# *Streaming Technologies and Competence in Live Online Classes During the COVID-19 Pandemic – A Case in Japanese Higher Educational Institutions*

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The IAFOR International Conference on Education in Hawaii 2023
Official Conference Proceedings

**Abstract**
The world was faced with a global viral pandemic forcing individuals and nation-states to change the way society interacts. In 2020, Covid 19 presented fundamental challenges in the way education was conducted in the form of lockdowns and stay home orders. The move from face-to-face classes to an online classroom environment confronted the need for educators to quickly adopt new technologies and expertise to maintain the level and quality of education expected by their institutions. The virtual classroom required a rethink in the way of traditional classroom management styles and pedagogies that was based on physical proximity. Not only were educators required to familiarize themselves with new methodologies but were also expected to be competent and confident enough to provide technical support to a generation of students in Japan completely unfamiliar with computer systems. This study documents the use of streaming technologies and video conferencing applications in combination with Microsoft Teams, and the Office 365 ensemble for live online lessons at a university in Chiba, Japan. It addresses problems faced by educational institutions and instructors when attempting to deliver a quality educational program through the online medium. Furthermore, it provides recommendations for pedagogical and classroom management adjustments while emphasizing the necessity for ongoing instructor competence in information communication technologies (ICT).

Keywords: Competence, ICT, TPACK, PII, Streaming Technologies

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## 1. Introduction

Education has for a long time been using technology to distribute information to an ever-increasing student population of all demographics. Advances in technology has provided a means of distributing knowledge to a number of people while systematically attempting to reduce socio-economic limitations.

In the years leading up to 2020, there had been a shift to embrace both analog and digital technologies in classrooms in what is commonly known as blended learning. In one such definition, blended classes use paper-based texts in combination with digital devices such as tablet computers and laptops (Sharma, 2004). Software components for these devices have expanded as developers increase software availability to be used in the classroom.

In early 2020, covid-19 forced many educational institutions to re-think its approach on delivery mediums and how to continue to provide an established standard of education while charging students full tuition fees. Japan, In particular, was faced with a monumental task as the country was still subscribing to a traditional education and work culture where paper was regarded as proof of work (Aoki, 2010).

## 2. Literature review

Transferring from traditional face to face classes devoid of digital technology to using ICT based classrooms has been an ongoing process in universities around the globe long before the pandemic. Countries like Australia, Malaysia and the US had been slowly developing software and hardware to accommodate for this transition through the use of blended classrooms (Alazam et al., 2012; Caldwell, 2020; Hayes, 2007; Patrick, 2008). As progressive as this seems, instructor motivation in developing practical competence and implementation of these technologies has remained at low to moderate levels (Copriady, 2015).

In Japan, the delivery of education has been done using tested but antiquated technologies, focusing on the more analog aspects of educational technology such at chalk boards, physical print-outs and other paper based mediums. Very little progressions has been seen in regards to ICT professional development, investment and implementation in classrooms across the educational spectrum.(Aoki, 2010; Caldwell, 2020; Miller & Kumar, 2022; Wu et al., 2022) (ref). The covid-19 outbreak highlighted the failure of Japan to facilitate a movement towards ICT and resulted in a struggle to transfer delivery into the digital medium (Yacob et al., 2020).

In 2020, the rate at which the virus spread, decisions were made by governments to quickly contain it by implementing sudden stay home orders in particular, educational institutions. As a result, there was very little time for those unfamiliar with ICT to develop their understanding and use of it as well as a general reluctance to learn and incorporate it into their pedagogical practices (Tallvid, 2016). It resulted in an inadequate online learning system where teachers would set up web cameras in front of chalk boards (Osaki, 2021), overuse asynchronous teaching (Murakami, 2021), use of unofficial email services to manage materials and assessment. (Clark & Silsbee, 2021) and a general confusion as to how courses should be designed and conducted and delivered in an online environment. This, unfortunately, lead to high rates of student dissatisfaction, leading to drops outs, mental anguish and in some cases, litigation against institutions (Hata, 2020; Murakami, 2021; Shoji, 2020; Singh, 2021).

## 2.1 Instructor competence

Instructor competence implies that Instructors are not only experts in their field of knowledge but also in the subsequent delivery methods. Anything less, then their suitability to the chosen career will be put into question.

This concern was outlined by Tucker and Cofsky (1994) in the publication by Sulaiman and Ismail (2020), revealing that competence encapsulates five constituents relevant to both face-to-face and online classes:

1. Knowledge of the subject area being taught
2. Skills of the medium being used to deliver content
3. Self-concept of the individual's philosophy and self-reflection
4. Character in reference to the individual's aptitude in what is being taught
5. Motives and true purpose of their actions

This work by Tucker and Cofsky was further built upon by Koehler and Mishra, (2009). Using the description by Shulman (1987) on pedagogy and content knowledge (PCK) Koehel and Mishara include technology as a medium of delivery and thus creating technology pedagogy and content knowledge (TPACK). Implementing this into an ICT instructor's repertoire would have a positive association on "self-efficacy belief about technology integration into teaching and learning" (Esfijani & Zamani, 2020) and provide an easier transition to an online environment. Further studies indicated that technological, pedagogical and content knowledge (TPAK) was vital for implementing ICT into an instructor's repertoire.

The change in delivery methods highlighting the second competence by Tuker and Cofsky, skills of the medium being used to deliver content, would have an immediate impact on Purposeful Interpersonal Interaction (PII) mentioned by Mehall (2020) to include a technology component relevant to both the design of ICT and online classes. PII is further divided into three types; "Purposeful interpersonal instructional interaction (PIII), purposeful social interaction (PSI) and supportive interaction (SI)."

# 3. Technology, Pedagogy and Content Knowledge (TPACK) and Purposeful Interpersonal Interaction (PII)

## 3.1 Technology, Pedagogy and Content Knowledge (TPACK)

TPACK, described my Koehler and Mishara (2009) is the foundation of instructor knowledge of technology, pedagogy and content knowledge and the relationships between the three.

Technological knowledge, describes the use of technology literacy as an understanding that information technology, depending on its situational use, can either be a hinderance or a functional asset requiring a continuous update in knowledge as new technologies develop. Instructors with this level of awareness can devise alternative methodologies to deliver course content to either maintain pace and ease of understanding or improve its efficacy.

Secondly, pedagogical and content knowledge refers to the instructor's knowledge of content relevant pedagogy. An instructor with this knowledge considers student agency through the student's prior knowledge, and ability. They are then able bespoke material, teaching styles

and classroom management practices to increase teaching effectiveness and students understanding of course content.

In combination, TPACK provides a package for instructor to use in a variety of situations. And becomes a complex system that requires consideration in its application. The use of each component in TPACK can be individually scaled and adjusted in regard to individual instructor skills sets, content curriculum, student abilities, and method of delivery.

### 3.2 Purposeful Interpersonal Interaction (PII)

Purposeful Interpersonal Interaction incorporates a human element to teaching. Described by Mehall (2020), it creates opportunities for social interaction between peers and instructors to develop shared understanding of course content and of each other. Within purposeful interpersonal interaction, are 3 subsets. Purposeful interpersonal instructional interaction, purposeful social interaction, supportive interaction.

Purposeful interpersonal instructional interaction (PIII) is meaningful communication be it verbal or non-verbal between peers and instructor that has a categoric relationship in the learning process. Students should be able to ask question and summarize their understanding in an environment free from ridicule. Relationships of trust organically develop, resulting increased support between course members that enhances the learning experience.

Secondly, in purposeful social interaction (PSI) environments, there exists a social relationship between all members. Such interaction is not forced upon learners such as in discussions and group work. These interactions are spontaneous and arise organically from the course content and human interactions. They are separate from course outcomes but essential for the learning process and student satisfaction.

Finally, supportive interaction (SI) is concerned with avenues of communication during class and outside of class. It is here that the choice of a learning management system (LMS) is important. Students must be provided with support and instructions on how to interact with the user interface. The LMS also provides the necessary channel to which students and instructors can communicate during class and outside of standard class hours that effects the rate at which feedback and supporting assistance is sent and received.

Mehall (2020) then further describes each type within an online environment summarized as;

Purposeful interpersonal instructional interaction

- Prompt feedback and error guidance
- Perceived direct communication between educator and students

Purposeful social interaction

- Immediacy of feed back
- Body language and gestures
- Technical support

Supportive interaction

- Instructional videos about basics of user interface
- Ease of User interface (UI)
- (UI) support
- Tools to assist course content

## 4. Purpose of development

The intent behind the development and subsequent case study of this online learning system was to primarily ground it to the two theories of TPACK and PII and document the hardware and software used in 2020 -2021 at a university in Japan. It presents reasoning behind component arrangements and use and intends to present an example of how to create an online learning environment that closely simulates a traditional student agency focused physical classrooms and Vygotsky's constructivist approach to education. It attempts to map itself to Esfiani and Zamani (2020) tracing of TPAK, and Mehall's (2020), summation of PII.

## 5. Design

Primary design parameters focused on the student's assumed needs and similarities to a traditional face to face classroom. The secondary consideration was instructor useability in relation to ICT competence. These parameters included;

1. A space where students could interact and complete their assignments
2. Interaction both written, verbal and non-verbal with the instructor
3. Logically ordered and purposeful screens for the students
4. Easy to view across all devices
5. Speed and accessibility of system by the instructor to deliver a smooth learning experience

For educators willing to implement new and essential ICT technologies, they will require pedagogical class management adjustments, investigations into suitable online environments suited to their teaching philosophy, hardware requirements and the familiarization of educational software such as MS teams. The main hardware components comprised of an x86 intel generation 6 i7, Nvidia GTX1070 graphics card, four monitors, and various input devices. MS Teams was chosen as the institutions educational software and provided a friendly and easy to use user interface (UI) for students to complete tasks online. This software was designed with digital classroom in mind without a steep learning curve on the part of educators and students alike (Amin et al., 2022; Pratama, 2021; Smolinski et al., 2021).

The virtual classroom was presented using video conferencing software such as Zoom, Webex and streaming software such as Open Broadcast Software (OBS) Air Server Connect and MS paint and Maschine 2.0 were also used as tools to simplify and aid student understanding of course material. The combination of the hardware and software systems allowed educators to take on a more constructionist approach to online classroom environments focusing on the students' abilities and needs (Basilaia, 2020).

## 6. Visual presentation

### 6.1 Scene design

OBS is an opensource software used to streaming content on platforms like YouTube or Twitch. As illustrated in Fig 1.0, it was used to create four content scenes each with its own design characteristics to provide the following user interfaces;

- Activity and exercise area
- Textbook display/PowerPoints
- Textbook display/PowerPoints and activity exercise area
- Internet access/online translators/Word Documents

Scene designed with different device display capabilities were taken into consideration such as traditional laptops and tablet computers. Scenes borders were sourced from copywrite free images and adjusted for multiple device viewing. Each contained a web camera feed of the instructor at the bottom right (F) and an optional closed caption window at the bottom center with the exception of scene 3.

In Figure 1, scene one was the activity and exercise area. Contained within (A) was the MS teams dashboard and student input area. Figure 2, Illustrates scene two which displayed textbook in PDF format editable with the IOS application, I-annotate or PowerPoints via the air server connect iPad mirror application us. Figure 3 shows scene three. It combined the iPad mirror via air server connect, and the activity and exercise area. It was used specifically to model responses to activities and exercises while simultaneously referring to the textbook or PowerPoint slides. Figure 4 marks scene four. I was used as a multipurpose screen to capture the web browser or online translator when further context on the topic required an internet search or translations. A combination of these four primary configurations could also be made and used at the instructor's discretion.


Figure 1: Scene one: (A) MS teams main display area and student input
(B) Instructor Webcam (C) Closed captions


Figure 2. Scene two: (A) iPad mirroring display (B) Instructor Webcam (C) Closed captions


Figure 3. Scene three: (A) MS teams main display area and student input
(B) iPad mirroring display (C) Instructor Webcam


Figure 4. Scene four: (A) Webtools (B) instructor webcam (C) Closed captions

### 6.2 Instructor's monitor organization

Four monitors were used in the design each tasked with managing important elements within the system. Monitors were assigned with a specific task as illustrated in figure 5.

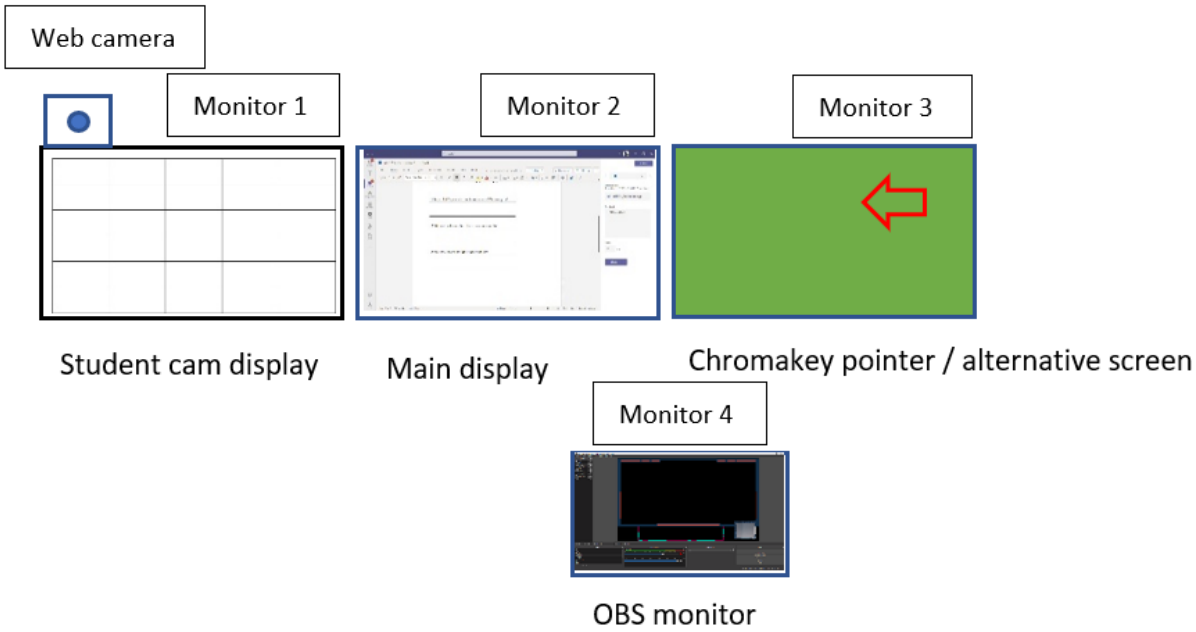


Figure 5: Monitor arrangements of instructor's computer

Monitor one was used to view enrolled students in the Zoom/WebEx session and to display screen content to the students using the "pin to center stage" or spotlight option respectively. The instructor's web camera was placed on top of it. Monitor two served at the main content screen viewable by students. All four OBS scenes were displayed here. Monitor three contained MS paint filled in green chromakey. This mode allowed for a red, movable arrow, to guide students to different parts of what was shown throughout all scenes. It was also used as a space for class notes and a whiteboard, internet access and online translators and displayed through scene four in OBS. Monitor four on the bottom, contained the OBS

program. It displayed which scene was in use and a lineup of other scenes, available digital stamps, and audio channel controller.

### 6.3 Controls and external peripherals

#### Scene control

Scenes were controlled using a Stream Deck by Elgato. The stream deck has 15 customizable LCD keys on each page to enhance workflow (ref). By using programmable keys, the instructor was able to switch between scenes, control necessary executable programs and display digital stamps as a means of student feedback.

### 6.4 iPad camera

The iPad camera allowed the teacher to physically demonstrate program specific keyboard shortcuts. The split screen on OBS layout three in figure 2, provided the environment to see the instructors keyboard and the resultant effects of the shortcut keys on the document. This addressed student software and hardware inquiries and digital competence.

### 6.5 Audio presentation

When lessons required listening activities, MP3 files were sliced into sentences using the music production software Maschine 2.0 and the hardware controller Maschine Mk 2 by Native Instruments. This was especially useful to emphasis particular parts of the wave file contents to repeat certain sections, elicit responses and provide confirmation of answers.

## 7. Student interaction

Before the course started it was suggested that students use two devices if available. Most students used their main computer or tablet computer for the Webex/Zoom virtual classroom to view the contents and visually interact with the instructor. The secondary device, usually a cellular phone, was used to link up with and input work using an installed version of MS Teams application.

## 8. Mapping system design to theory and observations

### 8.1 Technological, pedagogical and content knowledge (TPACK)

#### Technological knowledge

##### *Device limitations*

Device display limitations were considered when visually designing the online environment. Viewable area differences were noticed between IOS and desktop displays. Notably, IOS displays cut about 20% of the viewable area presented in OBS (figure 2- 4).

##### *Audio*

Multiple audio channels were added to OBS using the Virtual Audio Cable plugin. This permitted the use of changing and/or mixing the microphone audio channel with the desktop

audio channel when performing listening activities by splicing audio content or viewing content related AV media.

***Pre-course requirements and troubleshooting***

Students were required to view as pre-course video posted on a dedicated YouTube channel for students to follow. This video contained instruction on downloading, installation and login requirements. During the course, student problems were addressed live using the red chroma key arrow with bilingual verbal instructions.

***Simplicity of user interface***

The learning curve of MS Teams was relatively short. Important sections of the UI were clearly labeled. Students were able to navigate and be task ready in a timely manner. Students could check their individual progress and deadline submissions.

***Closed captions***

These were used during PowerPoint presentations. Closed captions allowed for greater understanding of content through listening reading and image association in the presentations. It also assisted students with hearing difficulties. However, the closed captions were language specific and didn't allow for language code mixing.

**Pedagogical knowledge**

***Student motivation***

Features in MS teams Assignment-document area indicted when students were logged into the assignment and were actively working on the assignment. The instructor was then able to identify if students were having difficulty either logging on to the system or with the content through the activity indicator on the cursor and on top of the menu bar on MS word.

***Positive feedback***

Digital stamps were used to indicate approval for attempts to participate in activities. Content and technical error guidance were addressed neutrally. The instructor repeatedly reminded students that the classroom is a *sandbox* where mistakes are solved and learnt from.

***Equity***

Students with different levels of technology and competence were able to participate in the lesson without fear of falling behind in the course or being negatively subjugated by peers or instructor.

**Content Knowledge**

***Bilingual instructions***

Course instructions, error guidance and corrections were verbally communicated in either Japanese or English depending on the students second language acquisition (SLA) ability.

Written corrections were solely done in English as a model guidance.

***Split screen display***

Split screens were used to guide students and explain the content of the lesson while being able to model answers. iPad projection on the smaller screen contained a PDF of the textbook while the bigger screen contained the student document area to input answers as seen in (figure 2).

***Annotations***

The instructor was able to error check student work by first verbally informing the student that error checking was taking place. Students were able to see which parts need attention though highlighting and verbal instructions and written solutions.

**8.2 Purposeful interpersonal interaction (PII)**

**Purposeful interpersonal instructional interaction**

***Instructor presence***

The instructor was always present, and, in all scenes, web camera was positioned on the bottom left corner of the view able area across all devices (figure 1). This gave the student the psychological assurance that the instructor was present and aware of the student's progress.

***Instructor availability***

MS teams allowed for the installation of a mobile application. Application notifications were set to make the instructor available outside class hours between 8am to 10pm 7days a week. Student concerns were address as soon as possible within the chat feature of the application.

**Purposeful social interaction**

***Addressing students***

Students were addressed on a first name basis at the very offset of the online class. Enrolment and attendance lists were viewable by the instructor via a separate monitor thus personalizing the class environment and increasing trust between instructor and student.

***Simulated direct communication***

The position of the instructor's web camera was important to simulate social protocols. When facing directly to the camera positioned on monitor one, the instructor was addressing either the group or an individual. When facing monitor two, the instructor was focusing on the individual assignment or course content.

***Non-verbal communication***

When students sought the instructor's attention the instructor's name was called accompanied by the physical gesture of raising their hand. Communication from both student and instructor

was performed verbally and non-verbally using universal gestures such as nodding, shaking head, shrugging shoulders, or giving the thumbs up.

**Supportive interaction**

***User Interface (UI) support***

The first week of the course exposed the students to the MS teams User interface. By using the chroma key arrow along with verbal bilingual instructions students were familiarized with the MS teams UI. UI support was available for students throughout the course.

***Use of World Wide Web***

Course content was supplemented using the worldwide web made possible by scene four (figure 4) web searches and translations tools were used to enhance learner understanding of the content.

**9. Student survey**

A survey was administered to students to assess the overall satisfaction of the course. There were 91 respondence with 45.1 percent in second year and 53.8 percent in second year. Most students had access to more than one device either a desktop platform or mobile device. 67 percent used their PC to access the video conferencing software and mobile device for MS Teams interaction while 36.7 percent used their mobile device to access the video conferencing software and PC for teams. Please see appendix for tabulated results.

**9.1 Ease of Use**

This part of the questionnaire related to the learning curve of MS teams.
How easy was it to do the following after 4 weeks into the course?

1. Signing into the system
2. Navigating the system
3. Accessing course material
4. Submitting assignments

Signing into the system 41.8 percent said it was very easy, 41.8 percent easy, and 12 percent easy. Accessing course material, navigating the system, and summitting assignments yielded a majority of easy followed by very easy and slightly easy. This suggest that the time required to become fully accustomed to using the system with assistance from the teacher was within acceptable limits of the course duration of 15weeks.

**9.2 Visual design**

The following was related to the visual design of the online course. When asked about the clarity of text and images, Most respondents answered yes at 87.8 percent while 12.2 percent answered no. Respondents who answered no, may have been due to the screen size of their mobile device if they use it to access the video conferencing software as well as the data transfer rate of their internet service provider.

On the use of multiple screens help to understand assignments more, 99 percent of the respondents agreed that the use of multiple scenes was beneficial to their understanding of the course content. The most used scenes were 1 and 2 (figure 1 and figure 2). These scenes were used to read over the information in the textbook while inputting answers.

### 9.3 Feedback

The main issues with online classes were the issues of timely and meaningful feedback.

MS Teams had the live feedback function built into the software. The following items then unpack some reactions to the live feedback and the students' feelings in terms strengthening personal confidence and establishing a trust relationship between the students and instructor.

The item, did real-time corrections feedback using teams and zoom help you correct mistakes and understand the course? Generated a 46.2 percent strongly agree and 41.8 percent agree response. This marked the importance of providing timely and immediate responses to student course content to increase the efficacy of their learning.

The next item, did real time feedback make you feel comfortable knowing that the professor was always checking and assisting you with your assignments during class? Provided insight into the student's psychological needs and dependance on instructor presence. 47 percent strongly agreed, and 41.1 percent agreed. The visual design of having the instructors webcam viewable at all times and the ability to interact with the students verbally, non-verbally, and written, in real time, reaffirmed the students were in a safe and controlled learning environment where mistakes are accepted, corrected and understood.

The last Item regarding feedback, did real time feedback help create a stronger student teacher relationship, addressed the face-to-face simulation of having the teacher present and establishing a human relationship with the teacher. The pedagogical approach of authoritative constructivism helped to create trust between both parties. Students we comfortable to ask questions and remain on task without the teacher chastising the student with negative commentary. It further elicited impressions from the students that the instructor was competent in the subject area well enough to explain at any stage of understanding.

### 9.4 Instructor ICT competence

The results of instructor ICT competence indicated that there is a direct link to the quality of the course design and approach. With an overall result very good or good knowledge, students felt comfortable knowing that the instructor was skilled in not only the course content but also the technical aspect of the class, alleviating apprehension from the student allowing them to concentrate on learning the course material.

### 9.5 Course satisfaction

Lastly How satisfied are you with the format of the class? Yielded 45.1 percent very satisfied, 46.2 percent satisfied, and 8.8 percent slightly satisfied. The results were overwhelmingly positive however, curriculum design should also be taken into consideration in that it may or may not have confidently included prominent ICT usage by students which could have led to the 8.8 percent slightly satisfied result.

## 10. Limitations

The student survey proved to be a limiting factor in the study. While it did achieve an insight into student satisfaction, A mapping of the survey to TPACK and PII using statistical analysis would have yielded more in-depth insight into the efficacy of the technological and pedagogical approach taken by the instructor. This would have allowed for reductions or additions in future designs to improve its effectiveness as an educational tool and medium of delivery.

## 11. Conclusion

The design of the online class was to demonstrate a more ICT intensive delivery on digital classes during the covid 19 pandemic. It attempted to address student satisfaction and to justify the financial impact of full-fee tuition.

Instructor self-reflection and empathy towards the student was at the heart of the study. By placing oneself in the student's position and then designing a medium with technological pedagogical and content knowledge, it is hoped that it will contribute to the field of ICT and online delivery methods by providing an example of what is possible. By this, professional development initiatives can collaborate using this study as an example to bespoke future online classes through the awareness and importance of ICT, TPACK and PII and train educators both in the present and future to deliver quality education.

**Appendix**

**Ease of use**

| | Very easy | Easy | Slightly easy | Difficult |
|---|---|---|---|---|
| Signing into the system | 41.8 | 41.8 | 12.1 | 4.4 |
| Accessing course material | 35.2 | 42,9 | 22.0 | 0 |
| Navigating the system | 36.7 | 42.2 | 20 | 1.1 |
| Submitting assignments | 39.6 | 39.6 | 15.45 | 5.5 |

**Visual design**

| | Yes | No |
|---|---|---|
| Were all images and text clearly visible? | 87.8 | 12.2 |

| | Strongly agree | Agree | Slightly agree | disagree | Strongly disagree |
|---|---|---|---|---|---|
| Did the use of multiple screens help to understand assignments more? | 31.9 | 54.9 | 12.1 | 1.1 | 0.0 |
| Were the answer sheets for the course easy to type your answer? | 38.5 | 53.8 | 6.6 | 1.1 | 0.0 |

**Feedback**

| | Strongly agree | Agree | Slightly agree | disagree | Strongly disagree |
|---|---|---|---|---|---|
| Did real time correctio feedback using teams and zoom help you to correct mistakes and understand the course? | 46.2 | 41.8 | 11 | 0.0 | 0.0 |
| Did real-time feedback make you feel comfortable knowing that the professor was always checking and assisting you with your assignments during class? | 47.8 | 41.1 | 11.1 | 0.0 | 0.0 |
| Did real-time feedback help create a stronger student teacher relationship? | 40 | 44.4 | 15.6 | 0.0 | 0.0 |

**Instructor ICT Competence**

| | Very good knowledge | Good knowledge | Average knowledge | Poor knowledge | Very poor knowledge |
|---|---|---|---|---|---|
| Do you thing the quality of an online class is related to the computers kills of the professor? | 31.9 | 54.9 | 12.1 | 1.1 | 0.0 |
| How would you rate the professor's computer skills? | 38.5 | 53.8 | 6.6 | 1.1 | 0.0 |

**Student satisfaction**

| | Very good | Good | No difference | Poor | Very poor |
|---|---|---|---|---|---|
| How would you rate this online class compared to other online classes? | 31.9 | 54.9 | 12.1 | 0.0 | 0.0 |

| | Very satisfied | Satisfied | Slightly satisfied | Dissatisfied | Very dissatisfied |
|---|---|---|---|---|---|
| How would you rate the format of this class? | 31.9 | 54.9 | 12.1 | 0.0 | 0.0 |

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