ECS661U User Experience Design: Coursework 2

Part 1: Conceptual Design

The ethnographic observational study [1] revealed problems with the overall useability of QMPlus. The addtion of the newly integrated interface has made navigating through modules to view weekly resources time-consuming, overwhelming, and inconsistent by also moving/removing useful features (e.g., deadline calendar). This change of interface has caused both returning/new students experience with QMPlus counterintuitive. As QMPlus is the platform for all, I decided not only to design an alternative website interface, but also incorporate multi-modal technology to enhance students' interaction in a class.

The proposed idea is creating an interconnected ecosystem of peripherals linked by QMPlus to further enhance the educational experience in lesson/individually/groups. The ecosystem makes use of QMPlus, interactive workspace desk, wearable device, and AI; working in unison to heighten students' experience through augment/virtual reality, AI assistance, and wellbeing monitoring. Study's observations found that students were less eager to attend certain classes due to the lack of interactivity, delivery, and accessing of content. The proposed ecosystem intends to solve these issues.

1.1. Improving QMPlus:

1.1.1. Home Screen:

The new QMPlus page would remove the left sidebar and keep the top menu bar as it contained confusing directories e.g. 'My Modules'/'Module Index' expand modules in different areas, 'My Home' while on the home page and it being in the middle of the list, 'Badges' when students said they have never been informed/used them.

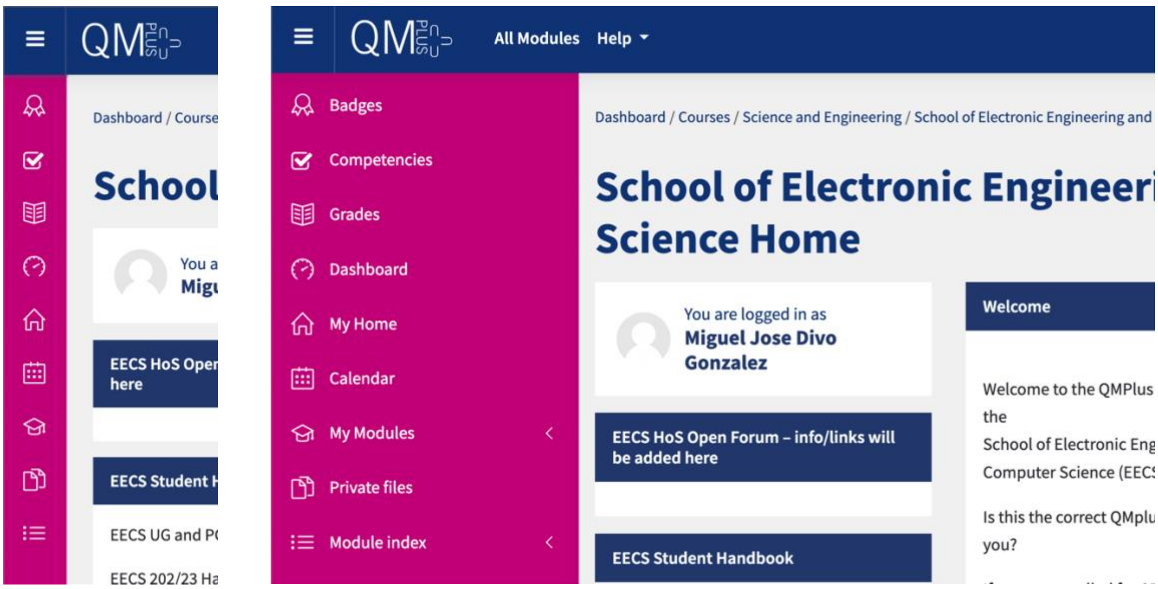

Figure 1: Current QMPlus Sidebar

The new design will have all the necessary information/directories available to the user through the 'Dashboard'. We found that the main issue with students was how they navigated QMPlus to their modules/grades/calendar which can be resolved by fixing visibility and mapping of the site. An overload of information and imbedded routes made accessing important pages more tedious by having to search through many sections rather than being able to access these pages immediately [2]. Reintroducing the 'Dashboard' feature from the previous QMPlus versions allows users to access all their essential, key pages through a single interaction. This new system will be ubiquitous, being able to be on any device type and is embedded within the device ecosystem (1.2).

Figure 2: Proposed UI

1.1.2. Dashboard:

Students can access important information in just one click; it is a hub for all the features a student is more likely to want to use. Students can customise aspects of the dashboard; add/remove certain widgets, ‘pin’ modules onto the dashboard. This allows the user to have more control over what they do on the site while still focussing on the core use of QMPlus. Moreover, this further improves the visibility and mapping of QMPlus by having an organised system for accessing modules/grades/announcements in one location.

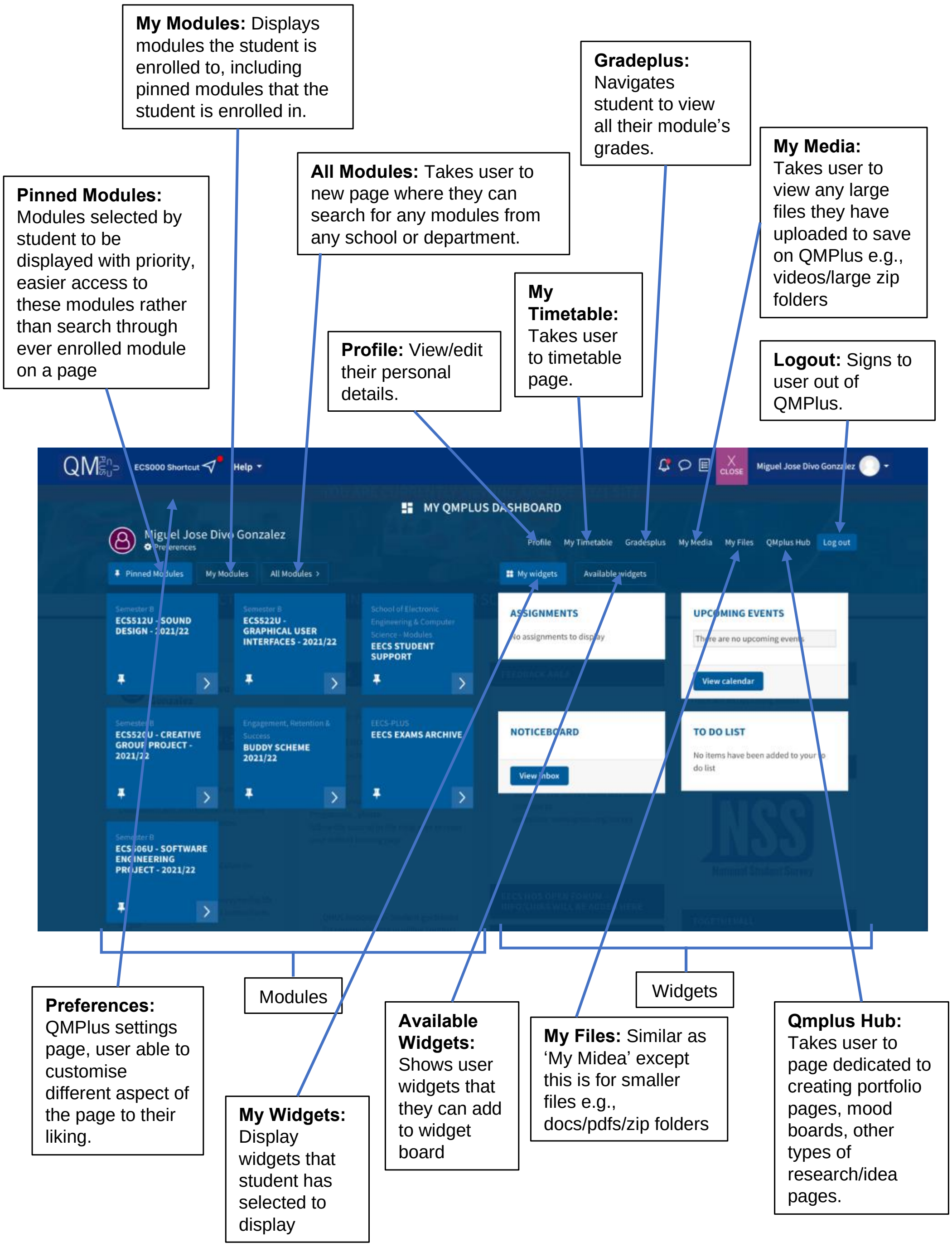

Figure 3: Dashboard

1.1.3. Shortcut:

In the ethnographic study we found that students were having trouble to follow along lectures and simultaneously access resources, viewing resources, and make notes on their devices. 'Shortcuts' feature eliminates wasted time and attention by automatically sorting out the needed information/resources to use while in a lecture. The module's respective week content is presented alongside the student's open documenting software and lecture slides/stream (in-person/online respectively). The modular design allows students to layout the shortcut however they find suitable and personalise it by clicking on 'Shortcut Settings' and use any 3rd party software. Before the session starts, students will receive a QMPlus and device notification to remind that the session is about to start, and that the respective shortcut is available. If the student has the QMPlus app on their phone, they will also receive a notification to inform the availability of the upcoming shortcut.

Figure 3.1: Shortcut UI

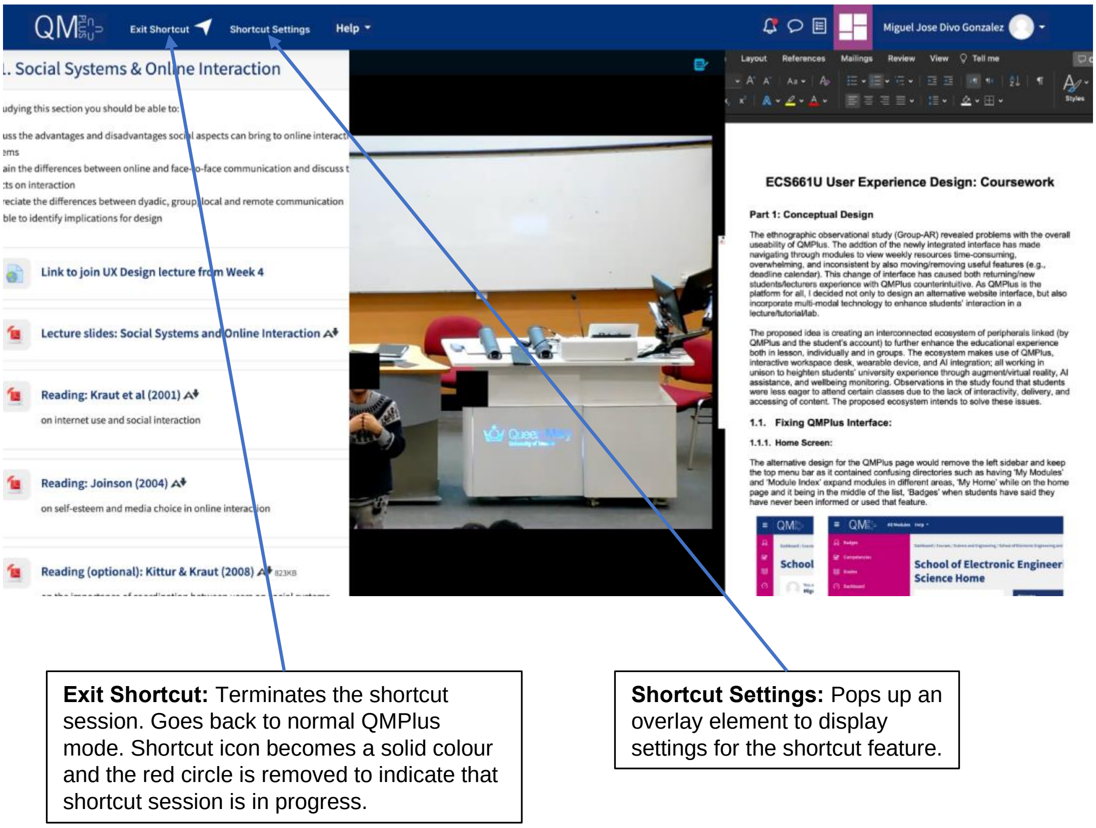

Figure 3.2: Shortcut in Use

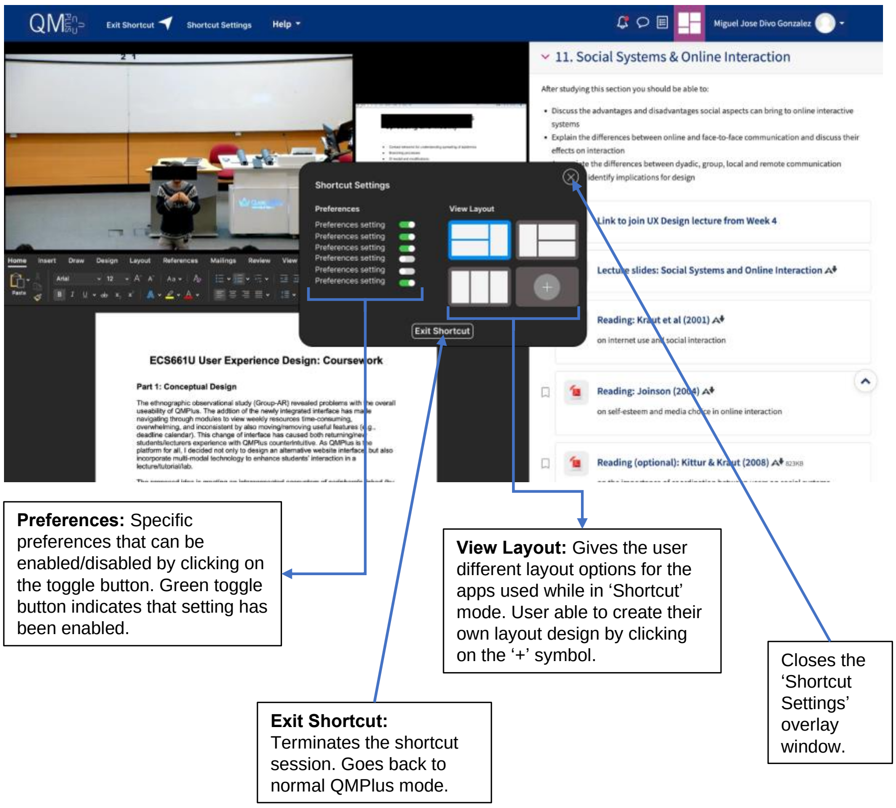

Figure 3.3: Shortcut Settings

1.1.4. AI Integration:

With the uprise of AI, its countless possibilities give beneficial use for assisting students. Designing for reflection during classes allows students to refresh on taught material and breaks during class intermissions. As students attending classes are assumed as a group in a system, implementing temporal perspective can show development in student's attitude to attending class. Adding reflection exercises to ease the student's mind throughout break session and having suggested questions to ask during the break can motivate behaviour change towards class [4]. To support struggling students/students with learning difficulties/disabilities will have access to AI generated summary notes about the class; this can increase student's wellbeing to not stress them due to extenuating circumstances.

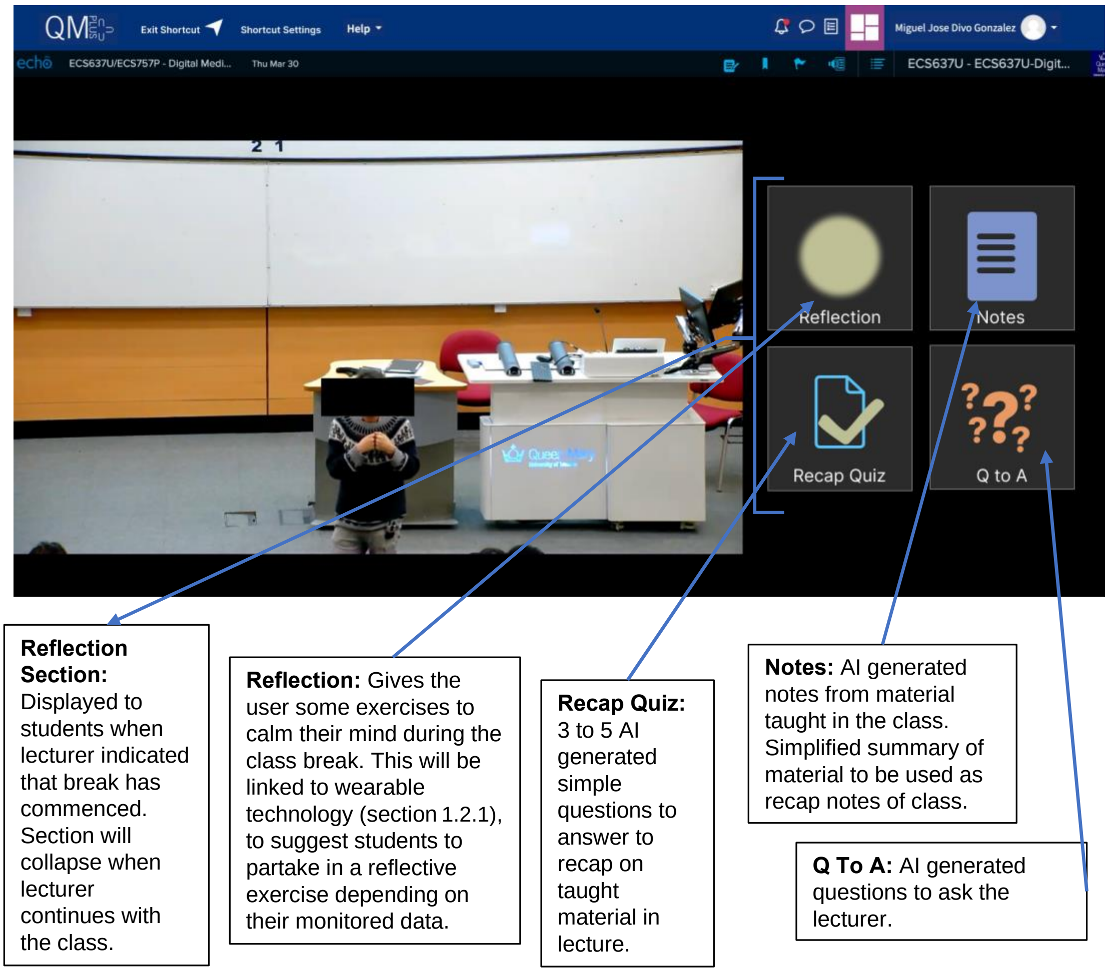

Figure 4.1: Break/Reflection Feature

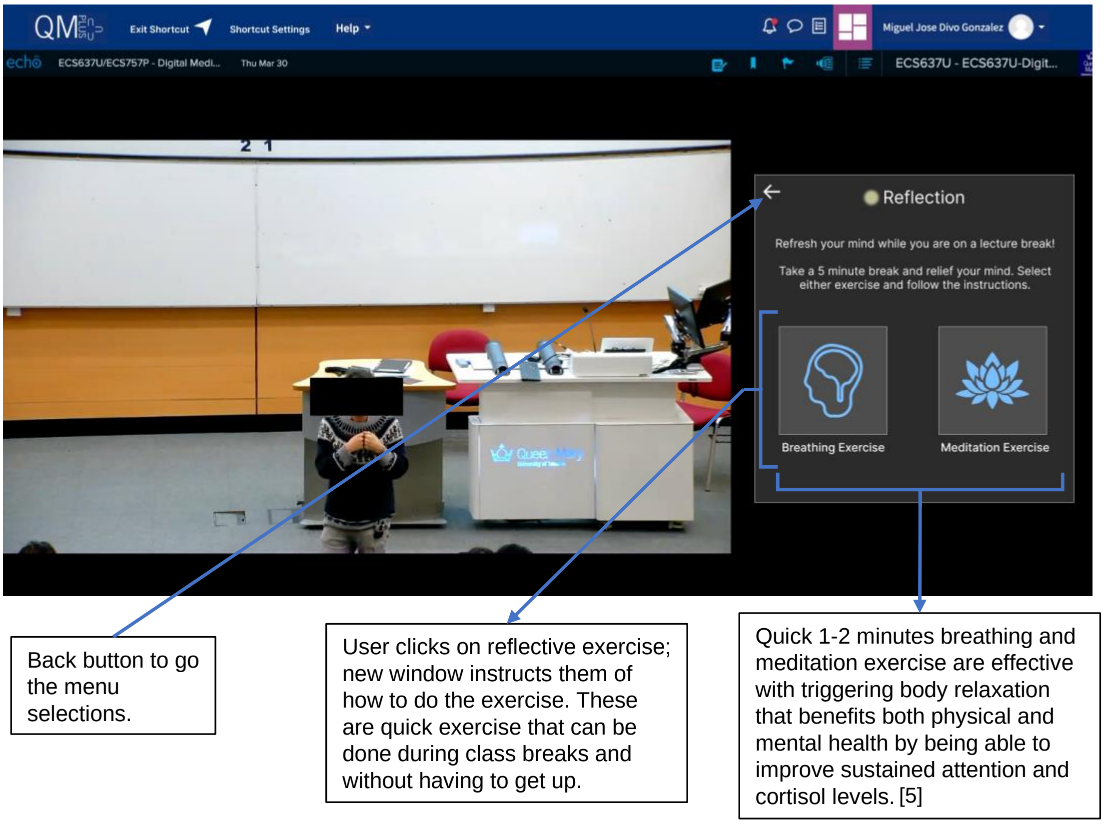

Figure 4.2: ‘Reflection’ Feature

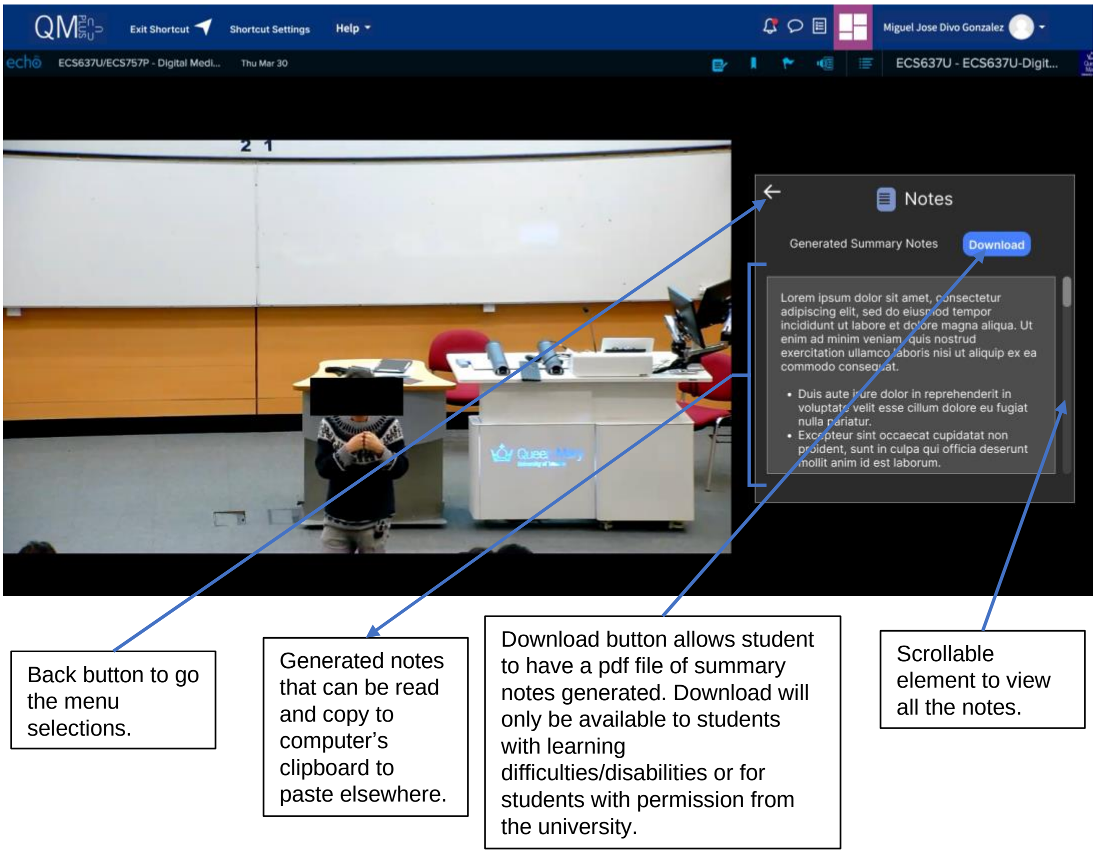

Figure 4.3: ‘Notes’ Feature

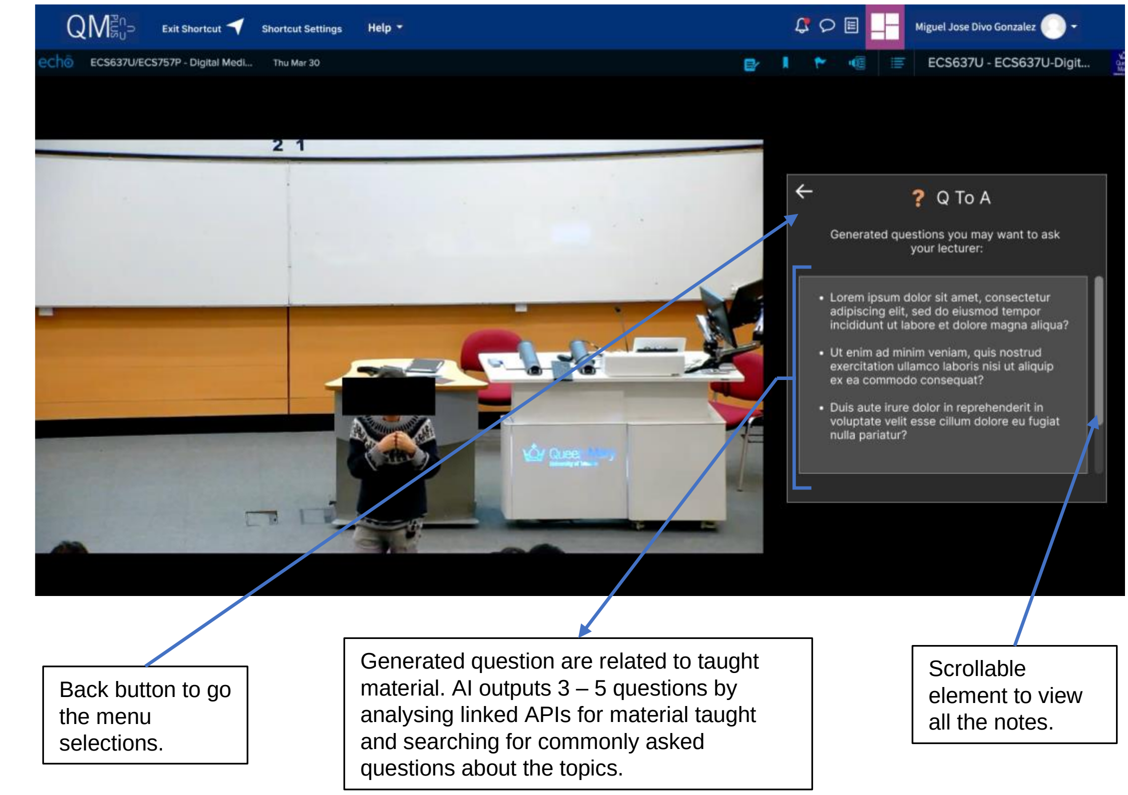

Figure 4.4: ‘QtoA’ Feature

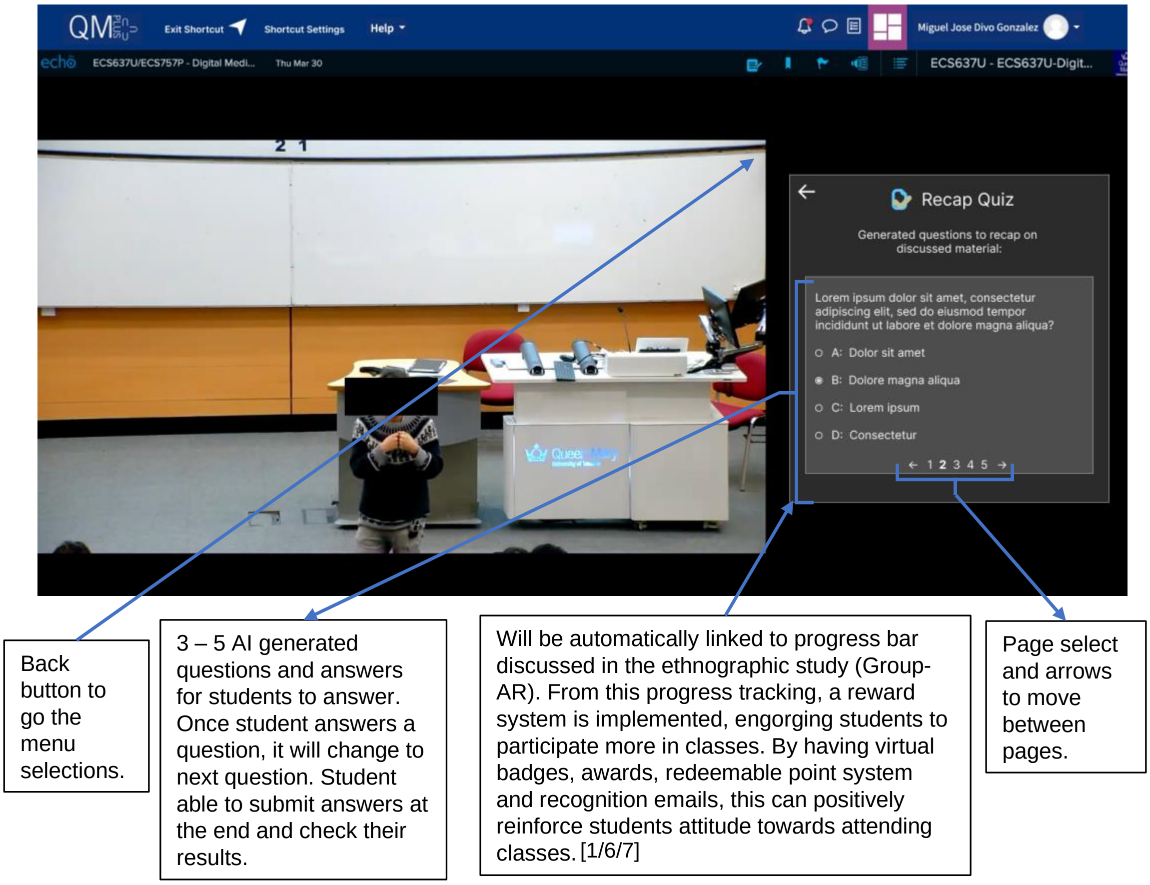

Figure 4.5: ‘Recap Quiz’ Feature

1.2. Device Ecosystem:

1.2.1. Wearable Device:

Incorporation of a multi-modal watch to replace student's ID functionality, measure stress and fatigue, improves the student's experience through increased automation by having a fusion of student's psychological inputs and outputting a fission of reflective results [8]. Device available to all students to help with stress and attention deficit.

Three sensors used in the watch:

- RFID: Radiowave emitting device to transmit data and identify/track objects/animals/people [9].
- EDA: Electrodermal-Activity sensor, measures the electrical conductance of the skin. Detects changes in stress levels/other physiological responses [10].
- PPG: Photoplethysmography sensor, uses light to measure blood flow, data can be manipulated to detect fatigue/attentiveness [11].

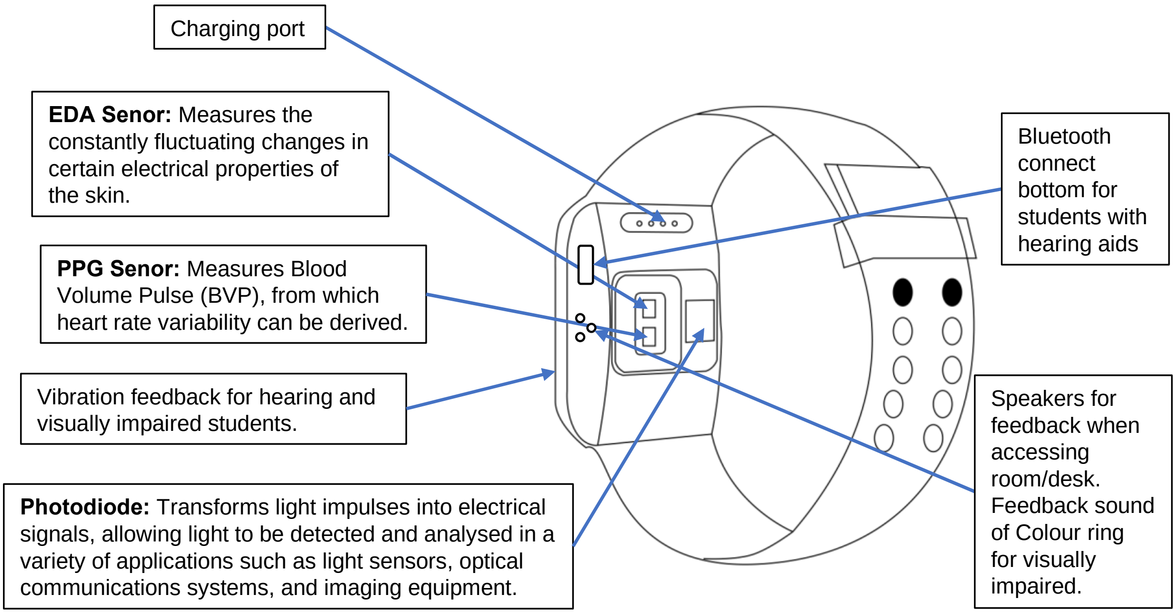

Figure 5.1: Interactive Watch

The watch does not include a screen to not be distracting in class and for the student to not be overloaded with information [12], all data analysed by the sensors are displayed through QMPlus. The respective app screen will be inspired by 'Happy Ring's app; simplified and detailed graphs/data on user's mental wellness [13].

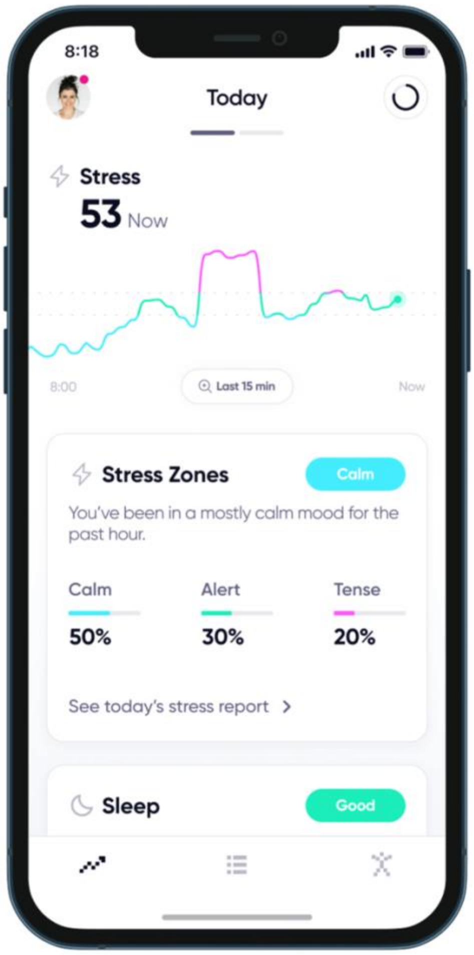

Figure 5.2: Proposed UI[13]

The watch would provide more natural interaction. Through the RFID tag, the watch will be able to:

- access buildings/rooms
- Track student's in-person attendance (linked with reward system discussed in 1.1.4)
- Automatically sign-in student to workspace desk without need for login or personal device (section 1.2.2).

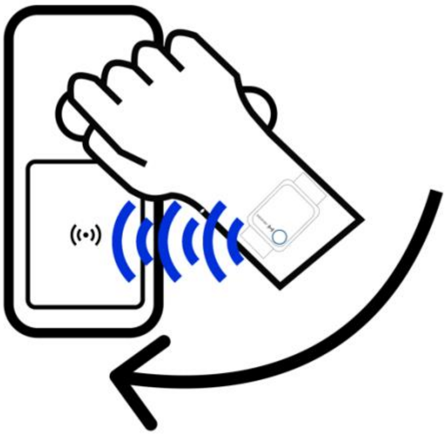

Figure 5.3: RFID Door Scanner Detecting Student's Watch

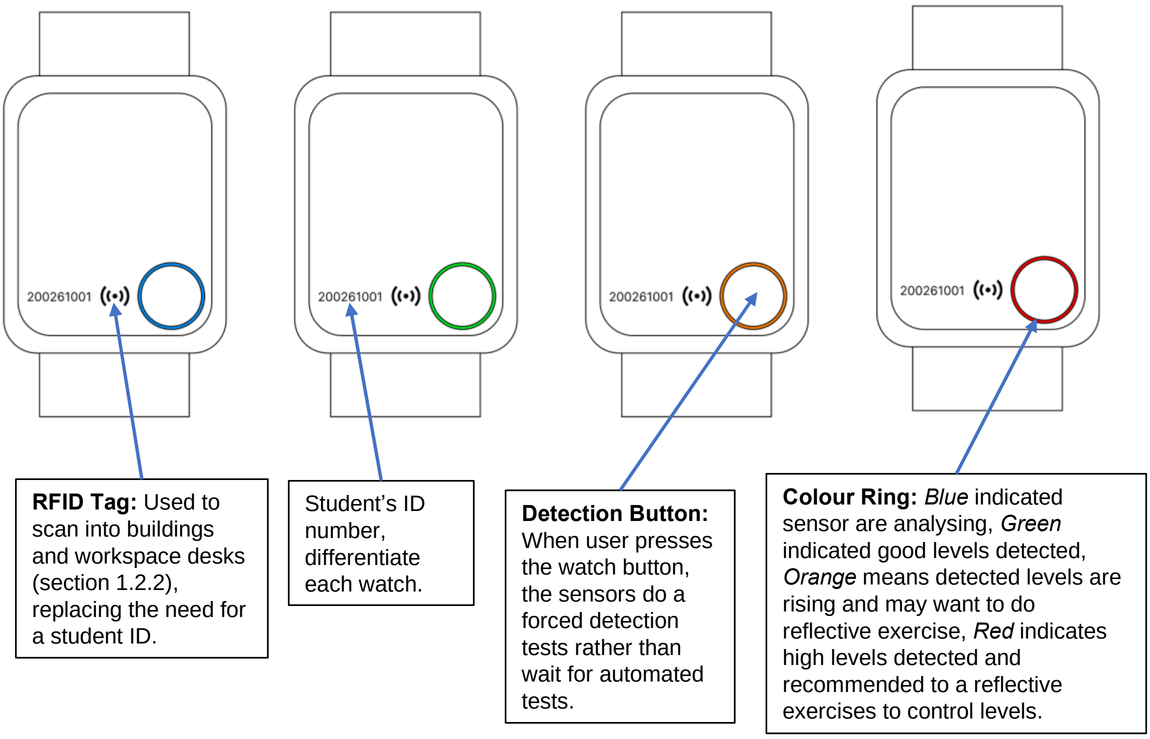

Figure 5.4: Watch Functionality

Sensors are used to measure the user's stress/fatigue levels. When these levels break a threshold (AI/machine learning to learn student's level cycles), the watch vibrates and flashes in the respective colour. Notification is sent to their device (phone/laptop/tablet) to inform of the level change and suggests advice/reflective exercises. Sonification through vibrations used to represent auditory equivalent of ring visualisation. Using sensory feeling of the vibrations, any student can process indicated data[14].

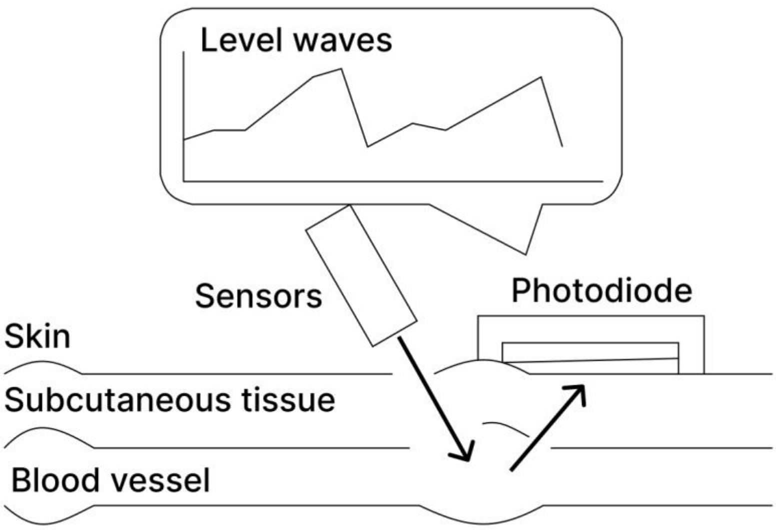

Figure 5.5: Overview of Sensors Functionality[15]

1.2.2. Interactive Workspace:

The multi-modal workspace desk provides students with evolving technologies (AR/VR, Internet of Things, holograms) to offer a universal learning environment for any student. Although the workspace is more beneficial for STEM students, other majors can benefit from the integration of all 3rd party available software.

Using AI, students seamlessly connect to the desk through their watch (1.2.1). IoT makes it possible for the desk to be compatible with any personal device and instantly connect with all the peripherals. Every peripheral communicates together to create an ecosystem of devices e.g., student can project a CAD project on the hologram, use the headset to sketch on the hologram and render it on their device.

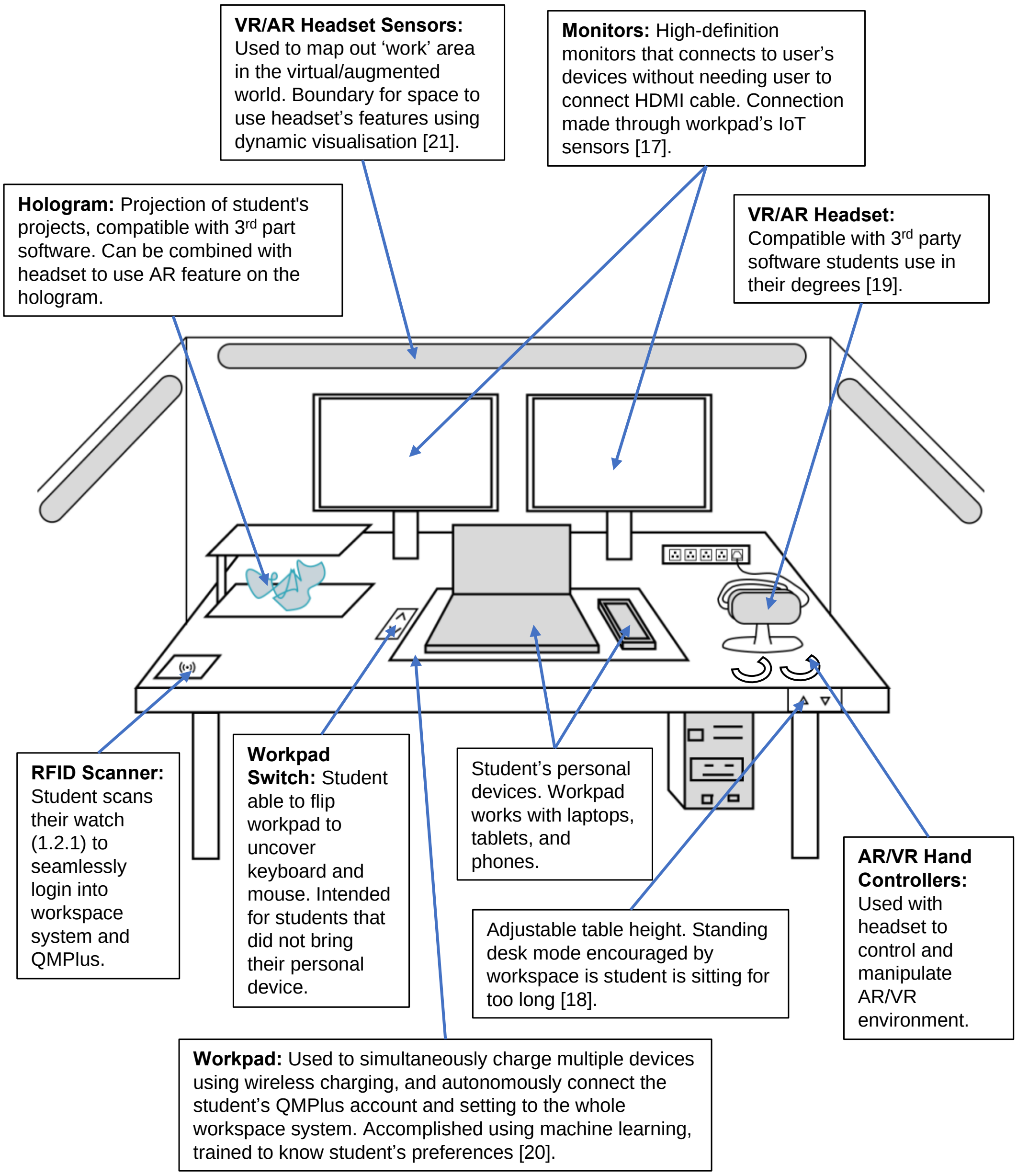

Figure 6.1: Workspace Desk

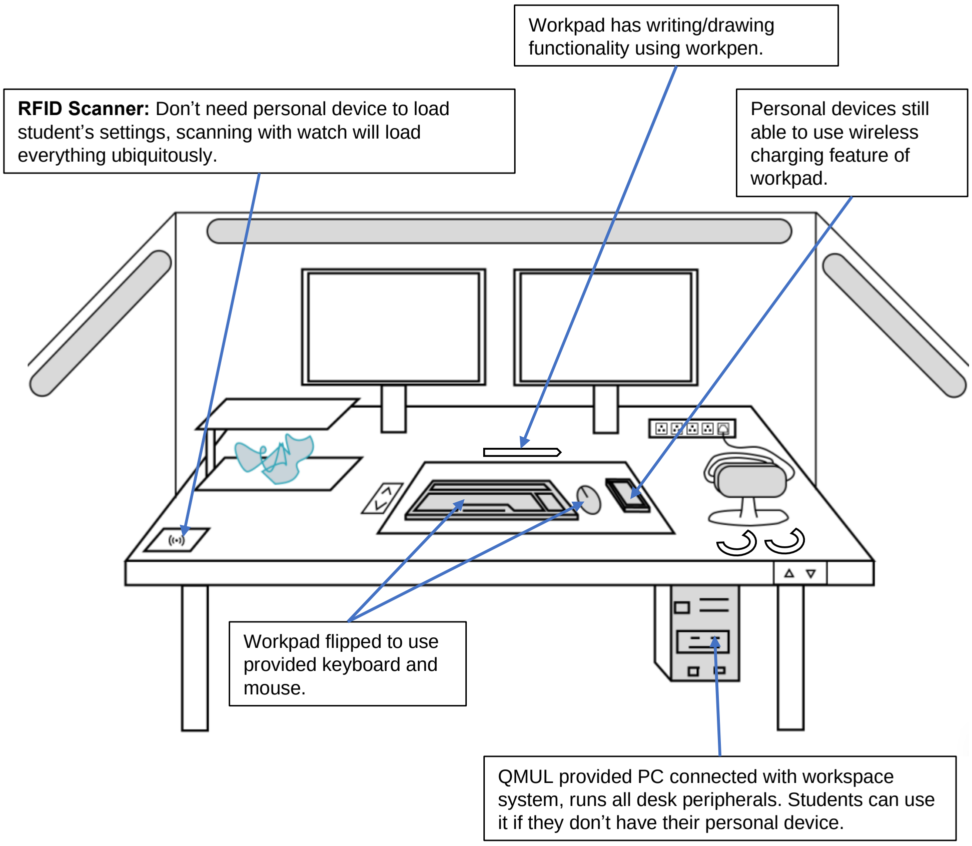

Figure 6.2: Workspace Desk (No Personal Device Used)

Headset allows groups to work in different workspace desk locations and still be able to work together. Empowering on social interaction design, students can work/question/recommend/organise, do any social action in the virtual/augmented world by connected to a 'Work Group' through QMPlus [22].

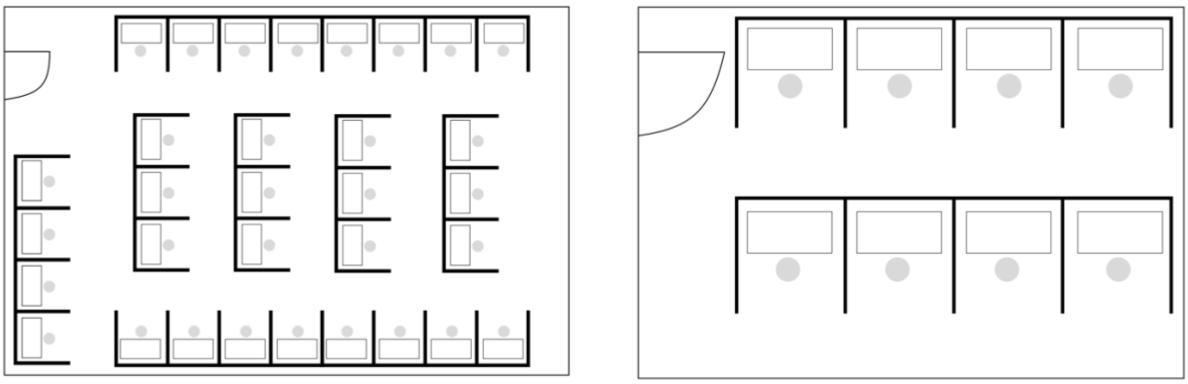

Figure 6.3: Workspace Rooms (Left: Any student use, Right: reversed for student who need accessibility help)

Simplified workspace desk will be installed in halls/rooms/classrooms/lab-rooms; same headset will be available. Linked with QMPlus and student's device, therefore, device screen will also be displayed through headset if wanted. Lecturer able to use 3rd party apps and software alongside their teaching material which students will be able to view through headset.

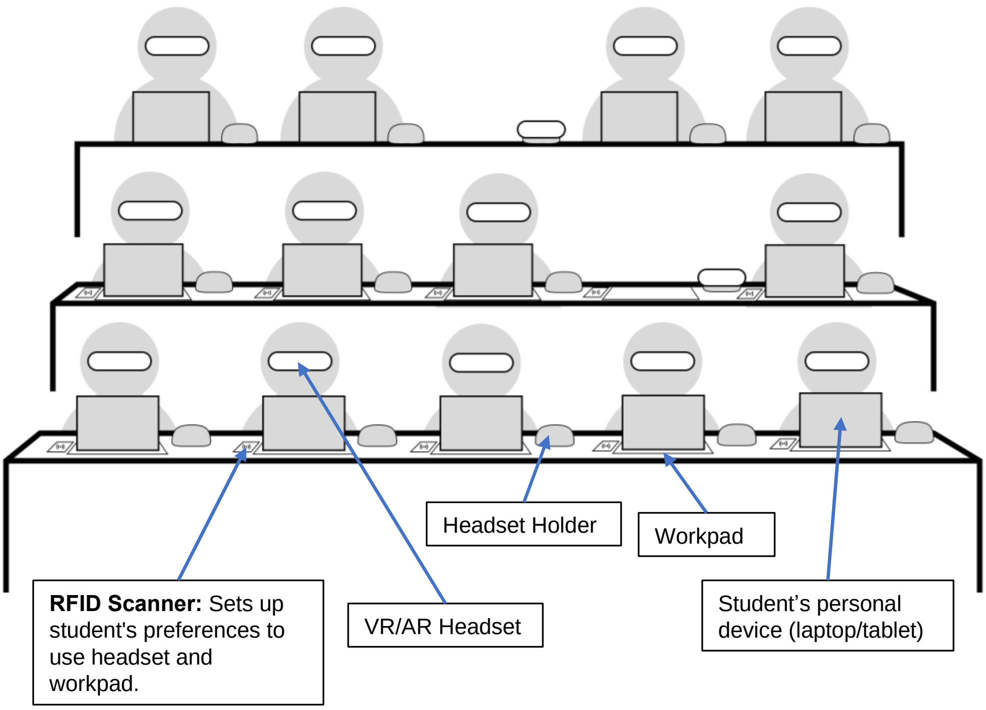

Figure 6.4: Workspace in Lecture

Part 2: Analysis

Individual cognition models (standard HCI) are convenient, but they are limited to the individual interaction between humans and computers and do not account for physical/social interactions, and external representations, that contribute to context. Instead of the overall system, these models focus on internal mental or computational representations and processes. Furthermore, individual systems cannot be reduced to the cognitive skills of individuals [23]. A distributed cognition analysis is used to solve this issue, focuses on the entire system, including all its components and computing processes outside the individual's mind. Systems may be built to reduce cognitive burden by unloading internal memory, as proved in ethnographic study to minimise confusion, by distributing cognition.

Distributed Cognitive Analysis

2.1. Unit of Analysis:

Unit of analysis is the initial phase of DCA. This is comprised of the entire system, people and artefacts that are needed to achieve computation; considers all components of the encounter, not simply what is happening within the mind of one student [24]. These include:

- Students
- Teachers
- Personal Device (Laptop/Phone/Tablet)
- QMPlus Website/App
- Device Notifications
- 3rd Party Educational Software
- AI/Machine learning
- Watch
- EDA Sensor
- PPG Senor
- Photodiode
- RFID Tag/Scanner
- Watch’s Detection Button
- Watch’s Colour Ring
- Watch’s Vibration
- Watch’s Speaker
- Workspace Desk
- Workspace PC
- IoT Sensors/Scanners
- Monitors
- Hologram
- VR/AR Headset/Controllers
- VR/AR Sensors
- Desk’s Workpad
- Workpen
- Workpad Switch
- Workpad Keyboard/Mouse
- Rooms/Halls/Labs

2.2. Memory Representation:

The identification of internal/external memory representations is the second stage of DCA. These are the elements and knowledge that both the students and the system must remember to complete the task. The QMPlus Ecosystem (QMPlus, Watch, Workspace Desk) spreads cognitive strain by offering numerous external memory representations automated by the system, reducing the demand for internal memory representations from the student [24].

Internal (User Memory)	Internal (Computer)	External
Sign-in to QMPlus	Server connection	Student's QMPlus account displayed
Uses 'Shortcut'	Software connection	'Shortcut' for current class displayed
Accesses 'Dashboard'	Server connection	Display 'Dashboard' and respective feature
Adjust settings & preferences	Server connection	Change QMPlus and its features according to customised settings
Engage in AI session break tasks	Server connection	Displays respective reflective exercise
Taps/clicks notification from 'Watch'	Sensory data, server connection	Notification takes student to mental wellness features of QMPlus
Taps 'Workspace' desk with 'Watch' or places personal device on desk's 'Workpad'	Server connection, sensory data	Student's QMPlus account displayed

Figure 7.1: Internal/External Memory Storage for QMPlus

Internal (User Memory)	Internal (Computer)	External
Reach for door handle	Sensory data	'Watch' vibrates/rings, door opens
Taps into 'Workspace' desk	Sensory data, wireless IoT connection. Student's account in server	Student's account connected to 'Workspace'
Subconscious mental levels change	Sensory data detecting mental levels change, wireless data connection to cloud	'Colour ring' light up, notification sent to student's device
Pressed 'Detection Button' on 'Watch'	Sensory data	'Colour ring' light up, notification sent to student's device

Figure 7.2: Internal/External Memory Storage for Watch

Internal (User Memory)	Internal (Computer)	External
Sign-in with 'Watch'	Sensory data, wireless IoT connection. Students account in server	'Workspace' boots-up with student's account, preferences, and settings
Place device on 'Workpad'	Wireless IoT device connection	Device's battery charges, student's device displayed on monitors and connected with peripherals
Uses 'Headset'	Wireless device connection, sensory data	AR/VR output, connected with peripherals and personal device
Uses 'Headset Controllers'	Sensory data	Outputs student's input to software
Uses 'Hologram'	Wireless device connection	Projects student's data from software
Flips 'Workpad' with 'Workpad Switch'	Sensory data	Uncovers keyboard/mouse for use, wireless charging still available for small devices. Personal use of desk's PC available.
Uses 'Workpen'	Sensory data	Outputs student's input to software
Connects with other student to form a 'Work Group'	Wireless device connection, sensory data, student accounts in server	Social interactions through augmented/virtual environment

Figure 7.3: Internal/External Memory Storage for Workspace Desk

The processing behind the whole system is complex and intricate, due to the nature of the technologies used and turning all elements in ubiquitous components to freely communicate/link with each other. The ecosystem's processing can be divided into separate sections; students, QMPlus, servers, 'Watch' and its sensors, 'Workspace' desks and its peripherals/sensors. Majority of the processing is handled by QMPlus and QMUL's servers to compute all data transfers and connections between students and devices. Sub-processing for the 'Watch's' features and 'Workspace' desk's features is done internally by each device's networks but are interlinked by QMPlus/QMUL's servers to seamlessly interact with each other.

All QMPlus related processes are done internally by its respective server to display the requested information and pages. Through external IoT sensors/detectors of the desk's 'Workpad' and the student's device communication, QMPlus can link with external peripherals; able to send/receive data to/from the devices through integration of AI and automatous technology. All student interactions with AI/machine learning integration in QMPlus is computed through QMUL's servers and API/learning algorithms to output necessary data to students.

The ‘Watch’s processing includes the use of data collected by the EDA/PPG sensors to the photodiode, and RFID communication. The data collected by the sensors is sent to the ‘Watch’s internal database to provide a quick response for students to receive at an instance. Simultaneously, sensory data is sent to QMUL’s cloud server to undergo further processing, prompting a secondary notification. This allows students to access detailed analysis of the data retrieved. RFID communication between the ‘Watch’ and doors/desks triggers feedback indicating task was successfully handled. Vibration motor, speaker and visual colour lights are activated to inform students of the primary sensory analysis results, and to indicate that RFID scan and student’s account data transfer was successful.

The ‘Workspace’ desk is the most complex due to all the integrated peripherals and connections needed for all elements to work in unison/universally. Through wireless connection and IoT, all peripherals can be used individually or in unity. Creating the augmented/virtual work environment, overhead sensors are used to map the usable space for computed interaction. All device communication and information is processed through the student’s QMPlus account (connected by scanning ‘Watch’ or student’s device on ‘Workpad’), QMUL’s server and desk’s integrated PC.

Student’s only deals with peripherals of the ecosystem and sensors within each component. Backend processing by servers on data communication allows the student to focus on processing their work with the available devices. E.g., students use their ‘Watch’ to sign-in to a ‘Workspace’, utilises the AR/VR headset controllers to sketch over a CAD project, which is projected by the hologram, then rendered by the integrated PC to be displayed on the monitors and saved on student’s personal device/QMPlus account.

2.3. Information Flow:

The information flow between all components of the system is the third step of DCA. This is the data that is transmitted between the internal and external memory representations, as well as the direction in which it is flowing [24].

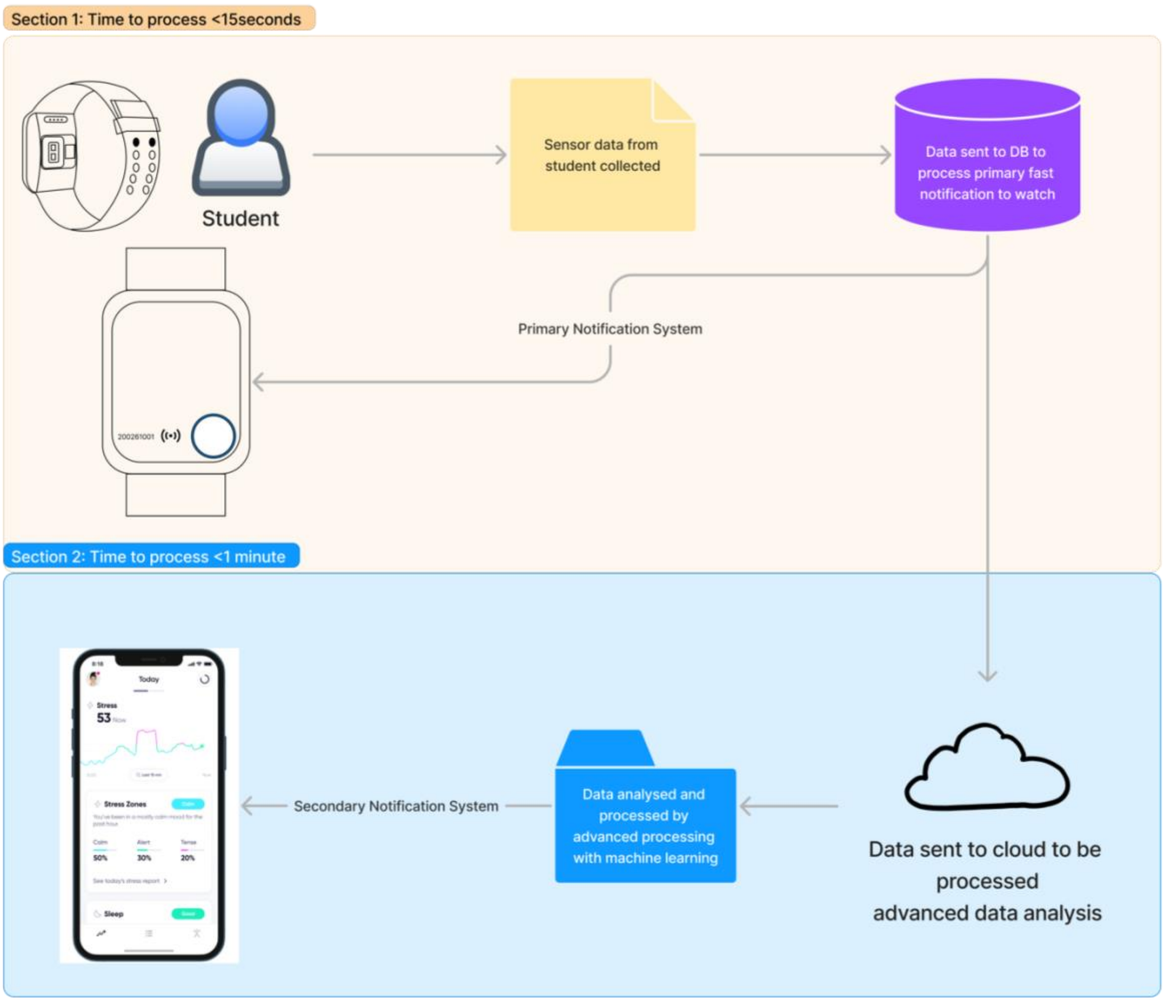

Figure 8.1: Information Flow of Watch System[16]

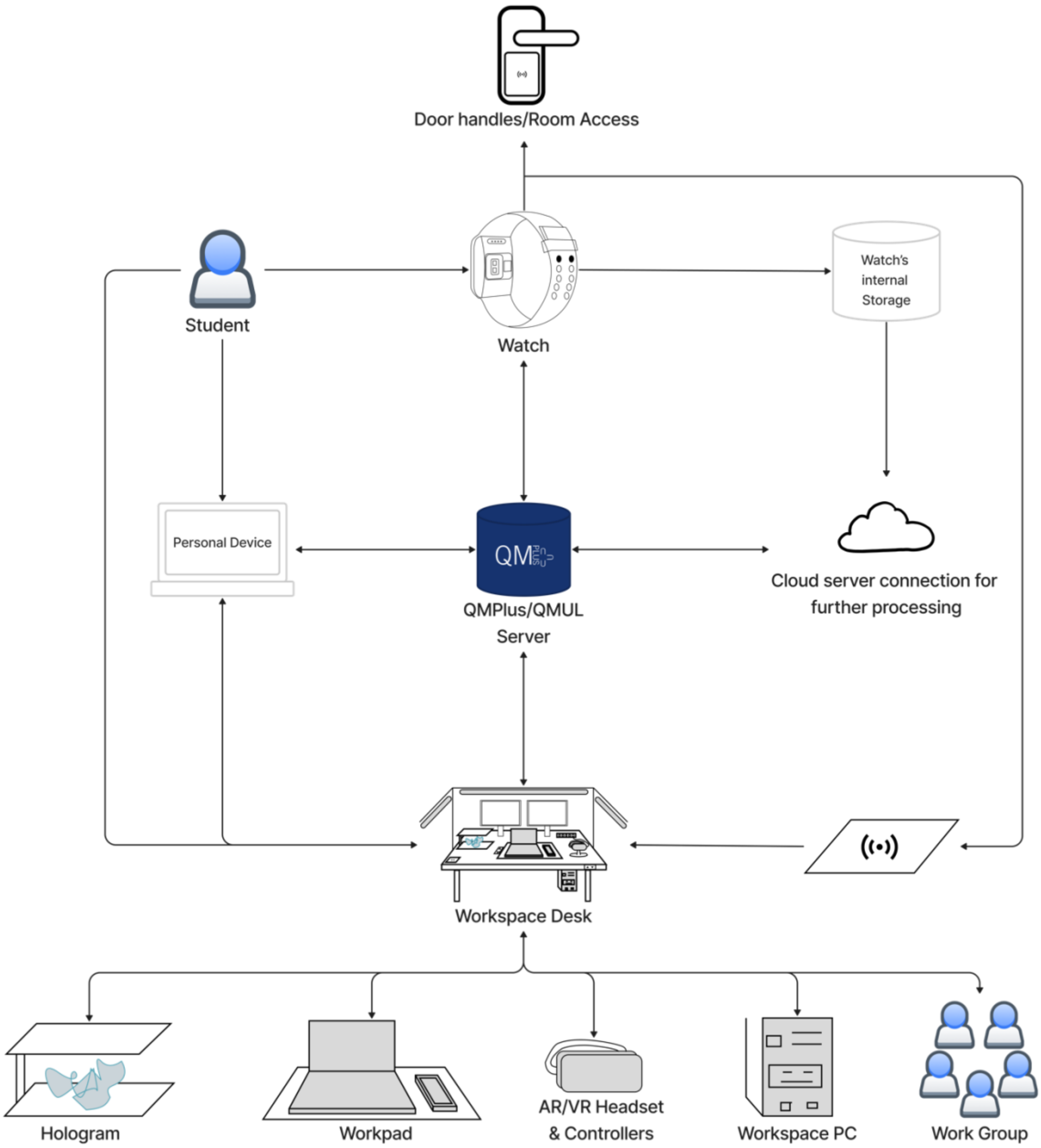

Figure 8.2: Information Flow of QMEsystem

2.4. Activity Theory:

In contrast to DC analysis which analyses unit of analysis, memory representation, and information flow, using Activity Theory will observe tools/subjects/objects participating in the system, as well as the desired output. The DC unit of analysis and AT tools provide similar findings; AT subjects will investigate the sort of users engaged, whereas memory representation will go further into the internal representation of the users involved. Objects from AT will investigate the technologies necessary to attain the desired results, while data from DC will investigate the transfer of data between devices in the system [25]. DC analysis would be more appropriate for QMEcosystem as it suits better for complex systems.

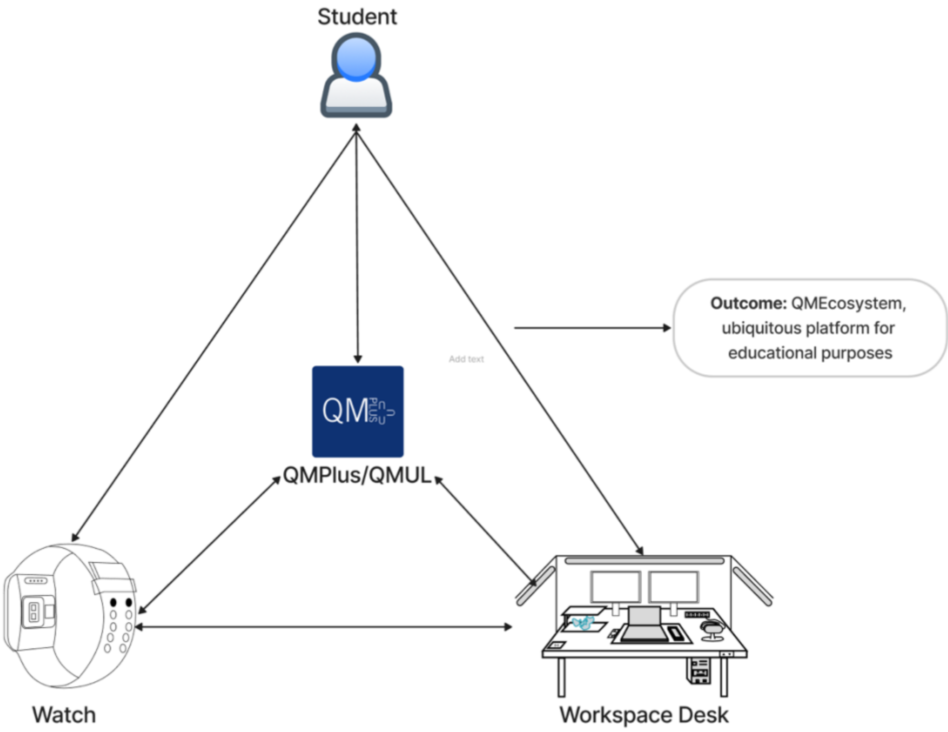

Figure 9.1: Full Activity System

2.5. Advantages/ Disadvantages of System:

This ecosystem of technologies interlinked with student's QMPlus, creates an autonomous educational experience, both for personalising the experience for the students need, but also amplified the way students learn and connect with others to create more in the technological realm.

However, as this would be new for majority of students, training would be required for students to fully grasp the limitless possibilities the combination of this ecosystem has to offer.

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[25] Matthew Purver (Updated by: Corey Ford 2023) *Activity Theory*, Lecture Slides/Notes, User Experience Design ECS661U, Queen Mary University of London (Delivered: 27/03/2023)

Word Count:

Available Word Count Total: 2400 +-10% (=2640)
(Excluding Figures/Diagrams/References)

Available Words for Each Part: 1320

Part 1: 1291

Part 2: 1315

Total: 2606