Identifying Issues of Video Conferencing Tools for Teaching and Learning Using the PACT Framework

Siew Eng Ling[1], Margaret Kit Yok Chan[2], Md Saifuddin Khalid[3], Siew Ching Ling[1] and Adeline Engkamat[1]

[1]College of Computing, Informatics and Mathematics, Universiti Teknologi MARA (UiTM), Sarawak Branch, Kota Samarahan, Malaysia

[2]Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA (UiTM), Sarawak Branch, Kota Samarahan, Malaysia

[3]Department of Applied Mathematics and Computer Science, Technical University of Denmark (DTU), Lyngby, Denmark

lingse@uitm.edu.my
drmchan@uitm.edu.my
skhalid@dtu.dk
lingsc@uitm.edu.my
adeline@uitm.edu.my

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Abstract: The usage of video conferencing tools in teaching and learning has become a norm in today's higher educational institutions, recognized across various academic settings. The experience gained by most educators in using video conferencing tools for teaching during the COVID-19 pandemic could be leveraged to enhance these tools. The study aims to capture the current practices and explore the issues of using video conferencing for teaching and learning in Malaysian higher educational institutions. It focuses on three target groups with hands-on experience: academicians, students, and e-learning consultants or information technology (IT) support staff. Interview and focus group protocols were developed based on the four elements of the PACT framework: People (P), Activities (A), Contexts (C), and Technologies (T). Data were gathered through focus group discussions and in-depth interviews with the target groups. There were 24 participants involved in three focus group discussions and 28 participants in individual in-depth interviews. The PACT framework was employed to analyze the data, aiding in understanding the current situation, identifying areas for improvement, and envisioning future scenarios. Qualitative data were transcribed and categorized based on the four PACT elements. The study identified differences in the People element with four scenarios/practices on physical differences, six on psychological differences, three on mental models, and five on social differences. A total of twenty differences were identified under the Activities element, with six on temporal aspects, four each on cooperation, complexity, and safety-critical aspects, and two on the nature of the content. Under the Context element, one scenario/practice was identified for organizational circumstances, five for social circumstances, and three for physical circumstances. In the Technology element, five scenarios/practices were identified: two related to the input part of technologies and one each for the output, communication, and content parts of technologies. From the scenarios/practices of the responses, a total of fifty-two issues related to using video conferencing for teaching and learning were identified. These findings will serve as the basis for ideation in developing innovative video conferencing toolkits for teaching and learning.

Keywords: Video conferencing tools, Teaching and learning, PACT framework, Higher educational institutions

1. Introduction

Video conferencing has opened a new dimension for 21st-century education, enabling teaching and learning to be conducted anywhere in the world, including collaborative activities with other institutions. Video conferencing has become widely used in both business and education, with its usage accelerated during the COVID-19 pandemic (Adipat, 2021; Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021). The high daily usage of these tools for interactions has now become the new normal, extending participants' locations from local to global compared to physical interactions (Adipat, 2021). Popular video conferencing tools include Skype, Webex Meetings, Zoom Meetings, BlueJeans Meetings, Google Meet, Intermedia AnyMeeting, RingCentral Video, GoTo Meeting, ClickMeeting, Microsoft Teams, Zoho Meeting, Slack, MyOwnConference, and Loom. The advancement of video conferencing has flourished alongside the progress of the Internet and technology.

In Malaysia, the most widely used video conferencing tools among educators are Google Meet and Microsoft Teams. Other tools such as Zoom Meetings, Webex Meetings, and Skype are also utilized for teaching and learning. These tools can be accessed via any communication device without time and venue constraints, saving

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both students' and educators travel time for face-to-face meetings (Adipat, 2021). Common features of video conferencing tools include instant group video calls, video recording, screen and file sharing, access to the desktop, and editing during virtual meetings. These features bring teaching and learning closer to a face-to-face environment, enabling both students and educators to achieve their teaching and learning goals.

Research on video conferencing is still limited, and ongoing improvements are needed for video conferencing platforms. The goals of this study are to capture current practices and explore issues related to video conferencing for teaching and learning using the PACT framework (P-People, A-Activities, C-Contexts, and T-Technologies. The findings will serve as the basis for developing innovative video conferencing toolkits for teaching and learning.

2. Video Conferencing Tools for Teaching and Learning

Literature defines video conferencing as real-time interaction using digital tools at any location with an internet connection (Camilleri and Camilleri, 2022; Purnell, 2019; Rop and Bett, 2012). Video conferencing tools are widely used for teaching and learning after the Covid-19 pandemic, as educators can conduct real-time virtual lectures to a broader range of borderless students, facilitate student engagement, monitor their progress, and provide immediate feedback (Camilleri and Camilleri, 2022). Additionally, virtual classes can be recorded or archived, allowing students to catch up with lectures and use them as revision material. Students can access their learning materials uploaded to the video conferencing platform at their convenience time (Camilleri and Camilleri, 2022).

The basic tools used in video conferencing include cameras, microphones, monitors, and mobile devices. Gladović, Deretić and Draskovic (2020) shared some important points about the basic equipment of video conferencing. They emphasized the importance of camera position, quality, and functionality during video conferencing. Additionally, they highlighted the significance of audio quality, noting that a slight delay of 0.5 seconds can cause misalignment between sound and images. Another disclosed point is the importance of lighting and the background of the participants involved in video conferencing.

Video conferencing tools used for teaching and learning have been accepted by students (Bandung, Tanjung, and Subekti, 2017; Sutterlin, 2018) and teachers (Gladović, Deretić and Draskovic, 2020). The tools are also perceived as very helpful for virtual classes by Rio-Chillcce, Jara-Monge, and Andrade-Arenas (2021). There are many reasons for using video conferencing tools as a teaching and learning modality. Literature reveals that video conferencing improves students' academic performance (García and Vidal, 2019; Sufyan, et al., 2020) and is an effective tool for learning (Maher, Moussa and Khalifa, 2020). Students also reported being comfortable with video conferencing tools, and they were motivated in their virtual classes (Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021). Dynamic interaction occurs in the application of video conferencing tools with suitable methodologies and teaching strategies (César et al., 2020). Other advantages of video conferencing tools include overcoming shyness of speech, thus encouraging more opinion contribution (Sufyan, et al., 2020). Gladović, Deretić and Draskovic (2020) highlighted the use of video conferencing in education, which extends teaching beyond textbooks and creates a new way of materials presentation, enabling connections between students and teachers from every part of the world. At the same time, teachers are accelerating the development of strategies that align with the advancement of technology in education.

Besides the unforeseen factor of the COVID-19 pandemic that has accelerated and expanded the usage of these tools, the teaching and learning environment recognizes immense benefits. These include catering to large groups of students (Nainggolan, et al., 2016), extending activities from local to global reach (Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021), addressing the shortage of educators (Marconi, et al., 2018), improving the quality of teaching and learning, solving transportation and distance issues (Wang, Minku and Yao, 2015), and eliminating travel costs (Adipat, 2021; Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021). Additionally, such technology enables synchronous and asynchronous teacher-student and student-student interaction (Ip, 2012), effective communication between educators and students (Al-Samarraie, 2019), and distance collaboration in learning between institutions (Hurst, 2020).

However, issues have been identified in using video conferencing platforms, such as subjects requiring laboratory work (Rahim, et al., 2020), network connection and speed, and self-conscious behavior (Maher, Moussa and Khalifa, 2020). Some educators still face psychological challenges due to the new teaching modality (Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021) and have to attend training on using these new digital tools to overcome psychological issues. Earlier studies also identified background noises and technical issues

that may influence interaction (Gillies, 2008), difficulties in maintaining concentration due to distractions, especially if speakers are not visible to students (Lee, 2007).

Challenges of using video-conferencing tools were reported by a few researchers. According to Ip (2012), the teaching methodology and pedagogy for video conferencing need to be developed, and the syllabi also need to be adjusted to fit the approach. It was also pointed out in the same study that the promotion of intercultural communication competence has its specific teaching methods and tools. Adipat (2021) emphasized that teachers must carefully plan learning sessions, set goals and expectations, as well as examine all conferencing tools that will be used to ensure the effective use of video conferencing as an educational tool.

Al-Samarraie (2019) summarized the use of video conferencing systems based on the learning paradigms: constructivism and cognitivism (p.130), as shown in Table 1.

Table 1: Features supported by video conferencing learning paradigms

Learning paradigms	Features supported by video conferencing
Constructivist	Collaborative learning Problem-solving Interaction and reflection
Cognitivist	Dialogue Competence

The features supported by video conferencing within the constructivist paradigm include collaborative learning, problem-solving, interaction, and reflection. In collaborative learning, students construct knowledge, while lecturers can engage them in various activities to support interpretation in learning problem-solving. The teamwork process is accurately reflected in video conferencing systems, providing information to assist students in reflecting on their responses to learning tasks and the learning environment. According to Al-Samarraie (2019), supportive communication such as sharing, presentation, and file transfers holds pedagogical value, creating external representations of theoretical concepts, evidence, and personal elaborations (p.130).

In the cognitive paradigm, video conferencing contributes by recording additional dialogue activities that facilitate the personal acquisition of information and knowledge. Feedback from the dialogues eases ambiguities, and opportunities to communicate after classes connect students with instructors, promoting knowledge acquisition. Learning materials available on the video conferencing platform give students the opportunity to recall prerequisite knowledge and connect with previously learned materials.

Al-Samarraie (2019) summarized that video conferencing issues from the literature are no longer relevant due to technological advancements, such as the lack of built-in microphones and the restriction of allowing only one person to speak. However, attention is still needed for inconveniences in learning complete knowledge when instructors constantly modify their teaching techniques, background noises, technical issues, and students' difficulties in maintaining concentration (p.132).

Rio-Chillcce, Jara-Monge and Andrade-Arenas (2021) shared their survey results on using video conferencing in the learning process during the pandemic. They reported that most teachers are psychologically and physically ready to use video conferencing tools. Additionally, teachers acknowledged medium stress levels and extended working hours for more than three hours per day. They admitted to fluid and constant communication with students in breakout rooms and felt comfortable with the new delivery method. Similarly, students revealed that video conferencing tools helped them in learning. They agreed that they have medium-high knowledge of video conferencing platforms but believed they needed to continually strengthen their digital knowledge.

3. The PACT Framework

PACT is the acronym for People, Activities, Contexts, and Technologies. This framework employs a human-centered approach, wherein people utilize technologies to engage in activities within specific contexts. The effectiveness, acceptance, productivity, safety, ethics, and sustainability of interactive systems depend on the interplay of these elements in PACT (Benyon, 2014, p.21). Benyon (2014) outlined four advantages of adopting a human-centered approach. The first advantage is the return on investment, emphasizing that considering people's needs and product usability leads to widespread acceptance, making the system more effective and users more productive. The second advantage is product safety. The third is ethics, ensuring truthful and open

design practices in a human-centered environment. The final advantage is sustainability, achieved through enhanced human values and acknowledging human diversity in design.

Moreover, the PACT framework is valuable for both analysis and design activities, aiding in understanding the current situation, identifying areas for improvement, and envisioning future scenarios (Benyon, 2014, p.43).

During PACT analysis, researchers need to explore the potential variations within each element of PACT. This can be accomplished through brainstorming, envisioning techniques, or data collection methods such as observations, interviews, and workshops (Benyon, 2014, p.43). Carroll (2002) emphasized that activities in context require technological support, and changes in technology can alter the nature of activities, as illustrated in Figure 1.

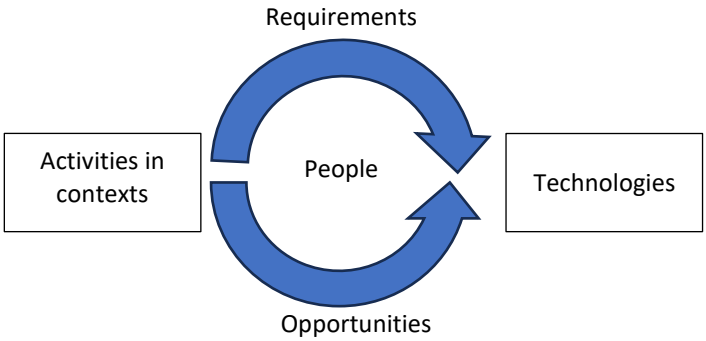

Figure 1: Activities and technologies (Source: Carroll, 2002, Figure 3.1, p.68)

3.1 People

People is the initial element in PACT, and due to the inherent diversity among individuals, Benyon (2005) categorizes People into three main types: Physical differences, Psychological differences, and Usage differences. In an earlier report by Benyon (2014, p.27-33), four types of differences were identified, as outlined in Table 2.

Table 2: Categories of People element

Types	Explanations
Physical differences	Physical characteristics such as height, weight, personalities, cognitive skills, and preferences. This encompasses all variations in the five senses – sight, hearing, touch, smell, and taste.
Psychological differences	Differences in people's physiology, including logical thinking, spatial ability, language, and memory.
Mental models	Mental models denote the understanding and knowledge individuals possess. Those with a robust mental model can perform actions adeptly, while those with a poor mental model may rely on rote actions.
Social differences	Individuals have varying reasons, goals, motivations, and interests in using products. Novices and experts often have distinct requirements, and the requirements for technology differ between homogeneous and heterogeneous groups.

3.2 Activities

Benyon (2014) outlined the primary features of the Activities element, encompassing temporal aspects, cooperation, complexity, safety-critical attributes, and the nature of the content, as summarized in Table 3 (p.33-34). In an earlier case study, Reinius (2011) regarded 'safety-critical' as a subset of safety features.

Table 3: The main features of Activities element

Features	Explanations
Temporal aspects	Temporal aspects cover features of activities such as usage, time pressures, peaks and troughs of working, and response times of the system.
Cooperation	This feature addresses the capacity of activity - whether it involve solitary or group participation. In group activities, considerations include awareness of others, communication, and coordination.

Features	Explanations
Complexity	Complexity involves the level of task definition, categorized as well-defined or vague. Well-defined tasks are more manageable for users, while vague tasks require additional time for exploration due to the need for extra information search before progressing to the next step.
Safety-critical	Certain activities are deemed 'safety-critical,' where any mistake could lead to injury or a serious accident. Hence, planning for potential risks is crucial.
The nature of the content	The nature of the content pertains to considerations of data requirements for activities. For instance, displaying color video necessitates a screen that supports color.

3.3 Contexts

Activities always occur within a specific context. Benyon (2014) categorized the Contexts element into three types: organizational context, social context, and physical circumstances. He defined context as either surrounding an activity or as the features connecting activities into a coherent whole. The three types of contexts are summarized in Table 4 (Benyon, 2014, p.34-35; Benyon, 2005 as cited in Reinius, 2011, p.19).

Table 4: The main features of Contexts element

Types	Explanations
Organizational	Organizational context pertains to the work environment, encompassing different locations, timings, and the impact of technology on communication and work practices within an organization (Benyon, 2005 as cited in Reinius, 2021, p.19).
Social	Social context involves the surroundings of the activity. A supportive environment aids individuals in the activity and addresses privacy concerns. Assistance may include training manuals, tutorials, or access to experts when individuals encounter problems.
Physical circumstances	The physical environment refers to the actual location where the activity occurs, including natural aspects such as weather and ambient sounds.

3.4 Technologies

Technologies represent the final element of the PACT framework, serving as the medium for interactive systems where various tasks can be executed with data or information. The Technologies element is categorized into four parts: input, output, communication, and content, as summarized in Table 5 (Benyon, 2014, p.36-43; Benyon 2005 as cited in Reinius, 2011, p.19).

Table 5: The main features of Technologies element

Parts	Explanations
Input	Input devices determine how people securely and safely input data and instructions into a system. Examples of data input include text, barcodes, voice, QR codes, touchscreens, and augmented-reality fiducial markers. Input devices include switches, buttons, trackballs, joysticks, data gloves, fingers, stylus pens, mice, speech, and various sensors (air pressure sensor, acoustic sensor, vibration detector, infrared motion, and accelerometer).
Output	Display technologies consider human perceptual abilities such as vision, hearing, and touch. Common visual output devices include screens or monitors driven by graphics cards. Speech output, as seen in satellite navigation systems, is also prevalent. Printers produce text or illustrations on paper, and haptics provide a sense of touch, allowing direct and immediate interaction with devices and media.
Communication	Communication in technologies refers to how people interact with devices, encompassing aspects like bandwidth, speed, and how the system communicates back to users. Communication can occur through wired or wireless means.
Content	Content relates to the form of data within the system, emphasizing the need for it to be up-to-date, accurate, and presented effectively.

4. Methodology

The study employed an exploratory method to delve into the current practices of utilizing video conferencing (VC) tools in teaching and learning, along with the didactics involving other tools for educational purposes. Three distinct target groups (TG) from Malaysian Higher Learning Institutions were involved in the research: TG 1 comprised academicians or researchers, TG 2 consisted of e-learning consultants and IT support staff, and TG 3 included students from higher learning institutions. All target groups possessed hands-on experience in video conferencing for teaching and learning.

Data were collected through focus group discussions and in-depth interviews with the specified target groups from higher learning institutions in Malaysia. There were 24 participants involved in the three focus group discussions and another 28 in individual in-depth interviews. Among them, 5 were e-learning consultants or IT support staff, 21 were university students, and 26 were academicians or researchers. The interview protocol was developed based on the four elements of the PACT framework: People, Activities, Contexts, and Technologies (Benyon, 2019). An investigative and explorative approach using the PACT framework was employed to comprehend the PACT dimensions within the three target groups.

The PACT framework served as a guide for data analysis. Transcribed data were categorized into four major elements: People, Activity, Context, and Technology. The presentation of the data was organized according to the three target groups of the study. The PACT analysis was employed as the framework to discern the existing scenarios and practices of video conferencing systems in teaching and learning. It aimed to identify current issues with the system and gather suggestions for enhancing video conferencing tools in future teaching and learning. The framework structured the analysis to understand the interactions between People, Activities, Contexts, and Technologies within the user interface. The study explored the potential variations in people, activities, contexts, and technologies in the current scenarios and practices of video conferencing systems in teaching and learning, including didactics involving other tools, through brainstorming and envisioning techniques.

5. Findings and Discussions

The study's findings were analyzed based on the PACT elements, segmented into three target groups.

5.1 People

The findings concerning People are categorized into four types, as outlined in Table 6. In terms of physical differences, the study identified variations in speaking and hearing abilities. Participants exhibited differences in voice characteristics, speech volume, and accents, prompting adjustments to device speaker volumes to ensure clear communication during video conferencing. Sensitivities to surrounding noise also differed among participants, with some students facing challenges in prolonged engagement due to noise disruptions in their environments. This aligns with Al-Samarraie's (2019) summary, where background noise was identified as an issue in video conferencing.

Diverse psychological aspects among individuals were observed, reflecting differences in intelligence and language abilities. Language barriers were evident among some participants, while others displayed a mix of active and passive involvement during video conferencing. Technical skills emerged as a primary factor influencing video conferencing tool usage, ranging from novice to tech-savvy. Varied levels of technical skills impacted technology control and usage, limiting lecturers in conducting constructivist instruction. Consequently, many lecturers preferred direct instruction over constructivist approaches due to these technological skill limitations. Some students highlighted challenges in maintaining self-discipline for self-learning.

The study identified diverse mental models among participants. While most could perform actions by rote, a smaller percentage demonstrated the ability to simplify complex solutions and apply them to relevant fields, indicating a strong mental model.

The social differences among the participants are evident in the motivation to use video conferencing tools for teaching and learning. Not all educators are motivated to shift their delivery platform from face-to-face to video conferencing. For those motivated educators, their enthusiasm and commitment to teaching vary compared to those who had no choice but to transition to video conferencing platforms, especially during the COVID-19 pandemic. This highlights the heterogeneous nature of educators in using video conferencing platforms. Conversely, students form a more homogenous group, sharing similar age ranges, backgrounds, and belonging to the same faculty.

Table 6: Summary of People differences

Category	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
Physical differences	Educators	• Difficulty in capturing students' soft-spoken responses and different accents. • Duration of concentration varies among students.	• Variations in speech volume and ascent due to individual traits and cultural background. • Lack of pedagogical skills to engage students in online learning.
	Students	• Disturbance in concentration from surrounding.	

Category	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
		• Individual sensitivity towards educators' voice pitch.	• Lack of conducive learning environment at home. • Lack manpower to support concurrent lectures.
	Technician	• Difficulty in assisting technical adjustment of the volume and pitch.	
Psychological differences	Educators	• Language barrier, and shyness of students to speak. • Difficulty in handling mixed active and passive learners • Resistant to change from lecture centred to students centred. • Difficulty in adopting constructivist instructions.	• Language barrier due to the mode of language practice. • Heterogenous type of learners. • Shyness due to a lack of confidence. • Educators lack pedagogical skills for video conferencing classes. • No streaming of students based on their individual learning ability. • Students lack self-discipline in online classes.
	Students	• Different levels of ability to pick up points of discussion. • Difficulty in establishing self-learning discipline environment.	
	Technician	-	
Mental models	Educators	• Inability of students to simplify complex solutions and apply them in the relevant field. • Difficulty in handling multilevel intelligences of students.	• Lack of higher-order thinking skills. • Lack of online pedagogical knowledge. • Lack of clear instructions for online learning.
	Students	• Different levels of understanding in following instructions.	
	Technician	-	
Social differences (Rio-Chillcce, Jara-Monge and Andrade-Arenas, 2021)	Educators	• Resistant to change the delivery method from face-to-face to online. • Novice in using online platforms to teach. • Different levels of technological skills to operate video conferencing tools. • Different levels of students' motivation to learn via the video conferencing platform.	• Lack of technical skills in online teaching and learning. • Preference of educators in mode of delivery. • Insufficient technical training for educators. • Lack of students' motivation to learn via online platform. • Lack of manpower and facilities to support the technical needs of the educators.
	Students	• Different levels of technological skills affect their usage of video conferencing tools. • Different motivation levels to learn via the video conferencing platform. • Different technological levels skills of lecturers.	
	Technician	• Insufficient manpower and facilities to support the technical needs of the educators.	

5.2 Activities

The findings of the Activities element are presented based on the five main features (Table 7): temporal aspects, cooperation, complexity, safety-critical, and the nature of the content (Benyon, 2014).

In the temporal aspects, the most common activities in video conferencing, as shared by respondents, include live lessons, discussions, sharing of resources (notes, tutorials), and teaching videos. One common problem was Internet speed, leading to interruptions in live classes and difficulties uploading long recorded videos. Some respondents lived in areas with poor Internet access, causing issues with activities requiring downloading, uploading, and online video watching. Assessment activities, such as quizzes and tests, were also conducted via video conferencing platforms. Lecturers noted the difficulty of invigilating students' tests and monitoring attendance in online classes through video conferencing platforms.

Individual and group tasks were conducted, but due to the limitations of skills on video conferencing tools, some respondents from TG1 mentioned not engaging in the cooperation feature as they lacked the necessary skills. In cases of group tasks, the issue was how to keep all students active all the time in group activities.

There were implications that students attending video conferencing classes preferred well-defined tasks compared to vague tasks, as stated in the Complexity feature. Educators assigned more well-defined individual tasks, while group tasks were considered vague.

Regarding the Safety-critical feature, lecturers raised concerns about assessment procedures and the confidentiality of questions. Due to limited Internet access, many students could not turn on their cameras during online assessments. Students admitted that they could easily copy from each other during online assessments. Technical staff shared that limited use of breakout rooms and frequent interruptions in uploading long videos hindered the proper supervision of assessments. They also pointed out that students' limited data subscriptions hindered the proper supervision of assessments.

Nature of content features for video conferencing classes included text, slides, and videos with colours supported by the video conferencing platform. There was congruence between TG1 and TG2 that natural content features were provided. Respondents from TG3 revealed that most tools, such as smartphones, tablets, and laptops, could support the content. The issues raised were the high cost of purchasing multiple applications to support the teaching and learning process, and the technical skills to handle multiple types of files.

Table 7: Summary of Activities differences

Features	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
Temporal aspects	Educators	• Time pressure to upload all teaching materials, tutorials, and quizzes on a weekly basis. • Difficulty uploading big data files such as pre-recorded video lessons. • Students' login and leave the online class physically but maintain the login in the platform.	• Longer time taken in preparing and uploading teaching materials. • Limited space and period to store recorded video in the platform. • Difficulty in tracing students' presence and engagement. • Longer hours for learning. • Unstable Internet connectivity and accessibility. • Lack of financial support in data subscription.
	Students	• Use daytime to attend online classes and night-time for revision, discussion, and tutorial. • Time taken to download recorded lessons. • Problem in downloading study materials.	
	Technician	• Frequent interruptions in uploading long video of more than 20 minutes.	
Cooperation	Educators	• Difficulty in keeping students active for individual and group tasks. • Difficulty in conducting segregated group activities.	• Lack of skills to use online engaging tools. • Lack of adoption of online engaging tools. • Limited knowledge of using breakout rooms. • Lack of demand for technical support.
	Students	• No motivation and interest in participating group activities. • Most of the tasks are individual tasks. Live group task difficult to carry out as many lecturers not using the breakout room feature for group discussion.	
	Technician	• Underutilization of breakout room feature.	
Complexity	Educators	• Instruction of tasks assigned not clear. • Preferred individual tasks as not familiar to the features of conducting group activities.	• Lack of well-defined individual or group tasks to ease students' self-learning. • Lack of technical skills in conducting group activities. • Lack of commitment in group activities. • Lack of skills to engage students in group activities.
	Students	• Not all members actively participate in group assignments. • Prefer to discuss physically in group assignment so that all members can concentrate in the work. Online group discussion has too many distractors.	
	Technician	-	
Safety-critical	Educators	• Difficulty in invigilating assessment online. • Possible assessment paper leak.	• Lack of standard procedures in conducting assessment. • Confidentiality of assessment questions.
	Students	• Avoid turning on the camera due to limited data subscriptions.	

Features	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
		• Copying from one to another always happen during assessments. • Access to Internet source during assessment.	• Limited data subscription hindered the proper supervision of assessments. • Risk of plagiarism.
	Technician	• Unable to turn on video camera through the assessment duration.	
The nature of the content	Educators	• Needs of preparing various types of files (Example: doc. Pdf, AVI, MP4) for teaching and learning (Note, tutorial, assignment and assessment).	• Lack of skills to use different types of files. • Limited budget to subscribe multiple applications for teaching and learning.
	Students	• Needs of installing and purchasing applications to read or run various type of files.	
	Technician	• Not all applications proposed subscribe by the university.	

5.3 Contexts

The third element of PACT is Contexts. The findings of Contexts are presented based on the types of contexts: organizational context, social context, and physical circumstances (Table 8).

The organizational context is defined by the features of video conferencing tools, allowing participants to attend or conduct classes without location limitations. Recorded online classes and videos enable students to learn at their own pace and time. While TG1 appeared unaware of guidelines, TG3 revealed a university policy allowing flexibility in venue and learning time.

Findings related to the social context can be identified in two aspects: instruction on technical and privacy issues. Most technical issues for learning were addressed by uploading pre-recorded videos explaining procedures. Despite encouraging students to share on video conferencing platforms, there is a need for heightened awareness of privacy issues, as suggested by TG3.

In the third context, which is related to physical circumstances, video conferencing classes could be conducted by TG1, and TG2 would attend from any convenient location with internet access. Respondents expressed concern about noisy environments disrupting classes and causing distractions. TG3 suggested that this issue could be resolved if the platform could use Artificial Intelligence (AI) technology to reduce surrounding noises and only pick up related voices.

Table 8: Summary of types of Contexts

Types	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
Organizational	Educators	• University do not have guideline for conducting video conferencing classes adherence to course structure/ subject syllabus.	• No standard guidelines and policies for video conferencing classes at university level.
	Students	• No consistent guideline for video conferencing classes.	
	Technician	-	
Social	Educators	• Prepare instruction as note or short demonstration video prior to conduct activities. • Not active in knowledge-sharing.	• Lack of well-defined instructions for activities. • Lack of knowledge-sharing culture. • Lack of knowledge and awareness on digital and web security. • Lack of 24/7 help desk. • Lack of content monitoring team.
	Students	• Time taken to understand activity's instruction in digital form prior to start activity. • Share any think they like. • Live question not available all time.	
	Technician	• No monitoring team on the content shared.	
Physical circumstances	Educators	• Conduct class at different locations such as at home, office, lecture room. • Attending classes in a noisy environment of some students	• No guideline on venue environment. • Disturbance of noises from various environments of attendees.

Types	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
		and the unwanted voices disturbs the class.	• Lack of artificial intelligent equipment.
	Students	• Attend online classes anywhere with internet access.	
	Technician	• Encourage to use artificial intelligent microphone to conduct or attend classes at a noisy environment.	

5.4 Technologies

The findings of Technologies element are presented in four parts: input, output, communication, and content (Table 9). Respondents only used simple devices for input, such as a stylus pen, smartphone, computer/laptop/tablet, headset (speaker and microphone), webcam, selfie ring light, touchpad, writing pad, and Wi-Fi booster. Not all devices could be used, as revealed by TG3. On the other hand, output devices used by the respondents could support the uploading of materials, and the haptic feature in most devices eased the output process. The output devices used by the respondents included computer/laptop/tablet, speakers and an additional monitor, and a printer. TG3 revealed that vision and hearing human perceptual devices were mostly used, as lecturers had no ability to use touch perceptual.

For communication in technologies, limited bandwidth hindered video conferencing classes in interior areas. While urban and suburban areas could communicate with access to 3G or 4G, they always encountered interruptions due to the service provider. Rural areas have better communication technologies; hence, they could communicate well in video conferencing classes. In terms of the content parts of technologies, participants from all target groups consensually agreed that video conferencing effectively presented the content in a good manner.

Table 9: Summary of parts of Technologies

Parts	Respondent's category	Scenarios / Practices of the response	Issues of using video conferencing tool
Input	Educators	• Only a few devices use for input such as writing pad and stylus pen, laptop or tablet, headset.	• Lack of multiple devices for input. • Stability of input devices.
	Students	• Commonly use input devices such as Smart phone, computer /laptop/tablet, headset.	
	Technician	• Provision of unavailable input devices.	
Output	Educators	• Use of conventional visual output devices. • All devices support the files and videos uploaded, and the haptic technology used in the devices makes the output more convenient.	• Lack of video conferencing toolkit with haptic technology.
	Students	• No advanced technological devices such as artificial intelligences devices but conventional visual output devices used by lecturers.	
	Technician	• Provision of unavailable output devices.	
Communication	Educators	• Frequent disconnected from live communication.	• Unstable Wi-Fi access and connectivity.
	Students	• Frequent disconnected from internet especially in rural areas and during rainy days.	
	Technician	• Upgraded internet connectivity system and speed. • More frequent check on modem and router.	
Content	Educators	• Difficulty in keeping up to date video conferencing system and the supported application.	• Extra budget to keep all application and system up to date.
	Students	• Affordability to update all applications use for video conferencing classes.	
	Technician	-	

6. Conclusion

The virtualization of education in the new normal is in a transition stage to meet the primary goals of both educators (TG1) and students (TG2), with support from IT experts (TG3). Assessing video conferencing tools for teaching and learning using the PACT framework has captured the issues of using video conferencing tools and the shortfalls of the ability of both educators and students to capitalize on the availability of video conferencing tools in education. In general, concentration is the distraction caused by unconducive environments and lack of engagement of TG1, and TG2. Currently, video conferencing tools are limited to individual tasks, as most educators have not embraced group tasks with widely dispersed groups in breakout rooms.

It has been recognized that the adoption of video conferencing tools has been associated with immense benefits for both educators and students in terms of flexibility of time and venue. The engagement of video conferencing tools by TG1, identified as being very personalized, facilitative, and responsive to available technology in institutions is limited by technological skills. TG2 is very adaptive but constrained by internet accessibility and available devices. Additional limitations experienced by TG2 were attributed to video conferencing tools' communication skills and low auditory recognition memory performance. TG3 highlighted that the competencies of TG1 need to be upskilled, particularly in group tasks, in their ability to operate video conferencing tools as an educational tool. They added that more advanced technological devices need to be acquired for incorporation into teaching and learning processes. These findings can serve as the basis for ideation in developing innovative video conferencing toolkits for teaching and learning. The findings can also serve as innovative ideas for video conferencing platforms developers to improve the functionality of the platforms.

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References

Adipat, S., 2021. Why Web-Conferencing Matters: Rescuing Education in the Time of COVID-19 Pandemic Crisis [Mini Review]. *Frontiers in Education* (Al-Samarraie, 2019), pp.752522. https://doi.org/10.3389/feduc.2021.752522.

Al-Samarraie, H., 2019. A Scoping Review of Videoconferencing Systems in Higher Education: Learning Paradigms, Opportunities, and Challenges. *International Review of Research in Open and Distance Learning,* 20(3). https://doi.org/10.19173/irrodl.v20i4.4037.

Bandung, Y., Tanjung, D. and Subekti, L. B., 2017, November. Design of mLearning application with videoconference system for higher education. *2017 6th International Conference on Electrical Engineering and Informatics (ICEEI),* (pp.1-6). Langkawi, Malaysia, 25-27 November 2017. Malaysia: IEEE.

Benyon, D., 2014. *Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design*. 3rd ed. Pearson Education Limited.

Benyon, D., 2019. *Designing user experience: A guide to HCL, UX an interaction design.* 4th ed. Pearson.

Camilleri, M. A. and Camilleri, A., 2022. Remote learning via video conferencing technologies: Implications for research and practice. *Technology in Society,* 68, pp.101881. https://doi.org/10.1016/j.techsoc.2022.101881.

Carroll, J. M., 2002. *HCI in the New Millennium*. Addison-Wesley.

César, J. S., Elar, R. G., Jhonathan, T. E., Anthony, T. A., Gary, V. R. and Laberiano, A. A., 2020, October. Analysis of the use of technological tools in the e-learning process. *2020 IEEE ANDESCON,* pp.1-6.

García, A. and Vidal, E., 2019, November. Mobile-Learning Experience as Support for Improving the Capabilities of the English Area for Engineering Students. *2019 International Conference on Virtual Reality and Visualization (ICVRV),* pp.202-204. Hong Kong, China, 18-19 November 2019. China: IEEE.

Gillies, D., 2008. Student Perspectives on Videoconferencing in Teacher Education at a Distance. *Distance Education,* [e-journal] 29(1), pp.107-118. https://doi.org/10.1080/01587910802004878.

Gladović, P., Deretić, N. and Draskovic, D., 2020. Video Conferencing and its Application in Education. *Journal of Traffic and Transport Theory and Practice,* 5(1). https://doi.org/10.7251/JTTTP2001045G.

Hurst, E. J., 2020. Web Conferencing and Collaboration Tools and Trends. *Journal of Hospital Librarianship,* 20(3), pp.266-279. https://doi.org/10.1080/15323269.2020.1780079.

Ip, W.H., 2012, November. Video Conferencing: Advantages and Limitations in Teaching Intercultural Communication in Foreign Language Education. *International Conference ICT for Language Learning,* Florence, Italy, 15-16 November 2012. Italy: Libreriauniversitaria.it.

Lee, L., 2007. Fostering second language oral communication through constructivist interaction in desktop videoconferencing. *Foreign Language Annals*, 40(4), pp.635-649.

Maher, Y., Moussa, S. M. and Khalifa, M. E., 2020. Learners on Focus: Visualizing Analytics Through an Integrated Model for Learning Analytics in Adaptive Gamified E-Learning. *IEEE Access*, 8, pp.197597-197616. https://doi.org/10.1109/ACCESS.2020.3034284.

Marconi, C., Brovetto, C., Mendez, I. and Perera, M., 2018, October. Learning through Videoconference. Research on Teaching Quality. *2018 XIII Latin American Conference on Learning Technologies (LACLO),* pp.37-40. Sao Paulo, Brazil, 01-05 October 2018. Brazil: IEEE.

Nainggolan, J., Christian, G., Adari, K., Bandung, Y., Mutijarsa, K. and Subekti, L.B., 2016, October. Design and implementation of virtual class box 5.0 for distance learning in rural areas. *2016 8th International Conference on Information Technology and Electrical Engineering (ICITEE),* pp.1-6. Yogyakarta, Indonesia, 05-06 October 2016. Indonesia:IEEE.

Purnell, D. J., 2019. *Video Conferencing in Early Childhood Education: Teachers' Perspectives*. Med. Auckland University of Technology. Available at <https://openrepository.aut.ac.nz/items/08a55619-3fee-4665-ad64-0008ea7d744b> [Accessed 20.07.2023].

Rahim, E. E. A., Daud, N., Kadir, S. A. A. and Jamil, N. W., 2020, November. Students' perceptions of Open and Distance Learning (ODL) for theoretical and lab-related subjects. 2*020 IEEE Conference on e-Learning, e-Management and e-Services (IC3e),* pp.29-32. Kota Kinabalu, Malaysia, 17-19 November 2020. Malaysia:IEEE.

Reinius, J., 2011. *The PACT Analysis Framework: A case study of 1177.se.* MSc. Blekinge Institute of Technology. Available at < urn:nbn:se:bth-3361> [Accessed 20.07.2023].

Rio-Chillcce, A., Jara-Monge, L. and Andrade-Arenas, L., 2021. Analysis of the Use of Videoconferencing in the Learning Process During the Pandemic at a University in Lima. *International Journal of Advanced Computer Science and Applications,* 12(5). https://doi.org/10.14569/IJACSA.2021.01205102.

Rop, K.V. and Bett, N.K., 2012, June. Video conferencing and its application in distance learning. *Annual Interdisciplinary Conference, The Catholic University of Eastern Africa, Nairobi Kenya (Vol. 1).*

Sufyan, A., Hidayat, D. N., Lubis, A., Kultsum, U., Defianty, M. and Suralaga, F., 2020, October. Implementation of E-Learning During a Pandemic: Potentials and Challenges. *2020 8th International Conference on Cyber and IT Service Management (CITSM).* Pangkal, Indonesia, October 23-24, 2020. Indonesia: IEEE.

Sutterlin, J., 2018. Learning is Social with Zoom Video Conferencing in your Classroom. *eLearn, 2018(12)*. https://doi.org/10.1145/3302261.3236697.

Wang, S., Minku, L. L. and Yao, X., 2015. Resampling-Based Ensemble Methods for Online Class Imbalance Learning. *IEEE Transactions on Knowledge and Data Engineering,* 27(5), pp.1356-1368. https://doi.org/10.1109/TKDE.2014.2345380.

