ETHNOGRAPHIC STUDY & ANALYSIS OF THE TECHNOLOGY USED FOR ONLINE EDUCATION

Part One: Ethnographic Study

Introduction

For this Ethnographic Study, we observed students, lecturers, and demonstrators and the interactions that took place between them at University. We determined the different components and linked them together in a meaningful way, multiplying the points of view and the sources of data. We have observed interactions during lectures, labs, and seminars. In this ethnographic study, we will discuss the patterns and interactions that we saw across all the modules online as well as in-person.

General Observations

In University, it's common for some students to be more involved in class discussions. We noticed that across all modules the lecturer uses at least 1 piece of educational technology to facilitate classroom discussions, whether that's in person or online. However, this was dependent on the lecturers and students using the technology, and we observed that where the technology wasn't being used by the lecturer, the students would not interact with them using that particular application.

Another commonality that was found was the usage of QMPLUS. One pattern we noticed was that after interviewing candidates on the difficulty of each module, modules that were described as challenging and had higher student counts had more interactions on QMPLUS, whereas modules described as "easy/moderate" didn't have as much interaction on QMPLUS. From this we can derive that the use of QMPLUS was in some way affected by the difficulty and size of the module. The more students the module had, and the harder the module, the more interactions would take place via QMPLUS.

Specific Observations

Module A – Lecture Observations

This module has around 200 students. It has 4 screens to project the information from the computer of the lecture (figure 1). One piece of educational technology used in this module is Mentimeter, which is a quiz application for students to input answers through their phone which gets output onto the screen for other students to see in real time. The lecturer starts by releasing the questions and once this happens the students begin to interact, discussing potential answers as seen in the transcript below:

Student A: "I don't think the answer is stream cipher, it has to be block cipher."

Student B: "Yeah, you're right"

The answers and results are then released on the screen (figure 2). The lecturer then proceeds to explain the reasoning behind the right and wrong answer and explains the context further as described in the transcript below (and figure 3):

Lecturer: "Block cipher, right? As there are different modes of operation, you can configure your block cipher to provide you with different security services. "

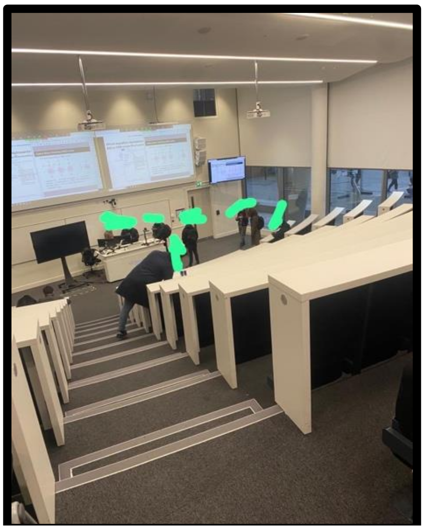


Figure 1: This image depicts the lecture theatre, where both the students and the lecturer are actively engaging in interactive communication with one another.

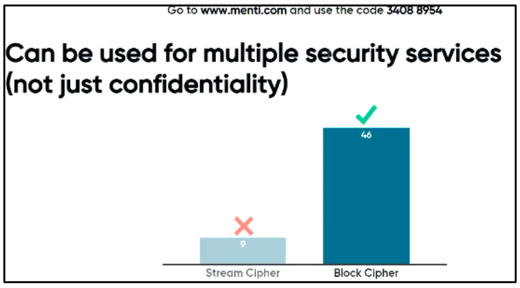


Figure 2: Depicts the application's functionality of displaying the responses submitted by the students.

Figure 3: Showcases the instructor elucidating the rationale behind the responses provided by the students, including an analysis of the correctness or incorrectness of their answers.

Here, we see the application supporting individual activity, as students simply input their own answers through their own phone and interactions with the lecturer as he explains the correct answers to the whole class. Halfway through the lecture we then observed the students going up to the lecturer to clarify their misunderstandings from the Mentimeter quiz. (Figure 4). A transcript of this is shown below:

Student: "I don't get why the answer was C and not B"

Lecturer: "Because the ciphertext generated didn't come from the decryption algorithm, so in order to decrypt the message you can still use the encryption algorithm to get the message."

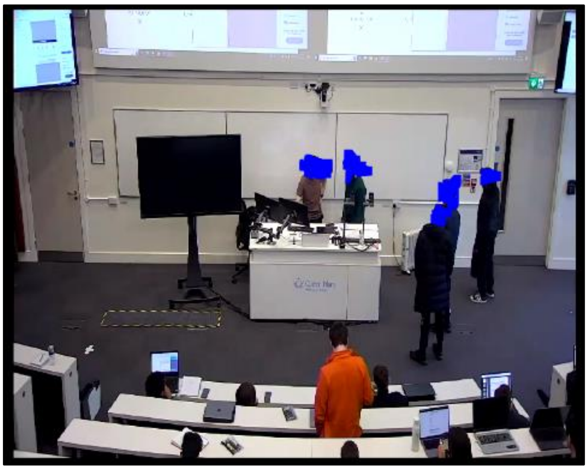
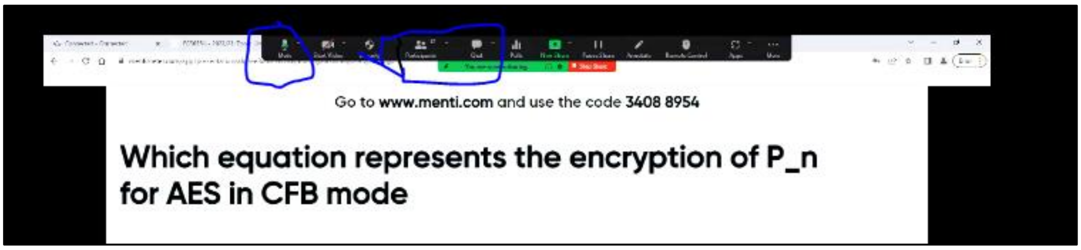


Figure 4: Portrays a group of students forming a queue to seek clarification from the instructor regarding the Mentimeter quiz.

From this we can see this application being used well to facilitate discussions between students and the lecturer by providing feedback and explanations for the students to understand concepts further and keeping them engaged with the course content, therefore enhancing their learning experience.



Zoom was used to deliver the lecture to students online. We observed 17 people in the zoom in the beginning which dropped to 10. This may have been due to less interaction from the lecturer to the people in the zoom, as his main focus was interacting with the students that were in person, and it may have been harder to juggle talking to people in 2 different locations. There was a chat box (Figure 5) where students could ask questions, which was empty. From this we can derive that the lecturer hasn't used this app as expected to interact with students effectively which from their perspective could have harmed their interactive learning experience and can also explain why the majority of students attend in person.

Figure 5: Displaying the software application known as Zoom being utilised during the lecture.

We also observed the lecturer using a drawing tool that zoom provides to write down some notation as a way of explaining a particular concept to the students during the mentimeter quizzing (Figure 6). This may be because he was

looking for a visual way to interact with the students and provide more visual examples. This allowed the students to get a better understanding of what the lecturer is trying to explain, which enhances their overall interactive experience with the lecturer.

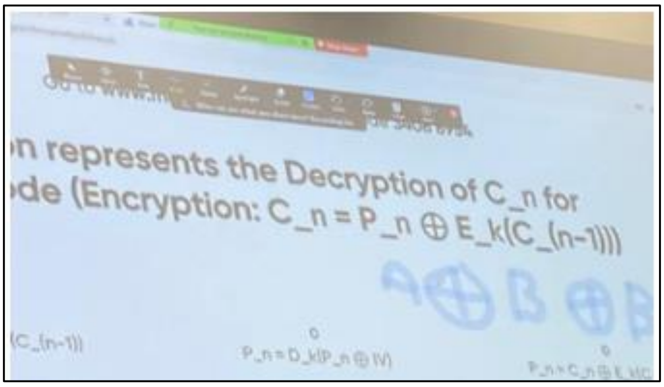


Figure 6: The lecturer employed the drawing functionality of the Zoom application, utilising its associated tools to enhance the visual clarity of their explanations for the benefit of the students.

Module A – Lab Observations

The labs take place in person in the ITL. The labs can be completed online through a piece of software called Jupyter (Figure 7). The lecturer posts the lab questions on this app for students to write their answers. Although we observed students completing the questions on the app individually, we also observed many students still interacting with the demonstrators. We wanted to get the reasoning behind this, so we interviewed a student. Below is the transcript.

Interviewer: "Why were you interacting with demonstrators when the labs posted on the application are designed to be completed individually"

Student: "I went to seek help from them ask them some questions, mainly because the lab was difficult, and I needed some help answering the questions"

From this we can derive that not only does the Jupyter allow individual activity in answering the questions but also allows interactions and collaborations between the demonstrators and the students where the students may have needed some help to understanding the content.

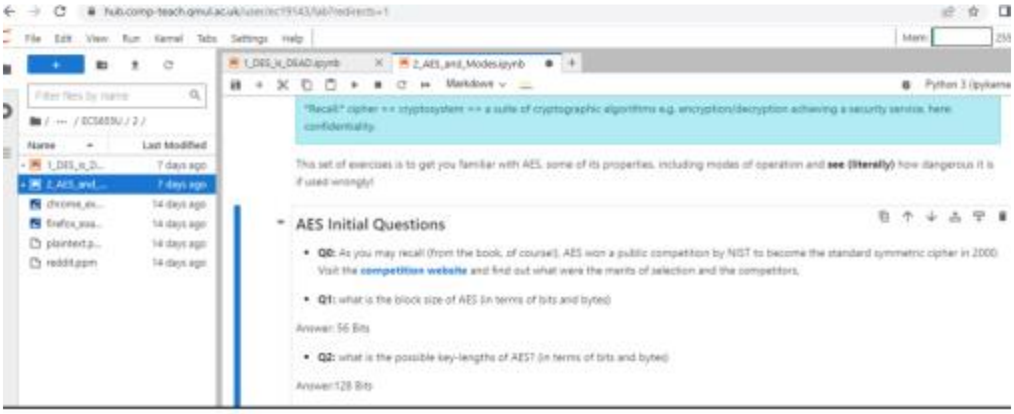


Figure 7: Portrays a demonstration of the educational utility of Jupyter, whereby the lecturer has provided lab exercises for the students to input their answers

Another Educational app used is QMPlus. The lecturer interacts with the students using QMPLUS by uploading a video going through the answers of the lab (figure 8). We noticed the students would then use QMPlus to ask the lecturer questions regarding the lab (figure 9) and the lecturer would then respond. An example of this is observed in figure 9 and transcript below of the forum (post 1).

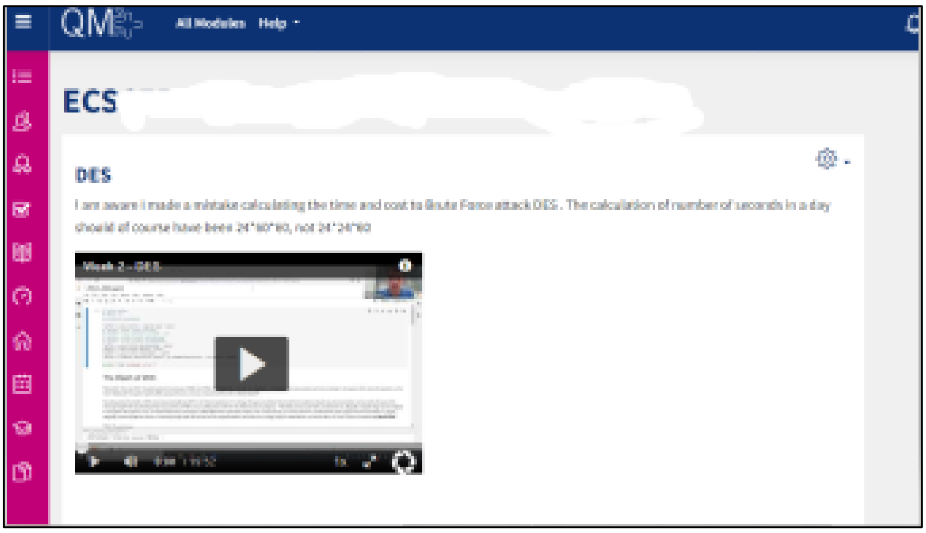


Figure 8: Displays the lecturers use of videos hosted on QMPlus as a medium for explaining the solution for the lab exercises.

Post 1:

Student:" Will the solutions for the labs be released?"

Lecturer: "Yes, as soon as I work out how to link the correct zoom recording to QMPlus (probably tomorrow)"

We also observed one student submitting a complaint on QM plus about the workload and complexity of the module (figure 9), which may be due to the lecturer not using the educational technology as intended to make the module easier for the students, or that the module is really difficult. We observed 7 questions asked in the forum for this module, which is a lot more than Module B and C. We interviewed some students and asked why this is the case we were told that it is a: *"difficult module with more students".* This module has more students so would naturally lead to more interactions.

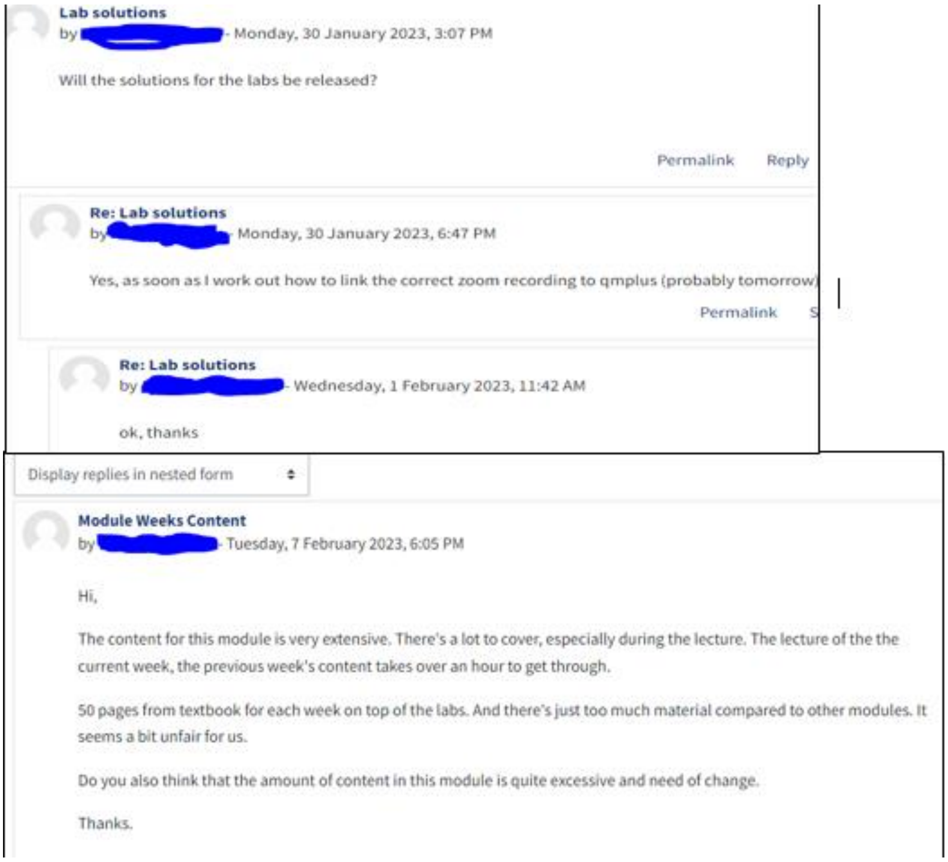


Figure 9: Demonstrates the dynamics of student-lecturer interactions on the QMPlus forum

Module B – Lecture Observations

One way that Module B aims to make effective use of educational technology is through the use of Zoom Meetings, for those unable to attend in-person lectures are able to observe the lecture online and still interact with the lecturer as they do in-person.

Students participating on Zoom are able to use the Chat system to ask any questions that they may have, as depicted below in figure 10. A transcript below is shown for the interactions taking place in the chat box.

Lecturer:" Any questions while I am waiting"

Student 1: "All good thanks!"

Student 2: "Not really but this is a cool lecture".

From this we can observe the lecturer making excellent use of the technology to support further interaction, to make sure that the students completely understand the content so that they are not at a disadvantage for not making it in person. From the student's perspective, we can derive that they are having a great interactive learning experience as they haven't raised any issues and are interacting constantly using the chat box and the overall system as expected.

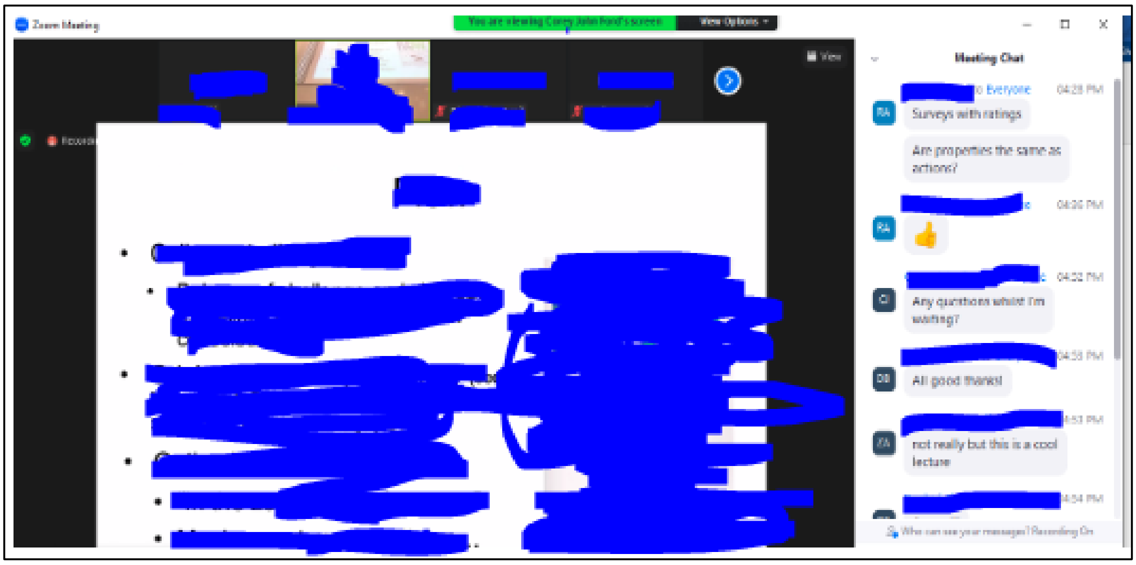


Figure 10: Shows the efficacy of student-lecturer interactions facilitated through the chat and camera feature on Zoom.

There is a microphone system for the lecturer to speak to the students that are online as well as in-person. Furthermore, the use of the camera system (figure 10) enhances the online delivery of the lecture as students can see the lecturer as well as his screen so they can gauge what he is trying to teach and ask questions. The advantage of this is that the idea of building a relationship with the lecturer would not be removed from the overall student experience, and they can still have the same interactive experience as those that are in person.

However, after conducting some interviews, we observed some difficulties that took place when it came to interacting using Zoom. Below is a transcript of what they said regarding their negative experiences interacting with Zoom:

Interviewer: "Why have you decided to join the lecture in person today rather than online?"

Student 1: "Well, the quality of online lectures is just not present, I have trouble understanding what is being said which is just so inconvenient. If I'm paying £9250 per year, I expect the quality to be up to standard you know.

Interviewer: "How have you been finding the online lectures for this module?"

Student 2: "I was unable to hear him properly, his microphone didn't seem to be working properly".

As a result of this, behaviours of the students had started to change when compared to the start of the module where student turnout was near maximum. By the students beginning to attend the lecture in person because of the difficulties he faced using Zoom, we can derive that the use of educational technology to deliver the lecture still has room for improvement. We were also able to conclude this after noticing a turnout of 9.18% (17 out of 185 students on zoom) which is significantly less than the turnout rate at the start of the module for online lectures. This shows that the educational technology hasn't been used completely as expected, therefore affecting the quality and number of interactions between students and the lecturers.

The use of QMPlus was also observed in this module. Here there were only 4 questions (figure 11) posted which is less than module A. We interviewed some students asking about the difficulty of this module and they mentioned it being "moderate". Also, this module has less students (185) than module A. From this we can derive that there are less interactions on QMPlus forums due to the module not being as difficult as well as there being less students in this module compared to Module A.

Figure 11: Displays four inquiries posed by students on the QMPlus forum, illuminating their engagement with the digital platform's interactive features.

Discussion	Started by	Last post ↓	Replies
lecture recording	[redacted] 26 Jan 2023	[redacted] 27 Jan 2023	1
groups	[redacted] 25 Jan 2023	[redacted] 25 Jan 2023	1
First session	[redacted] 23 Jan 2023	[redacted] 24 Jan 2023	1
recordings	[redacted] 23 Jan 2023	[redacted] 24 Jan 2023	1

Module C – Lecture Observations

This Module is the smallest of the three with around 40 students. The lecturer also uses Mentimeter in this module and starts the lecture by launching the application. We noticed that the questions asked in Mentimer were more open questions (figure 12) and wanted students to input open answers as opposed to a multiple-choice approach that was used in module A. The app encouraged individual collaborations amongst the students who discuss potential answers amongst themselves, and also public interactions between the lecturer and the rest of the students as she would use the answers of the students to promote a better class discussion as each of their answers were unique, so it is easier to gauge their point of view on a topic.

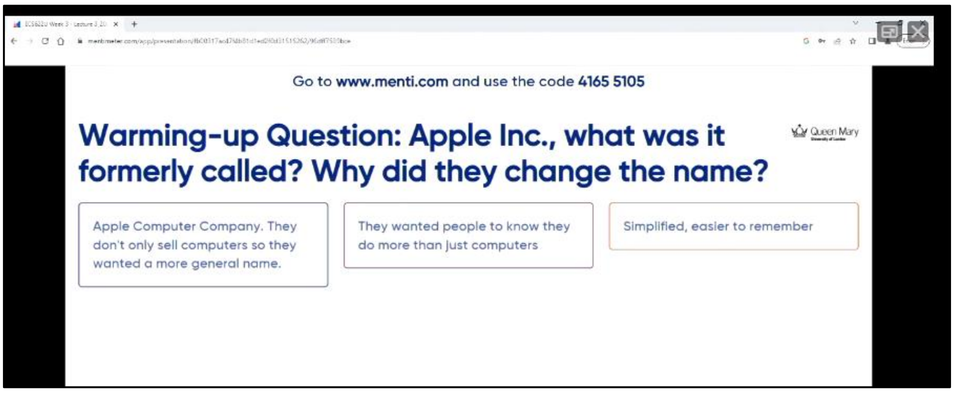


Figure 12: Shows the responses generated from Mentimeter and is being displayed on the screen in a manner that is visible to fellow students.

We repeatedly observed her asking students about their answers as the below transcript shows:

Lecturer: "Who wrote this answer? When you talk about people, who are you talking about? Is it the general public?

Student 1: Customers?

Lecturer: "And?"

Student 2: "Investors"

Lecturer: "Yes, correct" ...

Here the lecturer uses the answers on the application to improve the students' understanding of a concept by prompting them to specify what they mean after the questions are posted. In another observation students after gave their answers (figure 13) she proceeds to present the slides that discuss the answer to that question.

Figure 13: The student's responses being projected onto the screen for collective viewing.

In some scenarios, we observed no one responding when the lecturer asked, "who wrote this?". This may be due to them being unable to explain their answer or are unwilling to interact with the class and were only comfortable with answering questions through Mentimeter. From this we can gather that this technology has been used really well as it not only facilitates collaboration but also facilitates individual activity for those who don't wish to orally interact with the rest of the class and only want to use the application to interact and give their input. However, this raises the question of what can be done to make students more comfortable in sharing their thoughts in a classroom setting.

No interactions taking place between the lecturer and students during the break unlike in module A where people were queuing to ask questions. This was because the majority of the interactions had already taken place during the mentimeter quiz. Therefore, with the help of the app the students were able to understand everything and had no concerns.

QMPlus is rarely used with only 2 questions posted so far in the forum. This may be due to the discussions already taking place in person. However, it could also be due to the lecturer not using this app as it should be. As shown in figure (14), there were no responses to the questions asked in the form, which may have deterred other students from using it as they know they may not get a response. The module is also described as "easy" so it may mean that not much interaction is required with the lecturer. This module less students than Module A and B, so this could also be a factor contributing to the lack of questions posted.

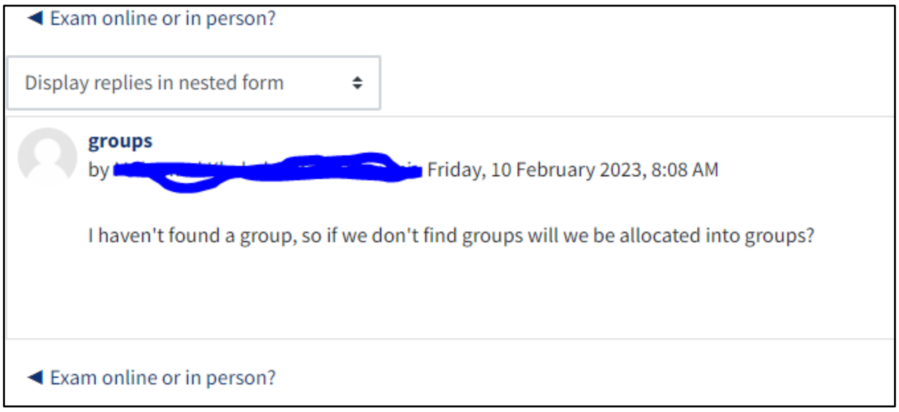


Figure 14: Displays the inquiries posed on QMPlus being presented, with the query remaining unanswered.

Part Two: Analysis

A) Norman's Principles

The first principle is making things visible. This involves the controls, feedback, and other relevant information being visible to the user and being able to understand what controls are available, what they represent and how to use them based on what they see on the interface. One problem that we came across was through the Jupyter hub application used to deliver labs. Upon starting the application, the user has no idea how to answer the questions. To understand what the controls were in running the code and answering the questions we had to ask the demonstrators. They then told us that to run the code you can either press the play button or press control enter, and to write your answers you double click the box and start typing. This is something we wouldn't have known by only looking at the interface because as can be seen in figure 15, the play button is extremely small and not as visible as it should be. To improve visibility, you could make the button bigger, so the user spends less time having to look for the right button to run the code.

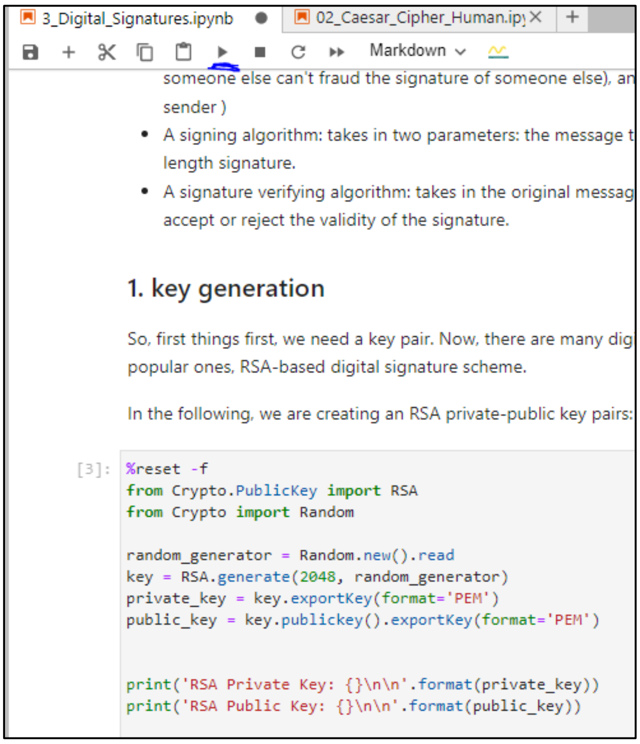


Figure 15: The Jupyter application is showcased, with particular emphasis on the execution functionality, denoted by the 'play' button.

The second principle is natural mapping, which involves the controls of an interface resembling the desired outcome for the user. This can include icons that users can recognise for certain actions based on things like culture, natural tendencies etc. In the Jupyter Hub application, the play button is not positioned next to the code and does not say "run code" on the button. Thus, the play button could represent anything, making it unclear that it is for this particular code. In most IDEs, the button is right next to the code, and it is clearly captioned as "run code," so users know that the button represents running that particular code. An example of how this should be done can be seen on the zoom application (figure 16) where Icons and labels are used to resemble what the user is looking for very well. For e.g. The mute/unmute button resembles a microphone icon, as it is a commonly recognized symbol for audio control, also the video on/off button uses a camera icon, as it is a commonly recognized symbol for video control. This is also seen on the chatbox, which uses a commonly recognised symbol for text communication. This is a good example of natural mapping, with each icon being labeled well so the user knows what it represents and allows them to navigate the application more easily. The icons are also located in a way that won't disturb their view of the presentation and give them a better interactive experience of the meeting.

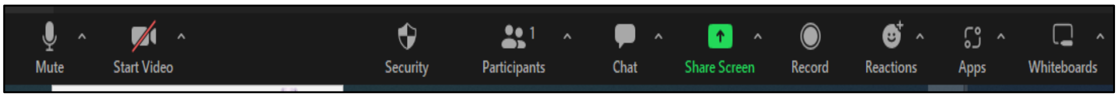


Figure 16: Illustrates the use of natural mapping in Zoom.

The third principle is feedback, which emphasizes that for every action performed by the user on the application, they should receive feedback to let them know whether their action was successful or not. This allows them to confidently move on to the next step. In the Zoom application, for example, a feedback problem we came across was the lack of feedback in terms of the microphone. There is no feedback on whether the microphone has been connected properly, and there are no problems with its quality for the person speaking. This resulted in many students complaining about being unable to hear the lecturer or that they can't hear the lecturer properly. To align with the feedback principle, this could be improved by informing the lecturer at the beginning of the lecture that there is a lack of quality in the sound. This way, if something is wrong, they can fix it from the beginning, allowing the rest of the lecture to flow smoothly, and students won't miss out on any crucial information or leave the meeting due to these issues.

B) Breakdown in Phenomenology

Breakdown in Phenomenology is when an event occurs while the user is interacting with the application and it does not follow their expectations or understanding of what the system should have done, causing a disconnect between them and the interface. Through these events, the user comes across new objects and has a new learning experience as a result of these events. These events can be positive or negative depending on the context.

The first stage in phenomenology before breakdown is ready-at-hand, when they are engaged with the task and are not fully aware of the smaller details and the technology that they are interacting with, and the completion of the activity is natural to them. They are using the interface with complete confidence. This is described as being in 'flow'. An example what we observed was when users are using a Jupyter hub to answer the lab questions posted by the lecturer and running the relevant code and going through each task one by one. Here the interface is READY-TO-HAND as in this stage they are engaged with the task and minimal understanding of the system is required to complete the task, as all they are doing at this stage is typing out their answers, then pressing enter to submit their answers, or control-enter to run the code. They are in flow and not much external thinking is required during this process as they simply input answers based on their knowledge, and have come across no obstacles that can cause them to be disconnected from the system.

While the user interacts with the system, if their actions have an unexpected result, the interface transitions into being PRESENT-AT-HAND. Here the objects which the user may not have noticed before become present as they try to figure out the root cause of the breakdown. Here there is a slight disconnect with the system as they are no longer in a flow state and using the system with full confidence. Continuing from the Jupyter notebook example, while the user is inputting their answers and running the code, in some scenarios an error will get outputted if they input code in a way that crashes the system (figure 18). During this phase, certain objects now become aware to the user, such as the keys that they are typing and each line of code they have inputted as it is these things that may have led to the breakdown. This allows a good learning experience for the user as it gets them to analyse where they have gone wrong in terms of their code and make them approach the problem by researching another solution, making them a better programmer. We observed many users asking for help from demonstrators when coming across these types of errors to get a better understanding of the system and the tasks.

```
%reset -f
from Crypto.PublicKey import RSA
from Crypto import Random

random_generator = Random.new().read
key = RSA.generate(2048, random_generator)
private_key = key.exportKey(format='PEM')
public_key = key.publickey().exportKey(format='PEM')


print('RSA Private Key: {}\n\n'.format(private_key))
print('RSA Public Key: {}\n\n'.format(public_key))
```

```
---------------------------------------------------------------------------
ModuleNotFoundError                       Traceback (most recent call last)
Input In [2], in <cell line: 2>()
      1 get_ipython().run_line_magic('reset', '-f')
----> 2 from Crypto.PublicKey import RSA
      3 from Crypto import Random
      5 random_generator = Random.new().read

ModuleNotFoundError: No module named 'Crypto'
```

Figure 17: Displays an error message when the user inputs code that crashes the system.

In essence, the concept of breakdown is an inescapable reality, and the objective of a designer is to proactively anticipate its potential occurrence and incorporate it in a manner that delivers a favourable user experience. In the realm of educational technology, breakdown can be perceived as a constructive phenomenon that presents an opportunity for users to engage in a learning curve, thereby enhancing their analytical competencies and, by extension, their academic performance.

[APPENDIX]

Transcript 1

Student A: "I don't think the answer is stream cipher, it has to be block cipher."

Student B: "Yeah, you're right"

Transcript 2

Lecturer: "Block cipher, right? As there are different modes of operation, you can configure your block cipher to provide you with different security services. "

Transcript 3

Student: "I don't get why the answer was C and not B"

Lecturer: "Because the ciphertext generated didn't come from the decryption algorithm, so in order to decrypt the message you can still use the encryption algorithm to get the message."

Transcript 4

Interviewer: "Why were you interacting with demonstrators when the labs posted on the application are designed to be completed individually"

Student: "I went to seek help from them ask them some questions, mainly because the lab was difficult, and I needed some help answering the questions"

Transcript 5

Student describing module A: "Difficult module with more students.

Transcript 6

Lecturer:" Any questions while I am waiting"

Student 1: "All good thanks!"

Student 2: "Not really but this is a cool lecture".

Transcript 7

Interviewer: "Why have you decided to join the lecture in person today rather than online?"

Student 1: "Well, the quality of online lectures is just not present, I have trouble understanding what is being said which is just so inconvenient. If I'm paying £9250 per year, I expect the quality to be up to standard you know.

Interviewer: "How have you been finding the online lectures for this module?"

Student 2: "I was unable to hear him properly, his microphone didn't seem to be working properly".

Transcript 8

Lecturer: "Who wrote this answer? When you talk about people, who are you talking about? Is it the general public?

Student 1: Customers?

Lecturer: “And?”

Student 2: “Investors”

Lecturer: “Yes, correct” ...

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2. Heidegger, M., 1927. Being and Time. Translated by John Macquarrie and Edward Robinson. First English Edition

**Completed with a team of 4 Developers