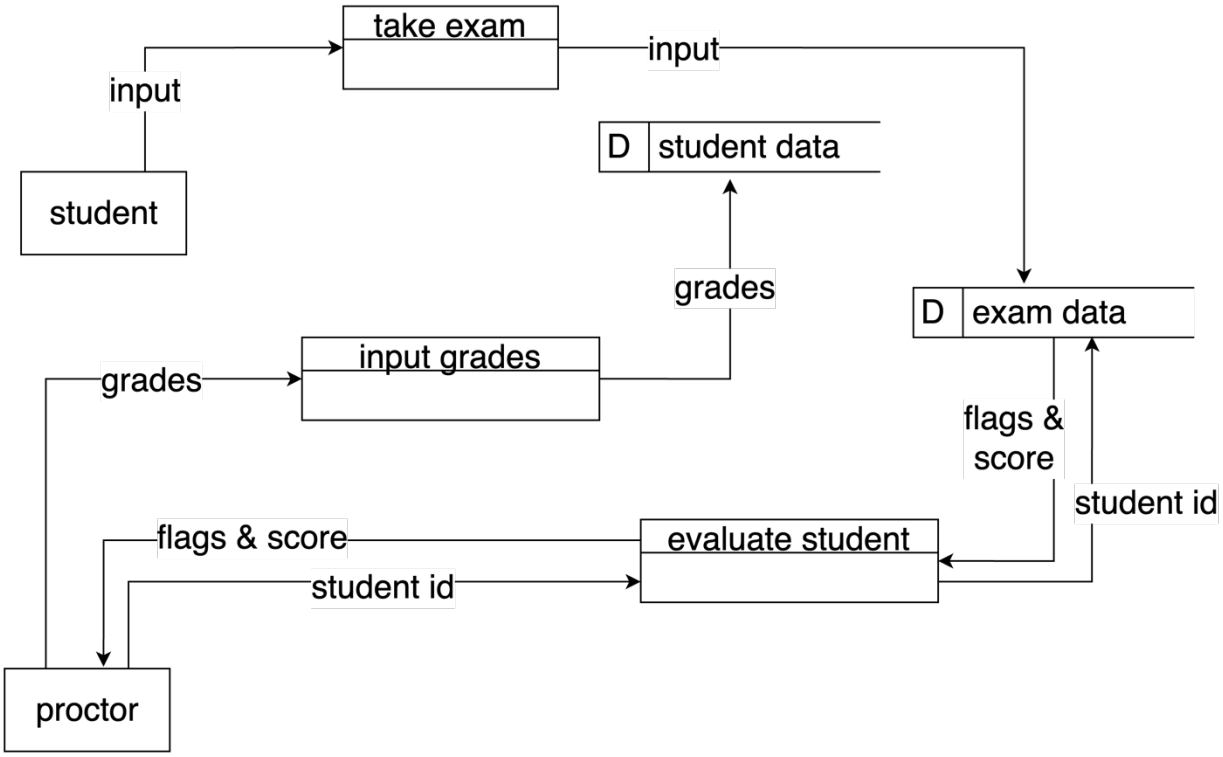


Figure 25: Level 1 data-flow diagram

Level 1 breaks down the single process from level 0 into multiple subprocesses to show more details of how the system itself works. In the diagram above, it shows more processes such as students taking exam, proctors evaluating and inputting grades, etc.

The key point here is to show more internal data flows and to help developers and system designers understand how the data is processed in a step-by-step manner.

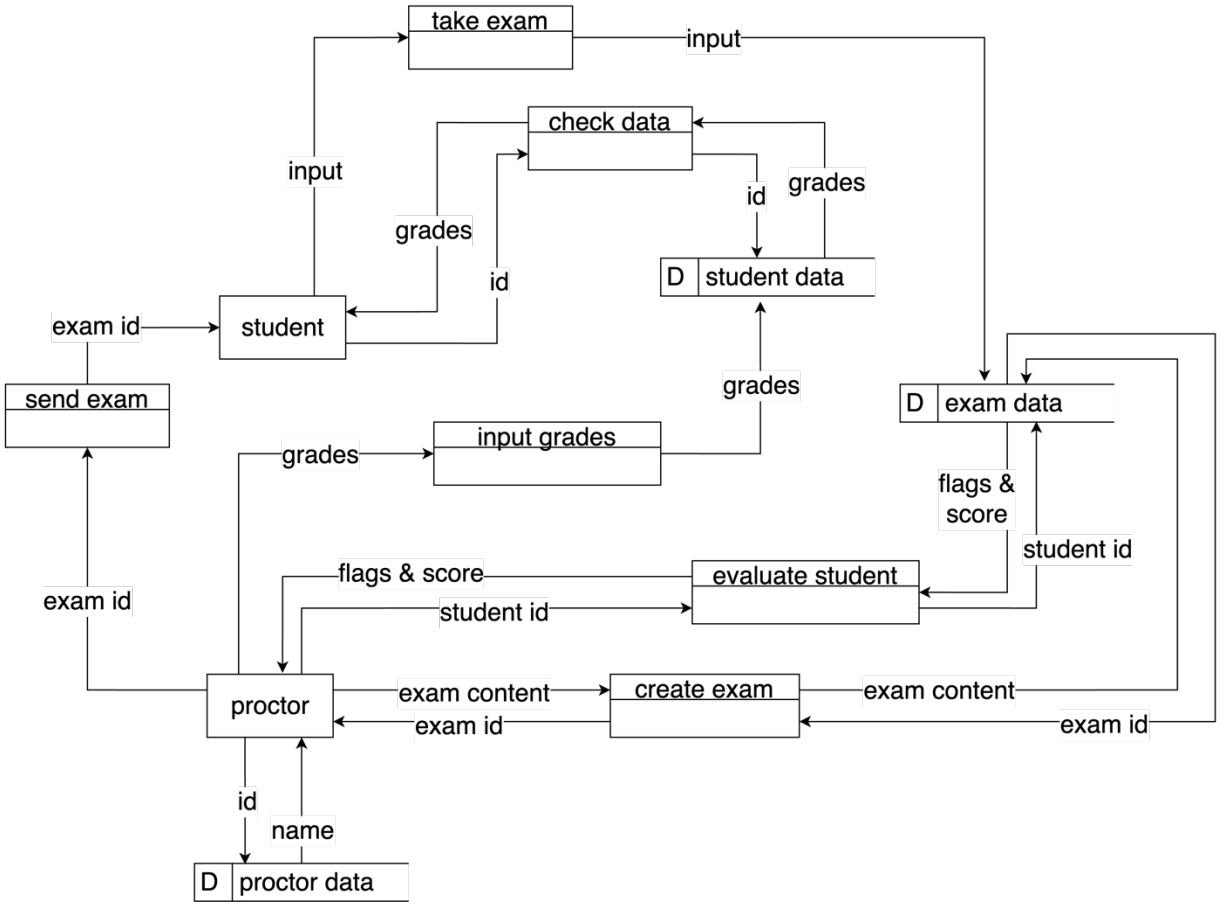


Figure 26: Level 2 data-flow diagram

Level 2 zooms in even further than level 1 as it breaks down one of the subprocesses from level 1 into even smaller and detailed processes. In the diagram above, it shows further details such as proctor creating and sending exams to students, students checking and taking exams, etc.

The main key point here is to deeply analyze a specific process within the system and to help developers, database designers or system analysts the exact logic of a feature. Additionally, it clarifies exact data validation, interactions and decisions happening within a specific subprocess.

Entity-relationship diagram (ERD) is a visual representation of a database design by showing the relationships between data entities, with their designated attributes, in a system **(Lucidchart, 2023)**.

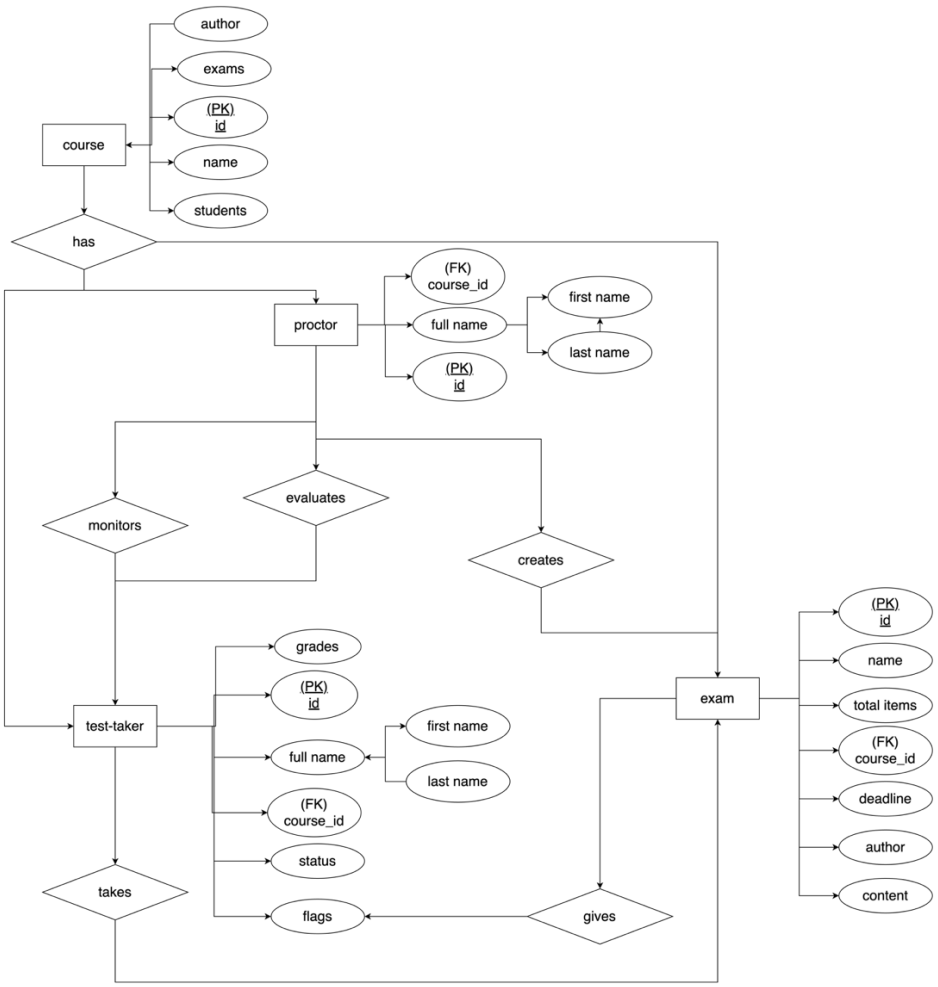


Figure 27: Entity-relationship diagram

An entity-relationship diagram (ERD) was used to visually represents how data is structured and how different entities relate to each other and how they interact with each other. In the diagram above, each entity such as Course, Exam, Test-taker, and Proctor all have designated primary keys. With that, foreign keys are also present wherein it relates to other entities such as exams belonging to a specific course or a course being under a specific proctor. The use of foreign key serves as data normalization which reduces redundancies or unnecessary duplicate data.

The main key point here is to communicate the structure of a database in a visual way. It helps developers and non-technical people understand how data flows and connects within a system. This more so acts as a blueprint for designing a database.

IMPLEMENTATION

This chapter outlines the technical and logical structure that is necessary to develop and deploy the system effectively. This includes hardware specifications, software tools and libraries used, and the core business logic that shows off system functionality and the purpose of the system.

HARDWARE REQUIREMENTS

The system is designed to function efficiently on standard devices without the need for specialized hardware. However, to ensure optimal performance, the following computer hardware is required at minimum of the client:

- **Processor**: Intel Core i3, Ryzen 3 or higher.
- **RAM**: 4GB.
- **Webcam**: 1080p resolution.
- **Internet**: Stable connection, 5 Mbps.

SOFTWARE REQUIREMENTS

The development and deployment of the system depend on a stack of scalable and reliable software technologies. These include:

- **Operating System**: Windows 10, macOS.
- **Frontend**: React, HTML, CSS, TypeScript.
- **Backend**: NextJS, Supabase.
- **Libraries/APIs**: WebGazerJS, DeepSeek V3.
- **Tools**: VSCODE, GitHub, Git, Vercel.
- **Browser**: Google Chrome, Microsoft Edge.

BUSINESS LOGIC

The core business logic governs how the system operates and responds to user actions. This includes all the key workflows and rules built into the system. Below is each function of the system with in-depth explanations and screenshots.

The system features admins creating accounts for each of the user types, which are students and teacher, then name of the user, email, and password. From there, teachers and students can sign-in using their pre-defined emails and password entered by the admin. Note that user accounts can be updated or deleted later by the admin, via the trash and edit buttons.

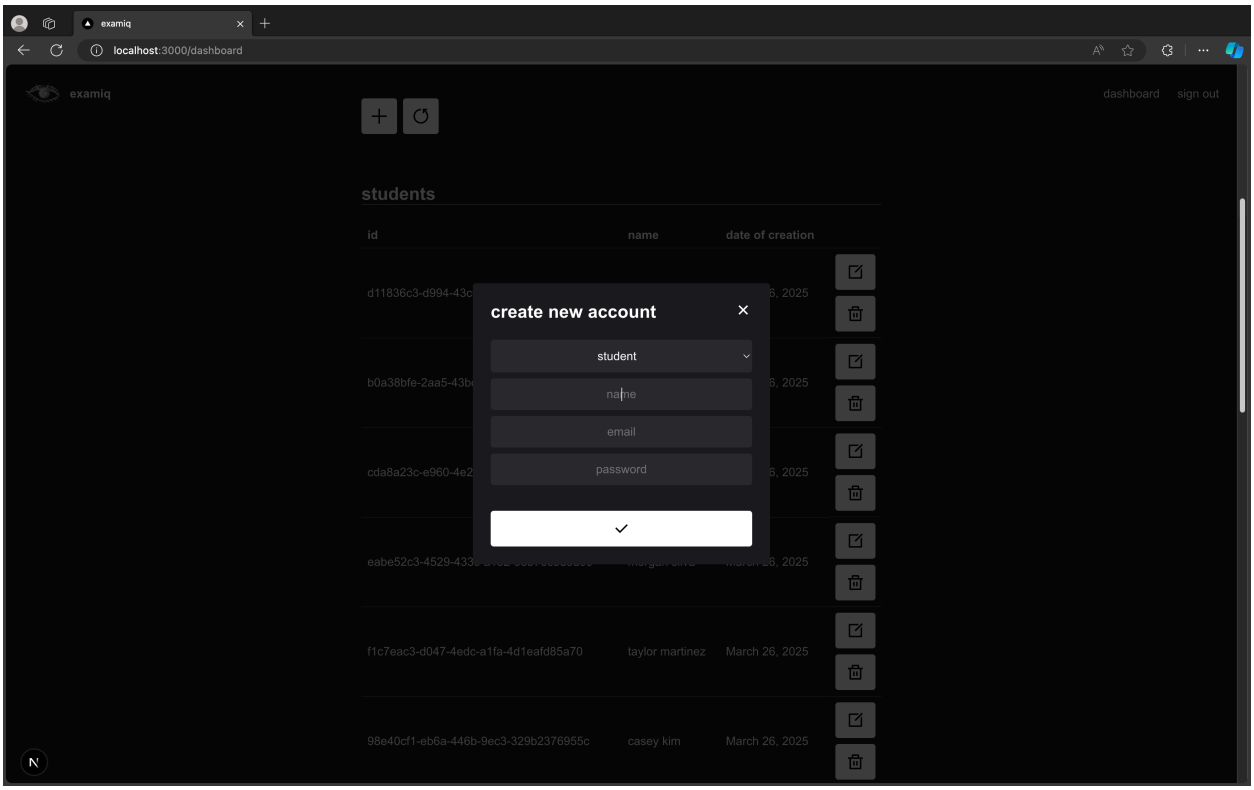


Figure 28: Admin creating a new user account

Although admins sound like a master account, it does not have any access to the other entities such as courses, exams, and results. This makes admin only limited to managing user accounts.

From there, teachers can create a course as a starting point in using the system, via the teacher dashboard. This is done by clicking the plus button and entering the name of the course, description, and the students that are to be enrolled arranged in a list by ticking the checkbox.

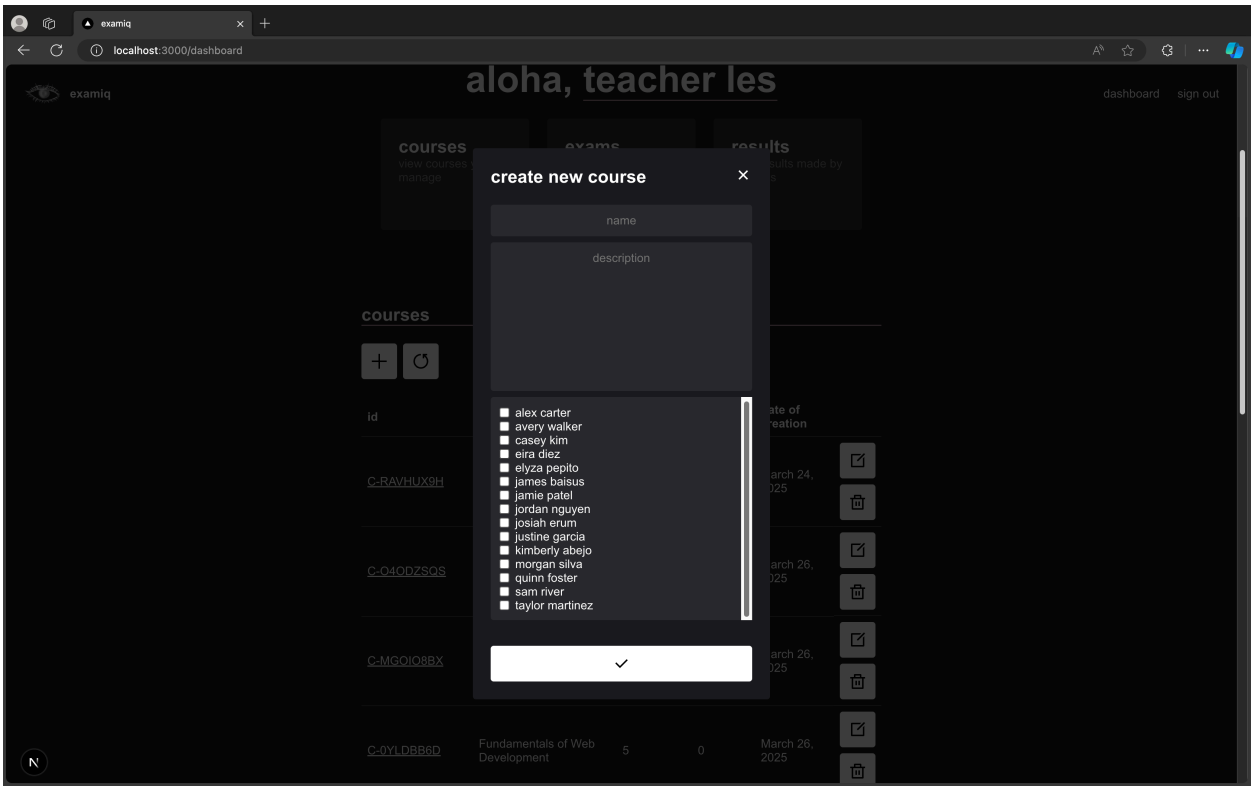


Figure 29: Teacher creating a new course

Note that courses can be updated or deleted later by teachers, via the trash and edit buttons found in the teacher dashboard.

After creating a course, teachers can now create exams that are associated with that newly created course. This is done by clicking the plus button and entering the selected course, name of the exam, duration, questions to be asked such as multiple choice, true or false, paragraph, or fill in the blank, and the question's answer key.

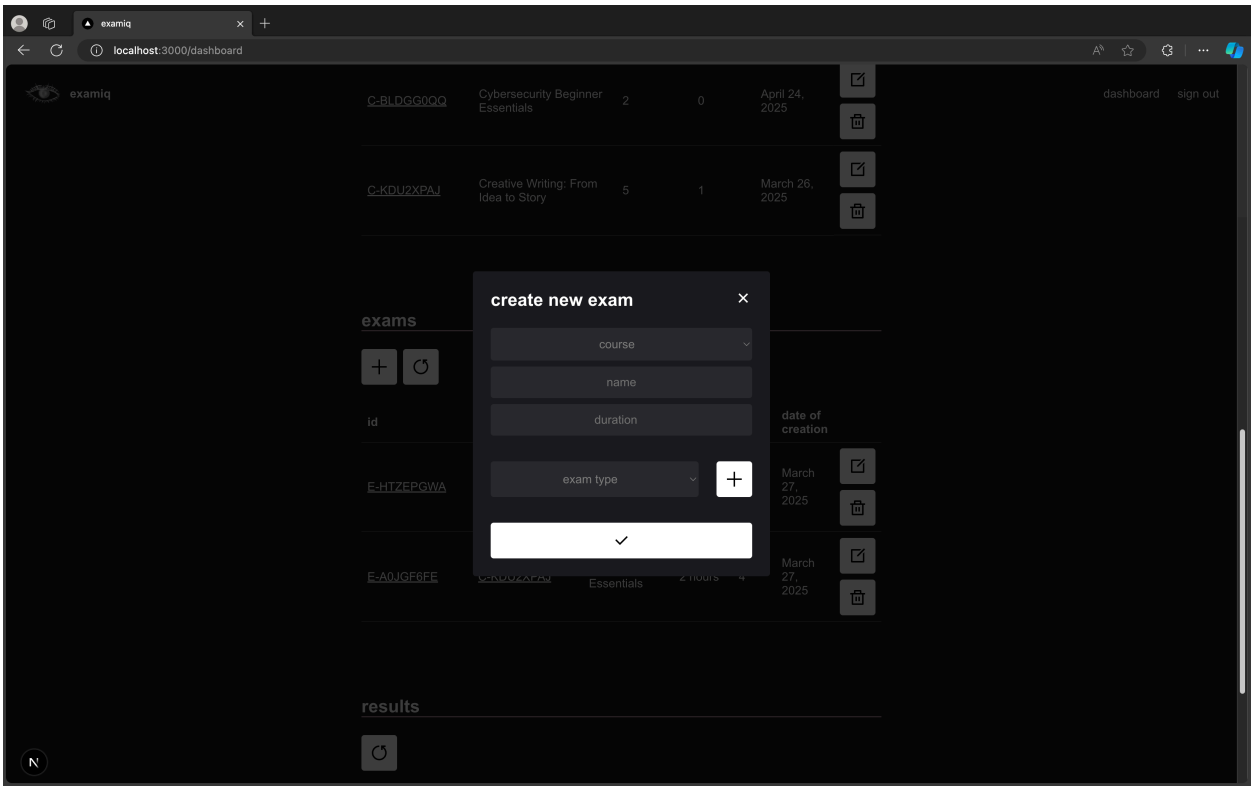


Figure 30: Teacher creating a new exam

Note that exams can be updated or deleted later by teachers, via the trash and edit buttons found in the teacher dashboard.

Moving over to the student dashboard, the students can view the courses that they are enrolled in a table list format. While at it, students can have a full view of the course with its details displayed in a separate page. This is done by clicking on the ID of the selected course the student wished to view.

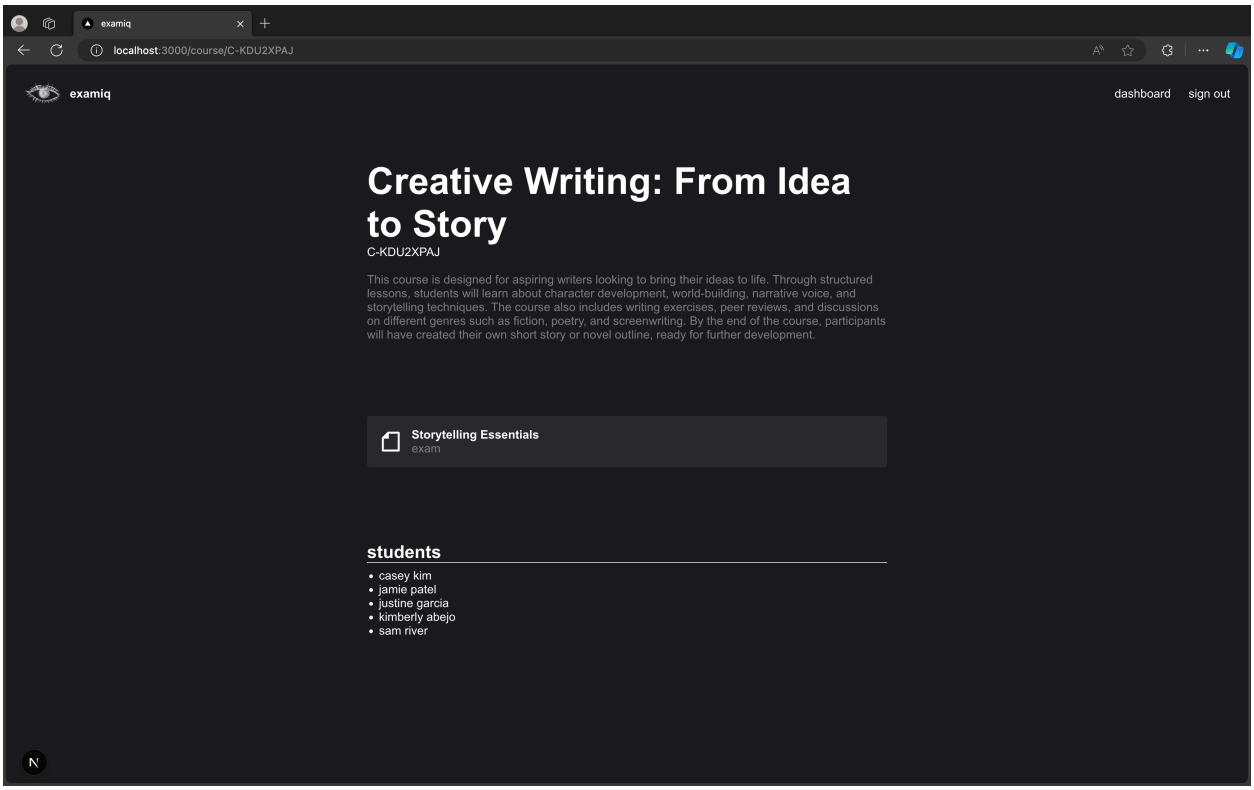


Figure 31: Student viewing a course

Students can also see the exams that they are required to take, under that selected course. This view is not only limited to the full course view, but it is also present in the student dashboard itself, which provides a way to summarize to-do tasks.

Clicking on an exam as a teacher previews the exam content, removing the submit button entirely and disables all keyboard and mouse inputs. While clicking on an exam as a student begins the exam workflow which first requires calibration of the gaze-tracking component. This is done by clicking on the calibrate button when presented and clicking on the red dots 5 times on each side of the screen whilst looking at said red dots. What this does is basically mapping the edges of the screen, so the model can estimate where the student's gaze is located.

Single time calibration is required before starting the exam, this is forced upon the student as the start exam button is disabled unless the model is calibrated.

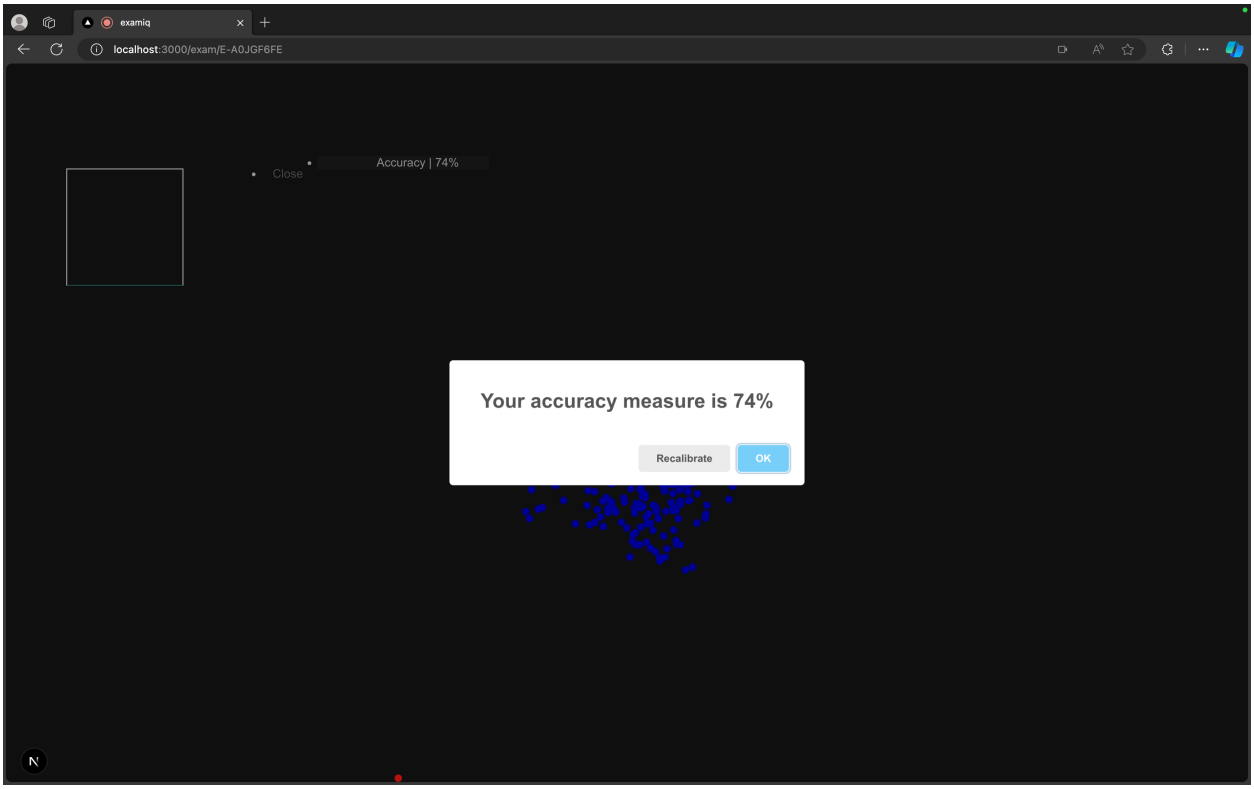


Figure 32: Student calibrating gaze-tracking component

Note that it is always best to aim for a higher accuracy percentage. In this case, a minimum is 60% accuracy is optimal. Anything lower results in distortion and inaccuracy of the gaze-tracking.

During the entirety of the exam duration, the system will track the student's gaze based on hotspots on each side of the screen. Through this, the model can then estimate a "likelihood of cheating" percentage. Upon clicking the submit button, the system automatically checks the student's answers based on pre-defined answer keys from the teachers during exam creation. The system uses DeepSeek V3 model to check questions that do not have pre-defined answer keys such as paragraph questions.

This method of gaze-tracking is all done within the client-side; this means that there is no data being sent to another location. The only data being sent out are database post and requests to the backend.

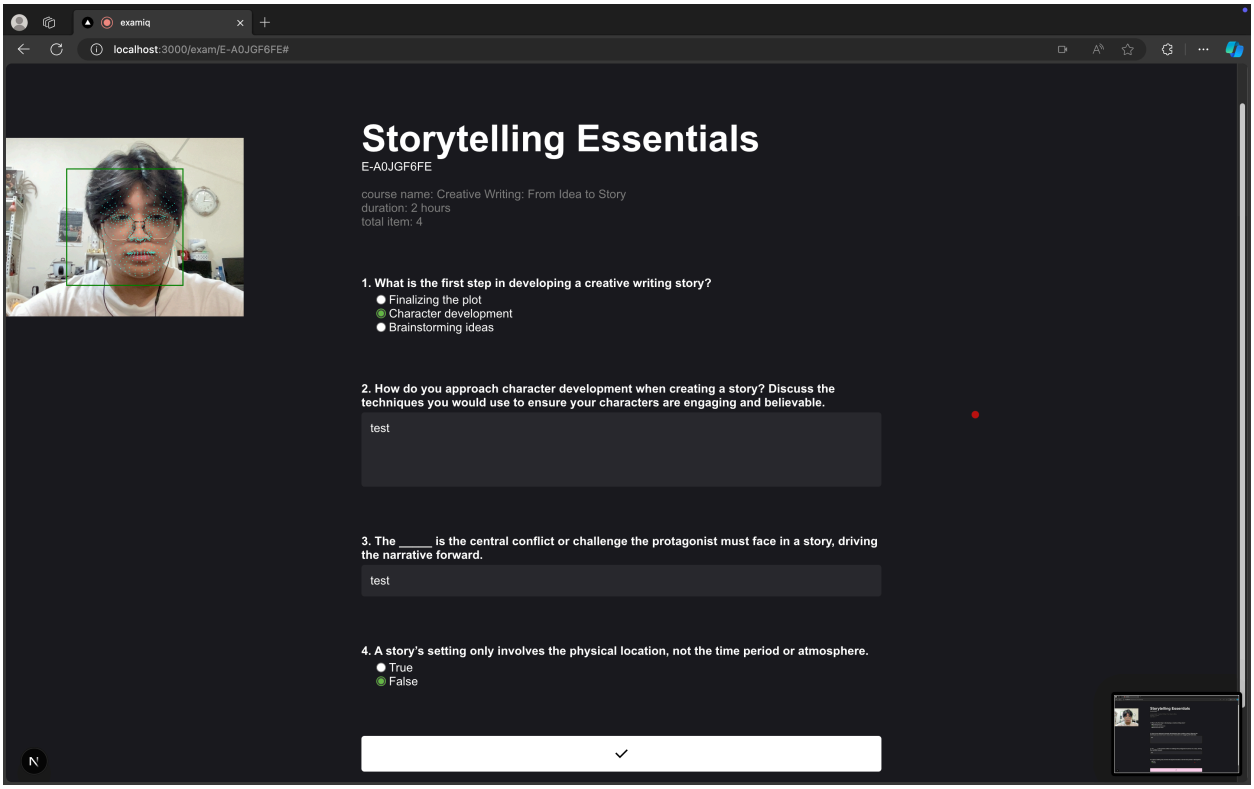


Figure 33: Student taking the exam with gaze-tracking

Note that results can be updated or deleted later by teachers, via the trash and edit buttons found in the teacher dashboard.

Finally, results can be viewed both in teacher and student dashboards. This features the score of the result after automatic checking and the likelihood of cheating percentage. Students and teachers can then view the full result of the exam in detail. This is done by clicking the ID of the result, which then redirects to a separate page that displays the exam content and student answers whether it is right or wrong.

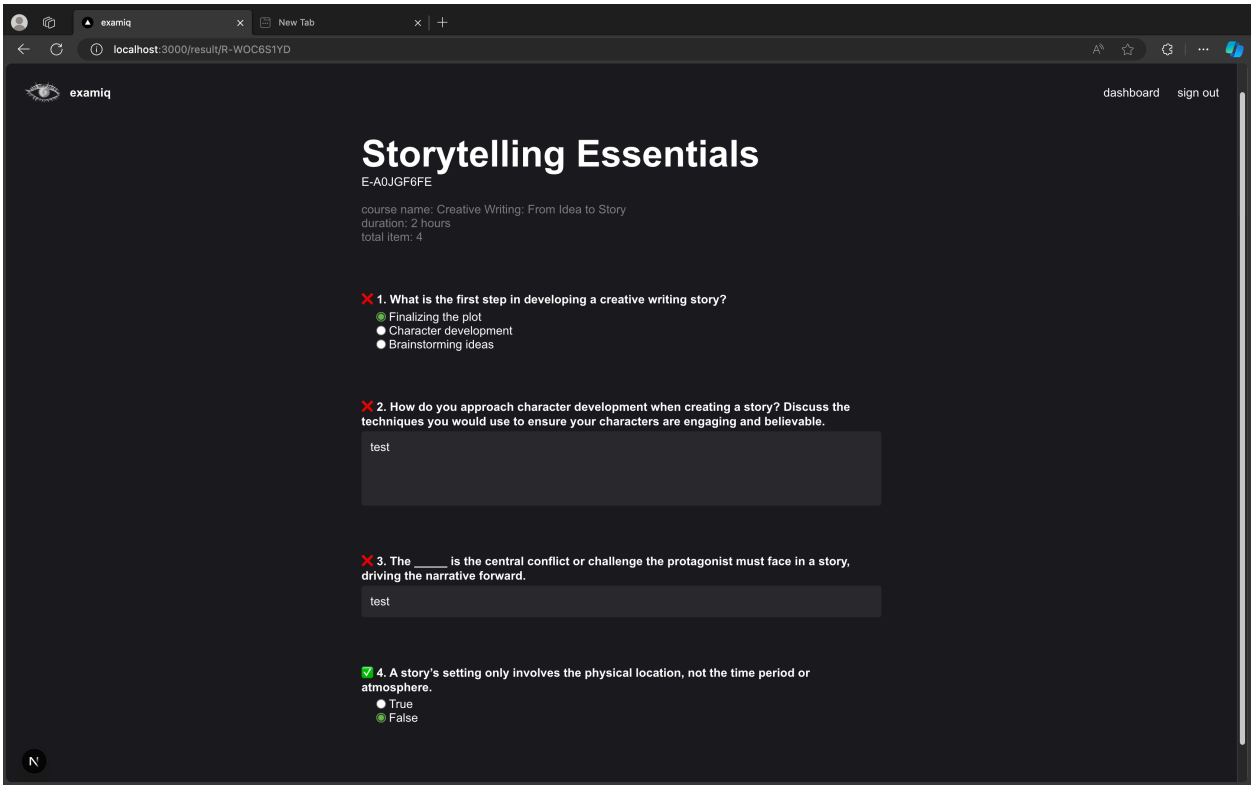


Figure 34: Student or teacher viewing result page

TESTING

This chapter outlines the phase in software development that ensures the system functions as expected, meets requirements, and is free of critical bugs or defects. It also talks about strategies and specific tests applied to validate the system.

TEST PLAN

This is the overall approach to testing the system, including what will be tested, how it will be tested, and its success criteria. Firstly, two types of testing will be used: unit testing and integration testing.

Unit testing is a technique where individual components are tested in isolation to ensure it works properly **(Schmitt, 2024)**. This technique is used for login, CRUD, and gaze-tracking.

Integration testing is a technique where multiple components are tested together to ensure it works correctly as a group **(Schmitt, 2024)**. This technique is used for user flows such as logging in, seeing the exam access, doing the exam, and submitting the exam.

The next chapter applies both types of testing in detail.

TEST CASES

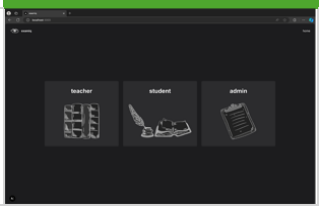
TEST CASE NAME:	Student, teacher, admin sign out
TEST CASE ID:	A003
OBJECTIVE:	Ensure users can sign out sucessfully
INPUTS:	N/A
EXPECTED OUTPUT:	User is redirected to home page
RESULT:	Pass
SCREENSHOT:	

Figure 35: User sign-in test case

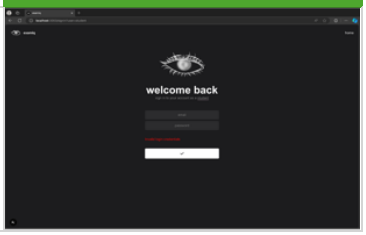
TEST CASE NAME:	Student, teacher, admin login error handling
TEST CASE ID:	A002
OBJECTIVE:	Lets users know that user entered incorrect account credentials
INPUTS:	**Email**: justine@email.com, **password**: thisisawrongpassword
EXPECTED OUTPUT:	Error must be visible in color red
RESULT:	Pass
SCREENSHOT:	

Figure 36: User sign-in error handling test case

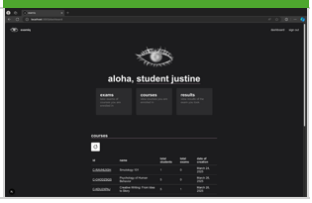
TEST CASE NAME:	Student, teacher, admin sign out
TEST CASE ID:	A001
OBJECTIVE:	Ensure users can sign in sucessfully
INPUTS:	**Email**: justine@email.com, **password**: 123456789
EXPECTED OUTPUT:	User is redirected to respective dashboard
RESULT:	Pass
SCREENSHOT:	

Figure 37: User sign-out test case

Above are the test cases for the system's authentication component used by all user types, that being student, teacher and admin. As seen in the screenshots above, all three of the test cases resulted in pass.

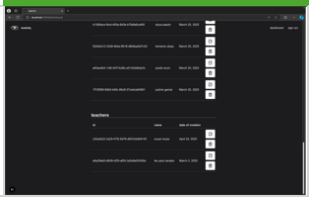
TEST CASE NAME:	Create user
TEST CASE ID:	U001
OBJECTIVE:	Verifies that an admin can create user accounts
INPUTS:	**Type**: teacher, **name**: susan boyle, **email**: boyle@gmail.com, **password**: 123456789
EXPECTED OUTPUT:	User account is created in the database
RESULT:	Pass
SCREENSHOT:	

Figure 38: Admin create user test case

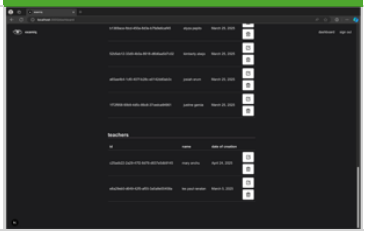
TEST CASE NAME:	Update user
TEST CASE ID:	U002
OBJECTIVE:	Verifies that an admin can update user accounts
INPUTS:	**Name**: mary anchu
EXPECTED OUTPUT:	User account is updated in the database
RESULT:	Pass
SCREENSHOT:	

Figure 39: Admin update user test case

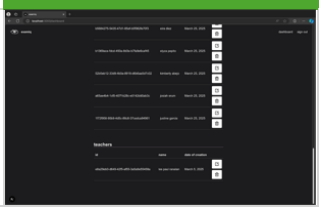
TEST CASE NAME:	Delete user
TEST CASE ID:	U003
OBJECTIVE:	Verifies that an admin can delete user accounts
INPUTS:	Delete mary anchu
EXPECTED OUTPUT:	User account is deleted in the database
RESULT:	Pass
SCREENSHOT:	

Figure 40: Admin delete user test case

Above are the test cases for the admin's create, read, update, and delete (CRUD) operations on user accounts. The admin inputs the account type, whether teacher or student, name, email and password. As seen in the screenshots above, all three test cases resulted in pass.

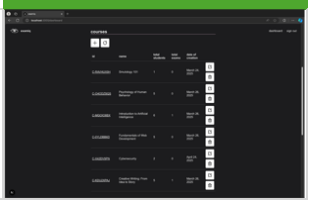
TEST CASE NAME:	Create course
TEST CASE ID:	C001
OBJECTIVE:	Verifies that a teacher can create courses
INPUTS:	**Name**: Cybersecurity, **description**: Ethical hacking and encryption, **students**: Jamie Patel, Jordan Nguyen
EXPECTED OUTPUT:	Course is created in the database
RESULT:	Pass
SCREENSHOT:	

Figure 41: Teacher create course test case

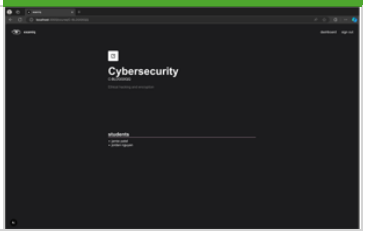
TEST CASE NAME:	Read course
TEST CASE ID:	C002
OBJECTIVE:	Verifies that course page reads correct course information
INPUTS:	View course Cybersecurity
EXPECTED OUTPUT:	Course information is displayed in a separate page
RESULT:	Pass
SCREENSHOT:	

Figure 42: Teacher read course test case

TEST CASE NAME:	Update course
TEST CASE ID:	C003
OBJECTIVE:	Verifies that a teacher can update courses
INPUTS:	**Name**: Cybersecurity Beginner Essentials, **description**: Cybersecurity principles, ethical hacking, encryption, and digital information protection
EXPECTED OUTPUT:	Course is updated in the database
RESULT:	Pass
SCREENSHOT:	

Figure 43: Teacher update course test case

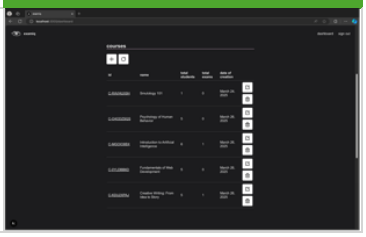
TEST CASE NAME:	Delete course
TEST CASE ID:	C004
OBJECTIVE:	Verifies that a teacher can delete courses
INPUTS:	Delete Cybersecurity Beginner Essentials
EXPECTED OUTPUT:	Course is deleted in the database
RESULT:	Pass
SCREENSHOT:	

Figure 44: Teacher delete course test case

Above are the test cases for the teacher's create, read, update, delete (CRUD) operations on courses. As seen in the screenshots above, all four test cases resulted in pass.

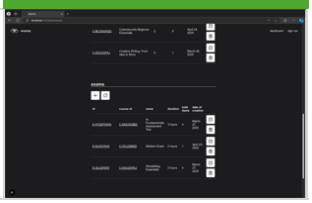
TEST CASE NAME:	Create exam
TEST CASE ID:	E001
OBJECTIVE:	Verifies that a teacher can create exams
INPUTS:	**Course**: Fundamentals of Web Development, **name**: Midterm Exam, **duration**: 2, **paragraph**: Explain the difference between HTML and CSS
EXPECTED OUTPUT:	Exam is created in the database, and referenced in the selected course
RESULT:	Pass
SCREENSHOT:	

Figure 45: Teacher create exam test case

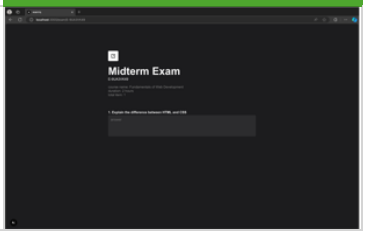
TEST CASE NAME:	Read exam
TEST CASE ID:	E002
OBJECTIVE:	Verifies that exam page reads correct exam information
INPUTS:	View Midterm Exam
EXPECTED OUTPUT:	Exam information is displayed in a separate page
RESULT:	Pass
SCREENSHOT:	

Figure 46: Teacher read exam test case

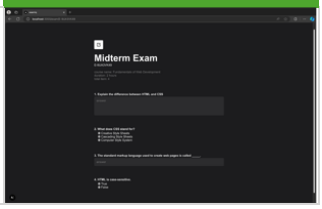
TEST CASE NAME:	Update exam
TEST CASE ID:	E003
OBJECTIVE:	Verifies that a teacher can update exams
INPUTS:	**Multiple-choice**: What does CSS stand for?, **fill-in-the-blank**: The standard markup language used to create web pages is called HTML, **true or false**: HTML is case-sensitive
EXPECTED OUTPUT:	Exam is updated in the database
RESULT:	Pass
SCREENSHOT:	

Figure 47: Teacher update exam test case

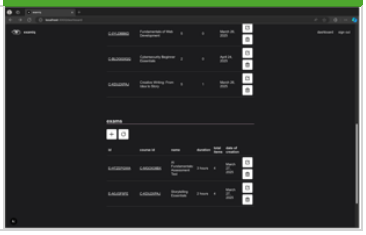
TEST CASE NAME:	Delete exam
TEST CASE ID:	E004
OBJECTIVE:	Verifies that a teacher can delete exams
INPUTS:	Delete Midterm Exam
EXPECTED OUTPUT:	Exam is deleleted in the database
RESULT:	Pass
SCREENSHOT:	

Figure 48: Teacher delete exam test case

Above are the test cases for the teacher's create, read, update, delete (CRUD) operations on exams. As seen in the screenshots above, all four test cases resulted in pass.

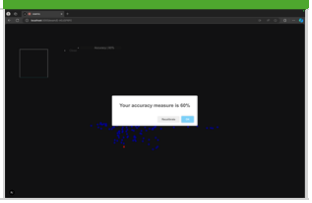
TEST CASE NAME:	Calibrating gaze-tracking
TEST CASE ID:	GT001
OBJECTIVE:	Verifies that gaze tracking is calibrated before students is taking exam
INPUTS:	When in an exam page, click calibrate
EXPECTED OUTPUT:	Displays accuracy percentage. Aim for 60% or higher
RESULT:	Pass
SCREENSHOT:	

Figure 49: Student calibrating gaze-tracking test case

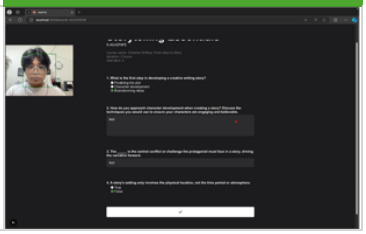
TEST CASE NAME:	Testing gaze-tracking
TEST CASE ID:	GT002
OBJECTIVE:	Verifies that gaze tracking is working after calibration
INPUTS:	Student moving their eyes
EXPECTED OUTPUT:	Red dot should estimate where the student is looking at
RESULT:	Pass
SCREENSHOT:	

Figure 50: Student testing gaze-tracking test case

Above are the test cases for the student's gaze-tracking component. As seen in the screenshots above, both test cases resulted in pass.

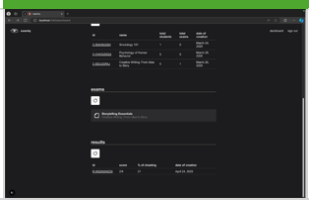
TEST CASE NAME:	Create result
TEST CASE ID:	R001
OBJECTIVE:	Verifies that a student can create their own result of an exam
INPUTS:	**Answers**: A, test, test, false
EXPECTED OUTPUT:	Result is created in the database and referenced to the student's UUID and exam ID
RESULT:	Pass
SCREENSHOT:	

Figure 51: Student create result test case

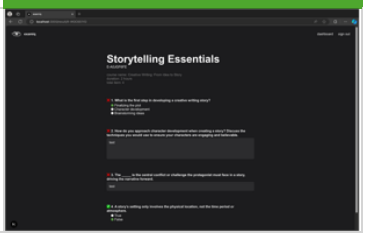
TEST CASE NAME:	Read result
TEST CASE ID:	R002
OBJECTIVE:	Verifies that result page reads correct result information
INPUTS:	View Midterm Exam
EXPECTED OUTPUT:	Exam information is displayed in a separate page
RESULT:	Pass
SCREENSHOT:	

Figure 52: Teacher read result test case

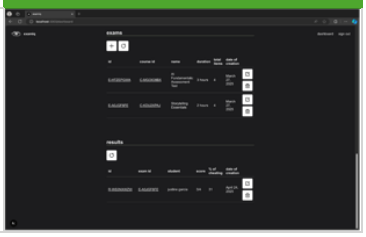
TEST CASE NAME:	Update result
TEST CASE ID:	R002
OBJECTIVE:	Verifies that a teacher can update results
INPUTS:	**Score**: 3, **likelihood-of-cheating**: 31
EXPECTED OUTPUT:	Result is updated in the database
RESULT:	Pass
SCREENSHOT:	

Figure 53: Teacher update result test case

TEST CASE NAME:	Delete result
TEST CASE ID:	R003
OBJECTIVE:	Verifies that a teacher can delete results
INPUTS:	Delete justine kyle garcia's exam result
EXPECTED OUTPUT:	Result is deleted in the database
RESULT:	Pass
SCREENSHOT:	

Figure 54: Teacher delete result test case

Above are the test cases for the student's and teacher's create, read, update, delete (CRUD) operations on results. As seen above, all four test cases resulted in pass.

CONCLUSION

The development of Examiq, an AI-powered proctoring solution addresses the growing need for secure, flexible, and scalable digital assessments. This combines feature such as user type authentication, automated exam evaluation, and gaze-tracking, the system ensures an environment that is fair. Whilst enhancing the convenience for both teachers and students.

Throughout the project, careful attention was given to the function requirements, data privacy, and usability which was extracted though literature reviews and data collections. Technologies such as React, NextJS, and WebGazerJS were effectively utilized to implement important components, from exam creation to live monitoring.

To conclude, this project demonstrates how intelligent automation, and thoughtful design can be used to create a reliable and efficient platform for remote examinations. With further enhancements, Examiq can be further expanded to serve broader and wider academic and professional examination needs.

FUTURE ENHANCEMENTS

WebGazerJS soley relies on the webcam itself. There are numerous factors that can create false-positives or inaccuracies in this kind of scenario, such as quality of the webcam and lighting of the room. As a starting point, WebGazerJS is optimal. However, when improving Examiq, a more accurate and specialized model would be more appropriate whether it requires hardware or not. The library also experiences bugs that are code breaking as it overrides major components such as the redirect function of NextJS for switching between pages.

Examiq would also benefit if it features AI generated content paragraphs wherein, like Turnitin, it checks if the student's answers are of naturally typed or generated by AI chatbots.

Finally, with enough time, Examiq would benefit overall if present bugs were fixed which improves quality of life use cases for all users.

BIBLIOGRAPHY

Domínguez-Figaredo, D., Gil-Jaurena, I. & Morentin-Encina, J., 2022. *The Impact of Rapid Adoption of Online Assessment on Students' Performance and Perceptions: Evidence from a Distance Learning University.* [Online] Available at: https://files.eric.ed.gov/fulltext/EJ1344926.pdf [Accessed 17 October 2024].

Haan, K., 2024. *22 Top AI Statistics And Trends.* [Online] Available at: https://www.forbes.com/advisor/business/ai-statistics/ [Accessed 18 October 2024].

Hill, M., 2020. *Online Assessment - The Pros and Cons.* [Online] Available at: https://www.mheducation.co.uk/blog/assessment-online-assessment-the-pros-and-cons [Accessed 18 October 2024].

Hofherr, J., 2018. *How Examity Prevents Students From Cheating During Online Exams.* [Online] Available at: https://www.builtinboston.com/articles/examity-prevents-students-cheating-online [Accessed 7 November 2024].

O'Brien, C., 2020. *Honorlock: What the online proctor does and doesn't do.* [Online] Available at: https://news.wisc.edu/honorlock-what-it-does-and-doesnt-do/ [Accessed 7 November 2024].

Packer, T., 2024. *Accelerating Our Transition to Digital AP Exams.* [Online] Available at: https://allaccess.collegeboard.org/accelerating-our-transition-digital-ap-exams [Accessed 17 October 2024].

Holden, O. L., Norris, M. E. & Kuhlmeier, V. A., 2021. *Academic Integrity in Online Assessment: A Research Review.* [Online] Available at: https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2021.639814/full [Accessed 1 December 2024].

Honorlock, 2020. *Who is Honorlock?.* [Online] Available at: https://honorlock.com/about-us/ [Accessed 7 November 2024].

Rosalyn, 2023. *Rosalyn Launches StableSight, an Exam Proctoring AI That Counters Generative AI Use and Cheating Rings.* [Online] Available at: https://www.businesswire.com/news/home/20231109705435/en/Rosalyn-Launches-StableSight-an-Exam-Proctoring-AI-That-Counters-Generative-AI-Use-and-Cheating-Rings [Accessed 17 October 2024].

Institute of Data, 2023. *Understanding the Iterative Model in Software Engineering.* [Online] Available at: https://www.institutedata.com/us/blog/iterative-model-in-software-engineering/ [Accessed 5 March 2025].

West Virginia University, 2023. *Primary and Secondary Research Data.* [Online] Available at: https://researchdata.wvu.edu/research-data-framework/data-guidance/sources-of-research-data [Accessed 21 March 2025].

Jama Software, 2023. *Functional vs. nonfunctional requirements: What's the difference?.* [Online] Available at: https://www.jamasoftware.com/requirements-management-guide/writing-requirements/functional-vs-non-functional-requirements/ [Accessed 2 March 2025].

Lucidchart, 2023. *What is a Data Flow Diagram.* [Online] Available at: https://www.lucidchart.com/pages/data-flow-diagram [Accessed 3 March 2025].

Lucidchart, 2023. *What is an Entity Relationship Diagram (ERD)?.* [Online] Available at: https://www.lucidchart.com/pages/er-diagrams [Accessed 7 March 2025].

Schmitt, J., 2024. *Unit testing vs integration testing.* [Online] Available at: https://circleci.com/blog/unit-testing-vs-integration-testing/ [Accessed 2 March 2025].

APPENDICES

APPENDIX A – PROPOSAL & GANTT CHART

BENG (HONS) SOFTWARE ENGINEERING: SEC 6201 UNDERGRADUATE PROJECT

STUDENT NAME

Les Paul Flores Ranalan

STUDENT NUMBER AND EMAIL

2230727 - lespaul021504@gmail.com

PROPOSED PROJECT TITLE

Website For Enhancing Examination Integrity Through AI-Powered Proctoring

PROJECT BACKGROUND

This topic was selected as a way for educational institutions to transition from paper examination to digital or online examination. Transitioning would benefit both the student and educational institutions as it offers flexibility, convenience, and efficiency **(Hill, 2020).** Additionally, this lets teachers create unique assessments that potentially motivates students to succeed.

Online examination has become especially prevalent during the years of the pandemic where schools enforced online assessments at home, where students are placed in an online meeting and are being proctored by a teacher or professor. Even today, it has become the norm as the College Board in the United States mentioned that they are transitioning their 12 out of 28 exams to fully digital starting May 2025 **(Packer, 2024).** This includes courses such as Computer Science and Computer Science Principles.

In this current age, AI has become prevalent as well with 71% of businesses adopting AI for at least one business function **(Haan, 2024).** As a way of improving online examinations, AI-powered proctoring was created as a way of mitigating academic dishonesty and evaluating students with efficiency. This is done by various techniques such as eye-tracking, predictive typing by sound, and detection of generative AI content.

Academic dishonesty or cheating is what keeps educational intuitions away from online examination. However, research shows that students, in general, do NOT cheat on online tests more than on face-to-face ones **(Domínguez-Figaredo, Gil-Jaurena and Morentin-Encina, 2022).** This means that evidence is inconclusive and that students WILL cheat eventually on both online and on paper, with studies saying that 35% of undergraduate business students admitted to cheating during the pandemic **(Wire, 2023).**

EVIDENCE OF INITIAL LITERATURE REVIEW

#1

StableSight is an AI-driven exam proctoring platform created by a company named Rosalyne. It uses advanced AI techniques to monitor and detect cheating during online examination, especially with the use of AI tools such as ChatGPT. It features gaze tracking (eye tracking) to identify if a student is using a secondary screen, a keyboard correlation model to detect concealed devices based on sounds of typing, and a system to review AI flags. Additionally, it features authentication based on facial recognition and ID verification. StableSight is currently being used by over 500,000 exams for institutions such as the United States Department of Defense, Coursera, Stripe, and Nexford University **(Wire, 2023)**.

Advantages:

- Facial recognition and ID verification
- AI tool usage prevention
- Face, gaze, and typing tracking
- Trust certified
- Full-fledged application

Disadvantages:

- Huge cost of delivery
- Not open source

#2

Honorlock is an AI-driven exam proctoring platform created by two students at Florida Atlantic University **(Honorlock, 2020)**. It combines live proctoring with AI to monitor the student's behavior, such as phone usage, blocking AI tools such as ChatGPT, lock down browsers to prevent searching in another tab, voice detection to prevent mobile assistant such as "Hey Siri" and "Hey Google", and video monitoring for live interventions of proctors. Additionally, it has authentication based on facial recognition and ID verification. Honorlock is used by over 3,000 exams in higher education institutions such as the University of Wisconsin-Madison **(O'Brien, 2020)**.

Advantages:

- Face and voice tracking
- Facial recognition & ID verification
- Browser lockdown
- Disability friendly
- AI tool usage prevention
- Protects student privacy via FERPA (Family Educational Rights and Privacy Act)

Disadvantages:

- Not open source
- False flags may occur
- Web application

#3

Examity is an AI-drive exam proctoring platform initially founded by Michael London **(Hofherr, 2018)**, now acquired by Meazure Learning. It features AI techniques to analyze video feeds whether students are moving their heads or looking away from the screen, flagging unusual activities such as opening other websites, unexpected noise or unexpected movement. It also offers additional authentication to students such as fingerprint scene, voice match, and facial recognition. Examity is used by over 400 clients, including Boston University, Yale University, and Pennsylvania State University **(Hofherr, 2018)**.

Advantages:

- Face and sound tracking
- AI tool usage prevention
- Secure identity verification

Disadvantages:

- Not open source
- Huge cost of delivery
- Data privacy concerns
- Web application

THEORIES/MODELS, KEY TERMS AND TECHNOLOGIES YOU WILL COVER IN THIS PROJECT (NATURE OF ACADEMIC CHALLENGE)

Theories/Models:

- **Iterative Model** – a software development methodology that breaks down the process of building a system into smaller iterations.

Key Terms:

- **Artificial Intelligence** – refers to the simulation of human intelligence processed by computers.
- **Computer Vision** – a field in artificial intelligence that enables computers to interpret and make decisions based on visual data.
- **Facial Recognition** – the use of artificial intelligence to identify a person's face.

- **AI-Powered Proctoring** – the use of artificial intelligence to monitor exam environments, ensuring that the students do not cheat.
- **Plagiarism Detection** – technologies that compare student's work to internet sources/database to ensure originality.

Technologies:

- **Electron** – an open-source framework using web technologies (HTML, CSS, JS) that enables cross-platform compatibility.
- **React** – a JavaScript library for building user interfaces.
- **NodeJS** – a runtime environment that allows the execution of JavaScript code on the server-side, outside of the web browser.
- **TensorFlowJS** – an open-source JavaScript library that allows developers to define, train, and run machine learning models directly within a web browser.
- **WebRTC** – stands for Web Real-Time Communication and it is an open-source project that enables real-time audio, video, and data sharing between web browsers/devices.
- **Firebase** – it is a platform developed by Google that provides platforms such as databases, storage, and hosting.

AIMS AND OBJECTIVES

Aims:

- To implement an online examination application for enhancing examination integrity through AI-powered proctoring.

Objectives:

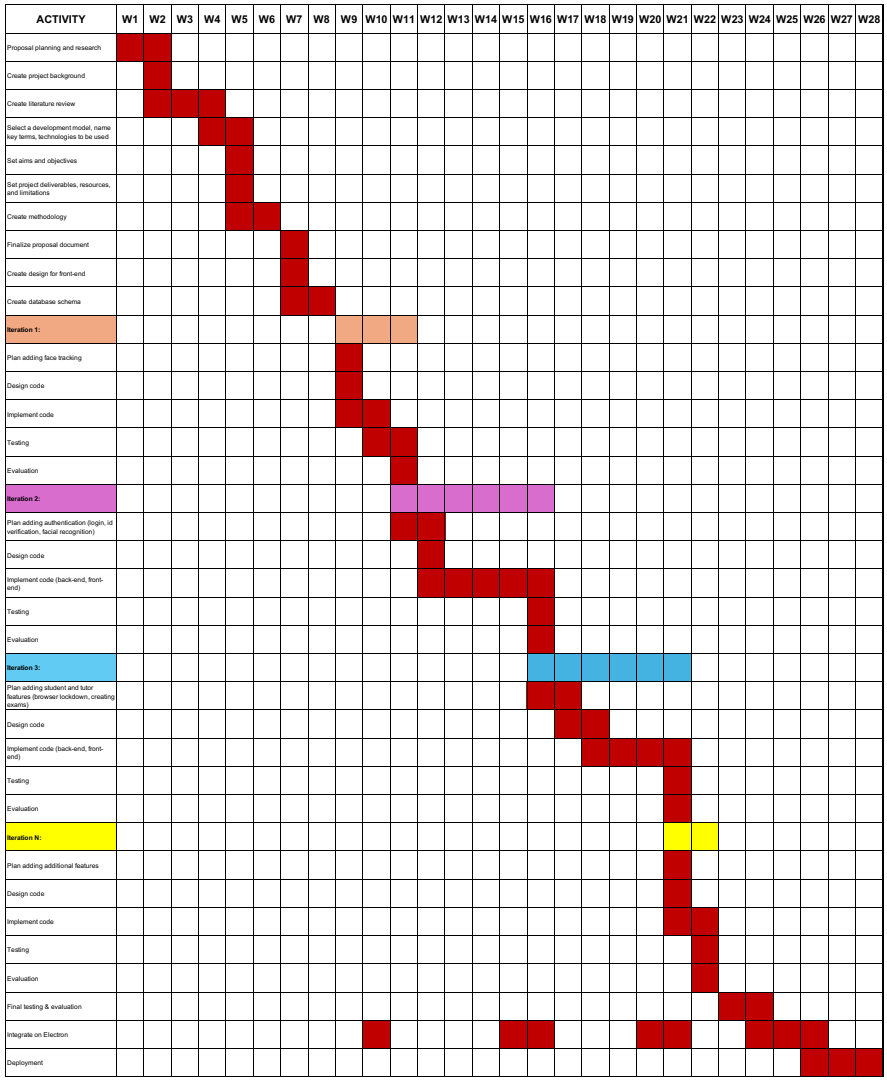
6. To conduct literature review of articles or case studies focusing on best practices for online exam applications.
7. To organize feedback sessions from students and instructors.
8. To develop a prototype of the application and conduct a usability test.
9. To research and implement security measures such as anti-cheating system and identity verification
10. To evaluate the application by collecting feedback and measure effectiveness.

DELIVERABLES, TIMESCALE, RESOURCES AND LIMITATIONS

Deliverables:

- Project Proposal
- Project Report
- Presentation
- Application

Timescale/Gantt Chart:



Resources:

- Software:
  - VSCODE
  - Programming languages
  - Frameworks
- Hardware:
  - Computer/laptop with a camera

Limitations:

- Potential bugs or integration issues that may delay final product.
- Time constraints.
- Not enough participants for identity verification.

METHODOLOGY

Project Model Methodology:

Iterative Model will be used for this project. It is a software development process where a system is built in small sections or iterations. Each iteration contains its own planning, designing, coding, and testing. After each iteration is refined based on user feedback or research.

Through this, the system is built upon continuous improvement and incremental development. It is flexible as more testing is required especially when dealing with face tracking. It also makes risk management easier as detecting problems from the get-go can easily be mitigated.

Data-Collection Method:

Primary Sources – interview and survey will be used to gather information on the project. With the interview target audience towards professors and educational leaders (quantity: 1), while the survey target audience will mostly be students (quantity: 20). Through this, data can be analysed and as a result, it will reveal key information of the application such as the features required, existing features that can be improved, and other relevant data based on student's and tutor's needs.

Secondary Sources – existing applications, research papers, and research articles has been covered within the literature review chapter; discussing the use of AI in online proctoring and the advantages and disadvantages of existing applications. Through this, each application's gaps can be revealed. This can then be used to improve the project based on the comparison of the 3 existing applications.

REFERENCES

Domínguez-Figaredo, D., Gil-Jaurena, I. & Morentin-Encina, J., 2022. *The Impact of Rapid Adoption of Online Assessment on Students' Performance and Perceptions: Evidence from a Distance Learning University.* [Online] Available at: https://files.eric.ed.gov/fulltext/EJ1344926.pdf [Accessed 17 October 2024].

Haan, K., 2024. *22 Top AI Statistics And Trends.* [Online] Available at: https://www.forbes.com/advisor/business/ai-statistics/ [Accessed 18 October 2024].

Hill, M., 2020. *Online Assessment - The Pros and Cons.* [Online] Available at: https://www.mheducation.co.uk/blog/assessment-online-assessment-the-pros-and-cons [Accessed 18 October 2024].

Hofherr, J., 2018. *How Examity Prevents Students From Cheating During Online Exams.* [Online] Available at: https://www.builtinboston.com/articles/examity-prevents-students-cheating-online [Accessed 7 November 2024].

Honorlock, 2020. *Who is Honorlock?.* [Online] Available at: https://honorlock.com/about-us/ [Accessed 7 November 2024].

O'Brien, C., 2020. *Honorlock: What the online proctor does and doesn't do.* [Online] Available at: https://news.wisc.edu/honorlock-what-it-does-and-doesnt-do/ [Accessed 7 November 2024].

PACKER, T., 2024. *Accelerating Our Transition to Digital AP Exams.* [Online] Available at: https://allaccess.collegeboard.org/accelerating-our-transition-digital-ap-exams [Accessed 17 October 2024].

Rosalyn, 2023. *Rosalyn Launches StableSight, an Exam Proctoring AI That Counters Generative AI Use and Cheating Rings.* [Online] Available at: https://www.businesswire.com/news/home/20231109705435/en/Rosalyn-Launches-StableSight-an-Exam-Proctoring-AI-That-Counters-Generative-AI-Use-and-Cheating-Rings
[Accessed 17 October 2024].

POSSIBLE SUPERVISORS (FOR SUPERVISOR USE ONLY)

1.

2.

3.

SUPERVISOR COMMENTS

SUPERVISOR SIGNATURE AND DATE

APPENDIX E – LOGBOOK

PROJECT LOGBOOK
STUDENT NAME Les Paul Ranalan
STUDENT EMAIL lespaul021504@gmail.com
PROJECT TITLE Examiq

DATE	WORK ACHIEVED THIS WEEK	PROBLEMS ENCOUNTERED – ACTION/RESOLUTION	WORK PLANNED FOR NEXT WEEK	VERIFICATION BY TUTOR
Oct. 11, 2024	Finalized 1 topic out of 3 topics.	Execution of the anti-cheating system was not clear – resolved by researching and finalizing the project with Electron.	Do research and write the proposal.	Dr. Rehna Kalam
Oct. 17, 2024	Created draft for project background, key terms, technologies.	Technologies that are to be used are still not finalized – resolved by researching resources further.	Finalize current draft and proceed to aims & objectives.	Dr. Rehna Kalam
Oct. 18, 2024	Finalized key terms and technologies. Created draft for aims & objectives.	Technologies to be used were confusing and had a lot of options – resolved by researching properly.	Finalize objectives with specific data such as how many, when is it to be done, etc.	Dr. Rehna Kalam

	Created draft for deliverables, timescale, resources, and limitations		Finalize deliverables, timescale, resources, and limitations.	
Oct. 25, 2024	Redone literature review, aims, objectives, deliverables, resources. Added theories/model. Added iterative model entry in methodology. Added references. Created draft for Gantt chart.	None.	Finalize methodology. Add more references based on past papers and research. Finalize Gantt chart.	Dr. Rehna Kalam
Nov. 7, 2024	Redone literature review to include 3 existing solutions, with description, pros and cons.	There are a lot of existing solutions/research papers out there – solved by handpicking only the ones which are already used by major universities and institutions.	Finalize entire proposal document. Submit proposal draft on Moodle.	Dr. Rehna Kalam

	Finalized and redone Gantt chart to show iterations. Added references for new articles.	Confused at how to create Gantt chart in an iterative way – solved by implementing iterations or cycles within current Gantt chart.		
Nov. 10, 2024	Submitted draft proposal document to Moodle. Finalized proposal document. Ready for final submission to Moodle.	None.	Decide how to execute data-collection methods and create questions for that.	Dr. Rehna Kalam
Nov. 14, 2024	Decided to do interview and survey as data-collection methods. The target audience for interview would be towards teachers and surveys towards students. Created a draft document consisting of questions to be asked to teachers.	Had difficulty towards deciding what type of questions to ask – solved by deciding on only the important factor: usage of AI in proctoring.	Finalize interview questions to instructors. Finalize Google Form.	Dr. Rehna Kalam

	Created a Google Form comprising of questions towards students.			
Nov. 15, 2024	Added 1 more survey question for student. Added 2 more interview questions for teachers Finalized and confirmed all questions with teacher.	None.	Do data-gathering. Submit proposal to Moodle.	Dr. Rehna Kalam
Nov. 22, 2024	Completed data-collection of student surveys.	Data-collection of teacher interview is not yet completed because schedule constraints of the teacher – solved by data collection completion.	Complete data-collection of teacher interview.	Dr. Rehna Kalam
Dec. 10, 2024	Listed all functional and non-functional requirements for project	None.	Create draft for report	Dr. Rehna Kalam
Jan. 21, 2025	Started working on report, completing the following chapters: abstract, acknowledgement,	None.	Continue upon the report, with focus on the following chapters: research	Dr. Rehna Kalam

	introduction, and literature review.		methodology, data collection, data analysis	
Jan. 29, 2025	Continued working on the report, completing the following chapters: research methodology, data collection, and data analysis.	None.	Start to produce an iteration that has front-end only, with minimal features such as user authentication. Create testing prototype of gaze tracking.	Dr. Rehna Kalam
Feb. 05, 2025	Created a test app for gaze tracking	None.	Build upon the test app such as the front-end and try to implement anti-cheating system.	Dr. Rehna Kalam
Feb. 16, 2025	Started working on diagrams such as entity relation, data flow, and use cases	No level 0 and level 1 of DFD. No primary keys and foreign keys specified in the ER diagram – solved by revising the DFD.	Build upon the frontend of the test app.	Dr. Rehna Kalam
Feb. 22, 2025	Finalized ER, with specified primary and foreign keys, and DFD diagrams, with level 0, and level 1.	With minimal knowledge of NextJS, using it can be a bit of a hassle – solved by watching guides and tutorials.	Improve front-end further and implement more backend.	Dr. Rehna Kalam

	Started working on the front-end, with login and basic user interface completed for student, admin, and teacher.			
Mar. 1, 2025	Implemented admin dashboard with account creation for students and teachers. Implemented teacher dashboard with create course back end.	None.	Implement more CRUD operations of teacher dashboard.	Dr. Rehna Kalam
Mar. 11, 2025	Implemented separate course page. Created a table filters courses that are made by the teachers. Implemented course CRUD operations in	None.	Implement teacher exam component. Implement student CRUD in teacher course component. Revise home page.	Dr. Rehna Kalam

	teacher course component.			
Mar. 15, 2025	Implemented student CRUD operations in teacher course component. The student list is of JSON format. Revised home page wherein user must click type of user and proceed to login.	Formatting of the students were an issue as their UUID is displayed instead of their full name – solved by filtering students first by name via their primary key.	Implement teacher exam component.	Dr. Rehna Kalam
Mar 20, 2025	Implemented exam CRUD operations in teacher exam component. The exam items were of JSON format.	With essay questions, there are not a fixed correct answer – solved by implementing automatically checking student answer via AI.	Revise admin dashboard to implement delete on user accounts.	Dr. Rehna Kalam
Mar. 25, 2025	Implemented edit modals on update operations of teacher course components.	None.	Implement exam CRUD operations	Dr. Rehna Kalam
Mar 26, 2025	Implemented delete on user accounts in admin dashboard.	None.	Create student dashboard.	Dr. Rehna Kalam

Apr. 3, 2025	Created a separate page for student dashboard. Implemented tables where it filters courses that the student is enrolled in and display the exams of that course.	None.	Create separate exam page.	Dr. Rehna Kalam
Apr. 9, 2025	Created an exam page where it displays the exam name, course, duration, and exam items.	Struggled with the form components as each of the exam item has its own type, making input, select, and textarea tags have varying factors – solved by differentiating each exam question from numbers 1 and upwards.	Implement answer checking system.	Dr. Rehna Kalam
Apr. 14, 2025	Implemented answer checking system by using fixed correct answers specified by the teacher when creating an exam. Implemented the use of DeepSeek	None.	Create results page.	Dr. Rehna Kalam

	V3 to check paragraph questions and other unique exam questions.			
Apr. 21, 2025	Created separate result page where it shows the student answers and whether it's right or wrong. Implemented RUD of results wherein the teacher can only update specific columns such as score.	None.	Implement a loader. Reimplement gaze-tracking.	Dr. Rehna Kalam
Apr. 22, 2025	Implemented loader based on if the system is performing something in the background. Reimplemented gaze-tracking via WebGazerJS.	Struggled on the loader component because of server-side rendering being async by default – solved by using NextJS's default transition component. Gaze-tracking's cheating probability calculation is a bit inaccurate – solved by refining the math equation.	Implement a timer system. Implement one-session memory whether on-going, done or late. Create final report draft. Revise result page.	Dr. Rehna Kalam

Apr. 24, 2025	Created final report draft in preparation for feedback. Implemented timer system and one-session system.	Not all the features are complete, thus final report is not officially finished – still submitted for feedback as final report will have the new features included with it.		Dr. Rehna Kalam
Apr. 27, 2025	Implemented input tracking and behaviour tracking. Revised result page.	None.	Finalize report and finalize presentation. Fix necessary bugs.	Dr. Rehna Kalam
May 1, 2025	Finalized report and presentation. Fixed bugs. Completed Examiq. Ready for final submission, presentation, demo, and viva.	None.	None.	Dr. Rehna Kalam

APPENDIX F – ETHICS FORM

Form RE1

University of Bolton
Teaching Intensive Research Informed

RESEARCH ETHICS CHECKLIST

August 2021

Note: *undergraduate and taught postgraduate students must use this form where human participants, human tissues or data, potentially sensitive material or a potential reputational risk forms part of their project. Research students, staff and external researchers must use the online EFIT system.*

This checklist should be completed for every research project. It is used to identify whether a full application for ethics approval needs to be submitted.

Before completing this form, please refer to the University **'Code of Practice on Ethical Standards for Research Involving Human Participants'** and the **'Scope of the Code of Practice'** document. The student's supervisor is responsible for exercising appropriate professional judgment in this review.

This checklist must be completed before potential participants are approached to take part in any research.

Section 1: Applicant Details

1.	Name of Researcher (applicant):	Les Paul Ranalan
2.	Status (please click to select):	Undergraduate
3.	Email Address:	lespaul021504@gmail.com
4a.	Contact Address:	Jamal Abdul Nasser, Sharjah
4b.	Telephone Number:	0521611925
5.	Project Title:	Examiq
6.	Course title/module name/number School/Centre:	SEC6201 – Undergradte Project, University of Bolton, RAK
7.	Supervisor's or module leader's name:	Dr. Rehna Kalam

8.	Supervisor's Email address:	rk18ext@bolton.ac.uk
9.	Supervisor's Telephone number:	+91 80869 93235
Comments from Researcher, and/or from Supervisor:		

Declaration by Researcher *(Please check the appropriate boxes)*

☒	I have read the University's Code of Practice
☒	The topic merits further research
☒	I have the skills to carry out the research
☒	The participant information sheet, if needed, is appropriate
☒	The procedures for recruitment and obtaining informed consent, if needed, are appropriate
☒	The research is exempt from further ethics review according to current University guidelines
☒	Where relevant, I have read the ethical guidelines of the regulatory body that is relevant to my discipline and verify that the research adheres to these guidelines

Section 2: Research Checklist (*Please answer each question by selecting the appropriate response)*

		YES/NO
1.	Will the study involve participants who are particularly vulnerable or who may be unable to give informed consent (e.g. children, people with learning disabilities, emotional difficulties, problems with understanding and/or communication, your own students)?	NO
2.	Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited (e.g. students at school, members of self-help group, residents of nursing home)?	NO
3.	Will deception be necessary, i.e. will participants take part without knowing the true purpose of the study or without their knowledge/consent at the time (e.g. covert observation of people in non-public places)?	NO

4.	Will the study involve discussion of topics which the participants (or readers of the research) may find sensitive or disturbing (e.g. sexual activity, drug use, controversial/extreme texts)?	NO
5.	Will drugs, placebos or other substances (e.g. food substances, alcohol, nicotine, vitamins) be administered to or ingested by participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	NO
6.	Will human blood or tissue samples be obtained for use in the research?	NO
7.	Will pain or more than mild discomfort be likely to result from the study?	NO
8.	Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?	NO
9.	Will the study involve prolonged or repetitive testing?	NO
10.	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	NO
11.	Will participants' right to withdraw from the study at any time be withheld or not made explicit?	NO
12.	Will participants' anonymity be compromised or their right to anonymity be withheld or information they give be identifiable as theirs?	NO
13.	Might permission for the study need to be sought from the researcher's or from participants' employer?	NO
14.	Will the study involve recruitment of patients or staff through the NHS?	NO
15.	Does the research have any potential implications for the reputation of the University?	NO
16.	Does the research involve socially or politically sensitive (actual of potential) topics?	NO
17.	Will the research have the potential to uncover or highlight illegal or potentially harmful activities?"	NO

If ALL items in the Declaration are checked and all items in the Section 2 checklist have been answered NO; **send the completed and signed Form RE1 to your School/Centre Research Ethics Officer (REO)** for information. You should receive a signed copy in return from your REO. You may proceed with the research but should follow any subsequent guidance or requests from the School/Centre Research Ethics Officer or your supervisor/module leader where appropriate.

Undergraduate and taught postgraduate students should retain a copy of this form and submit the REO signed version with their research report or dissertation.

If Question 6 in the Section 2 checklist has been answered YES; the University of Bolton does not hold a Human Tissue Authority (HTA) licence. Therefore, no researcher at University premises can store human tissue (which may be body parts, organs, tissue, cells, bodily waste products, including blood, serum, plasma, etc.), unless an exemption applies. Refer to the document Registration and Storage of Human Tissue for guidance and refer to your Research Coordinator, REO or Designated HTA Officer. **You cannot proceed with your research at this stage.**

If Question 14 in the Section 2 checklist has been answered YES; you will have to submit an application to the appropriate external NHS ethics committee for approval. After you have received approval from the NHS you should then submit an RE2(U) form together with a copy of the NHS approval to the School/Centre Research Ethics Officer who will arrange for UREC to consider your request. **You cannot proceed with your research at this stage.**

If Question 15 and/or Q17 in the Section 2 checklist has been answered YES; you will need to complete an RE2(U) form and send it together with this RE1 form to the School/Centre Research Ethics Officer who will arrange for UREC to consider your request. **You cannot proceed with your research at this stage.**

If ANY of the items in the Declaration are not ticked AND / OR if you have answered YES to questions in Section 2 (apart from Q6, Q14, Q15, or Q17); you will need to describe more fully in Section 3 of this form how you plan to deal with the ethical issues raised by your research. **This does not mean that you cannot do the research, only that your proposal will need to be approved by the School/Centre Research Ethics Officer or DREC/UREC**. You will be guided on completion of form RE2(D) or RE2(U).

Section 3: Addressing Ethical Problems

If you have answered YES to any of questions in Section 2 (apart from Q6, Q14, Q15, or Q17) please complete below and submit the form to your School/Centre Research Ethics Officer.

Project Title

Principal Investigator/Student

Supervisor

Summary of issues and action to be taken to address the ethics problem(s)

Please note that it is your responsibility to follow the University's' Code of Practice on Ethical Standards' and 'Scope of the Code of Practice' alongside any relevant academic or professional guidelines in the conduct of your study. **This includes providing appropriate information sheets and consent forms, and ensuring confidentiality in the storage and use of data**.

You may only conduct your research in line with the ethical approval received. Any significant change to the design or conduct of the research should be notified to the School/Centre Research Ethics Officer using form RE7 and may require a new application for ethics approval. You must stop your research until this variation is approved.

Signed: Les Paul Ranalan Principal Investigator/Student

Approved: _____ Supervisor/Module Leader (for UGT & PGT)

Date: Nov. 24, 2024

For use by School/Centre Research Ethics Officer (REO):

	Tick all that apply
No ethical problems are raised by this proposed study	
Appropriate action taken to maintain ethical standards	
The research protocol should be revised to eliminate the ethical concerns or reduce them to an acceptable level, using the attached suggestions	
Please submit School/Centre Application for Ethics Approval (Form RE2(D))	
Please submit University Application for Ethics Approval (Form RE2(U))	

Note to REO: ensure this form contains all appropriate signatures and is completed fully. Retain a copy on your file and send a copy to the applicant and their supervisors.

REO name: _____

Signed: _____

Date: _____