

EdViCon



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**Portable Video Conferencing Toolkits and Online
Applications for Engaging Learning Experience Design in
Higher Education Classroom**

Educational Video Conferencing Toolkits: Bridging the Distance in Education

Innovative Tools for Hybrid and Online Teaching in Different Countries

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EdViCon Toolkits

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A. Introduction: Bridging the Distance in Education

The global landscape of education has undergone a seismic shift. The rise of hybrid and online learning, accelerated by recent global events, demands innovative solutions to ensure seamless and engaging learning experiences, regardless of physical location. This book delves into the crucial role of technology in facilitating effective hybrid and online teaching, focusing on the development and implementation of portable video conferencing (VC) toolkits in the ERASMUS+ EdViCon project.

B. The EdViCon Project: A Collaborative Effort

The EdViCon project is a collaborative initiative involving seven prominent universities across the Europe and Asia and two organisations: a non-government organisation and a small and medium enterprise in software. Each institution, facing unique challenges and opportunities in its local context, contributed its expertise to a comprehensive investigation into effective VC toolkit design. The project's collaborative nature yielded a rich tapestry of insights, best practices, and innovative approaches, all documented to explore the methodologies to be used, the data collected, and the overall collaborative process.

C. Addressing the Challenges of Hybrid and Online Learning

Traditional classroom teaching models often fall short in the hybrid and online environment. The challenges are multifaceted, encompassing technological hurdles (unreliable internet, compatibility issues, etc.), pedagogical concerns (engaging online students, maintaining interaction, assessing learning outcomes), and organizational difficulties (resource allocation, access to equipment, training). These challenges are systematically addressed, offering practical solutions and guidance.

D. The Focus on Portable VC Toolkits

The EdViCon project centred on the creation of portable VC toolkits, designed to be adaptable and easily deployable across various learning settings. These toolkits are not merely a collection of equipment, but a carefully curated selection of hardware and software components. Their designs are informed by rigorous analysis of pain points identified through extensive data collection and collaborative brainstorming sessions among researchers and educators across diverse contexts.

E. Key Themes Explored

The key themes explored arising from the EdViCon project, provide a comprehensive guide to creating and implementing effective portable VC toolkits. The core themes covered should include:

- **Scenario Analysis:** Identifying and analysing various learning scenarios, from traditional classrooms to dedicated labs and home environments.
- **Parameter Definition:** Defining crucial parameters for selecting effective hardware and software, focusing on pedagogical effectiveness and technological feasibility.
- **Toolkit Design and Implementation:** Detailed descriptions of the toolkits developed by each university, showcasing the reasoning behind the chosen components.
- **Best Practices and Recommendations:** Offering evidence-based recommendations on the most suitable equipment and software, based on extensive testing and user feedback.

- **Case Studies:** Presenting case studies from each participating university, illustrating the unique challenges and successful implementations within varied contexts.

F. Purpose

This book serves as an invaluable resource for educators, instructional designers, and technology specialists involved in hybrid and online learning. It provides practical guidance and actionable insights to support efforts in bridging the distance in education whether it is to design new learning environments, improving existing ones, or seeking to enhance teaching practices through the effective use of technology.

Chapter One: DTU EdViCon Toolkits

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1.1 Introduction

This report is made by the Technical University of Denmark (DTU) which is one of the seven universities of the EdViCon project. This report delineates the developmental process of two video conferencing toolkits within the framework of the Edvicon project. Prior to the procurement of these toolkits, a discernment procedure was undertaken, grounded in the analysis of data obtained from DTU Compute (Department of Computer Science). Additionally, it was imperative to consider criteria such as portability, lightweight design, cost-effectiveness, and lendability for both toolkits. Conducting a comprehensive study to aim at the selection of video conferencing (VC) toolkits, the chosen toolkits are delineated as follows:

1. Toolkit One: Hybrid (face2face+online students): Laboratories/Traditional Classroom
2. Toolkit Two: Online (no face2face student): Home/Other

1.2 Scenarios

Khalid, Tretow-Fish, and Mahmuda (2023) synthesized the VCS use at DTU into five scenarios:

- . Galleries/auditorium
- a. Studios
- b. Traditional classroom
- c. Laboratories
- d. Teacher's office table
- e. Meeting rooms



Fig. 1. Auditorium - signature pedagogy (a)



Fig. 2. Studio - signature pedagogy of (b)



Fig. 3. Traditional class - signature pedagogy (c)



Fig. 4. VCS-mediated *supervision* & can simulate signature pedagogies (a, b, c & f)



Fig. 5. Laboratory cum traditional classroom - Signature pedagogy (d)



Fig. 6. Dedicated Laboratory - Signature pedagogy (e)

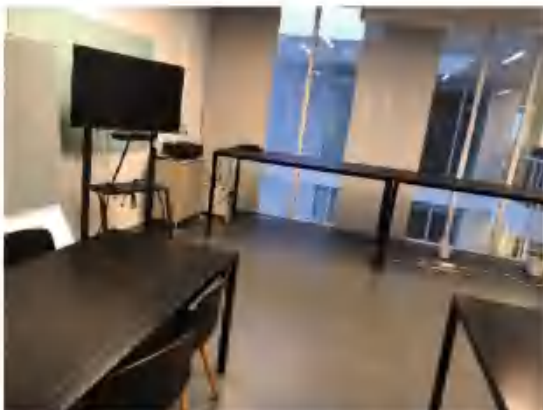


Fig. 7. VC system setup for a meeting room at DTU corresponding to the signature pedagogy of (g) for a mobile or portable setup.

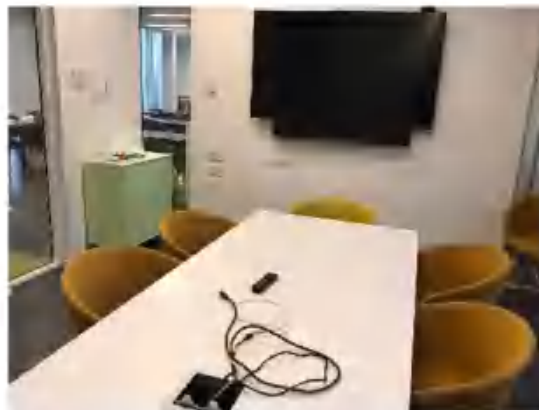


Fig. 8. VC system setup for a meeting room at DTU corresponding to the signature pedagogy of (g) with a fixed setup.

Based on the reported scenarios of VCS use in teaching and further ideation, it was concluded that three contexts of use should be prioritized:

- Laboratories**, where hardware and tables are installed.
- Home**, a table and laptop are used for online teaching.
- Traditional classroom**, where hybrid (students attend in class + online) teaching is conducted.

After highlighting the scenarios, the common elements of these three scenarios were identified to facilitate merging them and creating two toolkits focusing on good practices and other categories. Through brainstorming, it was determined that laboratories and traditional classrooms (hybrid scenarios) could be merged, utilizing the same hardware and software to alleviate pain points. The idea is that for hybrid participation, the face-to-face students' participation will require emphasis and in the case of home or elsewhere when only online participation will be considered, the priority will be to improve visual cues and engagement as possible.

1.3 Parameters for ideating video-conferencing toolkits

The initial or planned protocol was to identify and map pain points analysed and reported by all the partners and create a combined pool of 15 parameters essential for good educational practices and 20 parameters concerning other categories, such as economy, technical set-up, accessibility and, others. Based on the point-of-view statements expressing the pain points of the users, during the process of interpreting and defining parameters, it is found that the same "pain point" can be experienced and expressed both from technological and pedagogical viewpoints. The pain points are the "causes or effects of VCS use" expressed by the participants of an empirical study conducted at the Technical University of Denmark.

Firstly, a set of parameters were identified during a workshop with all the researchers from the project's seven university partner institutions.

Second, all the participant researchers from all partner institutions considered their respective institutionally collected data and analysis-based insights on the pain points or point-of-view statements.

Third, DTU researchers defined or labelled the pain point with generalizable terms or parameters for good educational practices, which should be considered as good interaction practices during hybrid and online teaching sessions. Table 1 is created by merging two different tables for (1) pedagogical and (2) technologies, economy, accessibility and other factors due to the various overlapping factors. The right most column “good practices can be” is a result of ideation exercises conducted by the partners for deciding on potential hardware and software tools for relieving the pains.

Table 1. Framework for Portable Video-Conferencing Systems’ Parameters for Technological and Pedagogical Improvement

Portable VCSs’ Technologies	What is at stake?	Parameters	Toolkit 1
1. Audio	Multimedia		
	Teachers’ voice	Wearable, handheld, connectivity, distance.	Headphone
	Students in physical classroom	Distance, connectivity, noise cancellation	Wireless Speaker & Mic
	Students in online classroom		
2. Video	Physical classroom students’ body and facial expression	Visibility/ visual cues	Mobile stand (to use personal mobile to show students’ classroom view & test how online students view)
	Teacher’s physical interaction in class/lab		- External Webcam with 360 degree rotation. - Camera stand
	Online students’ body and facial expression	Visibility/ visual cues	
	Blackboard/Whiteboard/Lab oratory View		
3. Light	Visual clarity of teacher’s facial and body movement	Conviviality	Laptop attachable light
	Visual clarity of students online		

	Visual clarity of students in physical classroom		
4. Content	Blackboard/Whiteboard writing by teachers	Familiarity, Control, Flexibility, Connectivity	Remarkable 2 - Sketchpad
	Multimedia content and annotation	Familiarity, Control, Flexibility, Connectivity	Wacom pen tablet
	Laptop/Computer Screen		
	Online Interactive Platforms for student-teacher collaborative activities		
5. Connectivity	Internet		
	Wifi		
	Bluetooth		
6. Power Supply	Power supply for laptop and other portable items		Multiport adapter with USB C

Fourth, Table 2 is created through a series of brainstorming sessions and collaborating with the IT operations and management roles in the process of exploring the tools that can be purchased as solutions to address the point-points identified or experience in teaching. Table 2 summarizes the generalized criteria for selecting and excluding hardware items to be purchased for the development of two toolkits. Focusing on the technologies channels involved in the video-conferencing systems, and while ideating potential solutions and trying out some items in own teaching, the table was made through an iterative process.

It is important to note that ChatGPT was tried to identify the pedagogical and technological parameters (Jan 2024). The outputs were too generic that did not allow the researchers to be able to decide on the hardware tools to be selected or excluded based on the parameters. So, those AI-generated parameters were excluded.

1.3.1 General Parameters applicable for hardware items of the Portable VCS toolkit

Table 2 shows 31 pain points, each of which is interpreted by researchers based on interviews and brainstorming, ideation of potential technological or pedagogical good practices which can solve the issue, and brainstorming generalizable parameters to be considered.

Table 2. Essential Parameters for Good Educational Practices Using Video Conferencing Systems

No	Pain points	Interpretation of pain points	Good practices can be	Parameters
1.	Teachers are unable to monitor the online students.	Unable to monitor interpreted as: 1. Teacher missing visual cues of students when he is sharing only one screen. 2. Teacher is unable to find out who is inattentive in class 3. Teacher is unable to monitor who has pressed the “hands up” button.	Extended screens can be used to monitor the online students when the teacher is sharing a screen.	<i>Visual feedback from students is absent when tied to single screen (Technological)</i>
2.	Teachers usually don't interact with online students when editing online boards.	Don't interact with students interpreted as : 1. Teachers frequently forgets online students. 2. Teacher has an issue of classroom management. 3. Teacher forgets to get online students' attention while he is editing something.	Extended screens can be used so that teachers don't forget the online students while editing something. An additional webcam can be used in the case of hybrid teaching.	<i>Feedback Mechanism Adaptability Communication Styles Out of Sight, Out of Mind (Technological & Pedagogical)</i>
3.	In hybrid situations online students get less attention.	Less attention is interpreted as: 1. During Q/A sessions teacher doesn't involve online students 2. Teacher forgets to check the “chat box” or “hands up”	Extended screen can be used so that online students get attention and teacher can monitor who has clicked “hands up” or who wants to answer or who asked a question.	<i>Adaptability of Communication Styles Interaction Consistency Across Channels Chat box and Raised Hand (Pedagogical)</i>
4.	Teachers are unable to contact with online students during the teacher's presentation	Unable to contacting is interpreted as: 1. During the teacher talking time teachers usually do not interact with online students.	Extended screen can be used to pay attention to the online students when the teacher gives his lectures.	<i>Adaptability of Communication Styles Out of Sight, Out of Mind (Technological & Pedagogical)</i>
5.	Teachers cannot see the students while screen sharing is used for presenting during a lecture.	Missing student view interpreted as: 1. Teacher is missing student gestures and body language.	Extended screen can be used so that teacher have online students visual questions.	<i>Visual feedback of students is absent when tied to single screen (Technological)</i>

6.	Students are having difficulties with late and long responses during online sessions even though their camera is turned on.	Late and long responses are interpreted as: 1. Due to share screen option teacher is unable to see if students ask any question teacher responses late 2. Sometimes for long responses teacher can't follow up with other questions from online students. 3. Forgets to pay attention to the online student.	Extended screen can be used so that teacher have online students visual ques. WhatsApp or other massaging app can be a option to send message.	<i>Out of Sight, Out of Mind (Technological & Pedagogical)</i> <i>Visual feedback of students is absent when tied to single screen (Technological)</i>
7.	Online classrooms are not engaging for online students	Not engaging is interpreted as: 1. No hands on activities planned for online students.	Wacom pen tablet or remarkable2 can be used for hands-on activities	<i>Familiarity/Motivation (Technological & Pedagogical)</i>
8.	Students frequently turns off their webcam	Turning off their webcam is interpreted as: 1. Surrounding is not online friendly. 2. They are shy to share their video.	A good headphone with noise cancellation can be a solution and may be background screen change option is suitable for these students.	<i>Control</i> <i>Familiarity/Motivation. (Technological & Pedagogical)</i>
9.	Students who participate online they are mostly inattentive	Inattentive interpreted as: 1. Due to lack of activities. 2. Due to getting less attention. 3. Due to students' surroundings. 4. Hard to focus on all popups from social media or mails.	Wacom pen tablet or remarkable2 can be used for hands-on activities	<i>Familiarity/motivation Pedagogical</i>
10.	Teachers are unable to establish a good relationship with students		A message service app is good to stablish a social bonding among students and also between studenty and teacher.	<i>Communication Familiarity</i>
11.	Students face difficulties to get help or support from teacher.	Difficulties to get help is interpreted as: 1. Hard to get teachers attention. 2. Sometimes technical issue happens teacher can't help students.	A training module can be useful for both students and teachers based on Frequently asked questions.	<i>Communication Visibility</i>

12.	Students face difficulties to access different tools.	Access is interpreted as: 1. Some tools are expensive for students. 2. In-app purchase requirement. 3. Some tools are not user-friendly.		Connectivity Training price
13.	Online students have difficulties to follow the blackboard or whiteboard.	Difficulties to follow the blackboard: 1. It is hard to follow the blackboard from a distance.	Remarkable2/iPad can be used as blackboard.	Multitasking
14.	Online Students have difficulties in taking notes during the lecture.	Difficulties in taking note: 1. Due to teachers' language barriers. 2. Internet connection latency.	Notes written by teacher in Remarkable can be shared with all students. Recorded lectures can be an option.	Multitasking
15.	Due to technical issues few students cannot participate the online session and unable to get class notes.	Students cannot participate is interpreted as: 1. Due to sickness 2. Due to bad internet connection 3. Due to distorted audio que.	The messaging app can be used, if a student facing problem to join in the meeting room. Extended screen can be used so that teacher can find out who needs help. Recorded lectures can be helpful for those who couldn't attend the lecture due to sickness or connectivity problem.	Connectivity
16.	Students face difficulties in getting help or support from teacher or fellow students for example during the coding class.	Difficulties to get help or support from teacher or fellow students interpreted as: 1. Students don't know how to seek help through the online system.	Extended screen can be used to support students who need help.	visibility/visual ques Adaptability of Communication Styles Training
17.	Teachers have difficulties to explain a topic	Difficulties to explain a topic interpreted as:	A camera with 360 view can used to avoid shifting.	Flexibility visibility/visual ques

	for online students on blackboard or whiteboard.	1. Teachers need to move laptop, camera and use microphones to explain a topic for online students on blackboard.	A good headphone can be used which had noise cancellation mode. Teachers can also use clip microphone which covers good range.	
18.	Teachers need alternative to blackboard.	Too much camera movement can interrupt the class flow.	Remarkable2/ iPad can be used as the alternative for blackboard.	Familiarity Flexibility
19.	Teachers lack the tools to show drawings.	Lack of tools interpreted as: 1. Not having knowledge about different drawing tools. 2. Different signature pedagogy's need different tools to draw for example in architecture classes teacher needs architectural drawing tools.	Wacom pen tablet can be used to draw in different signature pedagogies.	Familiarity, Training and feedback and Reviews
20.	Students don't have access to all drawing tools.	Access to drawing tools: 1. Tools are costly 2. In App purchase required.	Wacom pen tablet can be used to draw in different signature pedagogies.	Familiarity and Flexibility
21.	Students are unable to avoid noise of their surroundings.	Their surrounding interpreted as : 1. Students live at a non-online friendly environment. 2. Background noise around them.	Students need a noise cancelling headphone.	Noise cancellation
22.	Students have problems with the audio cues as teachers use audio devices.	Teachers' audio cues are distorted because of low quality audio devices. Some devices teachers use it doesn't come with noise cancellation option.	Jabra speaker or owl lab can be used to avoid distorted and noisy audio output	Wireless audio output and Noise cancellation
23.	During hybrid sessions students are unable to hear the teacher's audio.	Teacher doesn't carry the microphone.	Subzero M100H Miniature Digital wireless systems and Samson Go Mic Mobile Beltpack transmitter	Wireless audio output

	cue when teacher is away from the microphone.		with lavalier Microphone can be used so that in hybrid teaching situation online students can hear teacher's audio cues clearly.	
24.	Teachers need to move cameras to give visual cues when they move PC to blackboard during their hybrid teaching sessions.	Too much movement of cameras can be disturbing for online students.	Mobile stand, Logitech 360 camera or OWL LABS Meeting Owl 3 - conference camera can be used to avoid the too much of moving of cameras.	Camera features: Zoom, Tilt, pan and rotation
25.	Teachers' video quality is very bad.	The video cameras pixel quality is very bad.	Logitech 360 camera or OWL LABS Meeting Owl 3 - conference camera gives high quality of video output	Video quality
26.	Teacher missing the panorama view of his large classroom	Teacher doesn't have the view of the whole classroom.	Logitech 360 camera or OWL LABS Meeting Owl 3 - conference camera gives the panorama view of the large class.	Visibility
27.	Online students are not engaged	Teachers don't have online students view while they are sharing the screen. Sometimes teachers forget about the online students.	Extended screens will help teachers to engage the online students.	Communication and visibility
28.	Students get bad audio cues because of echoes.	Bad Audio cues interpreted as: 1. distorted audio caused by internet interruption 2. Latency. 3. Teacher's end audio output is bad. 4. Teacher's microphone is not able cover a good range.	Jabra speaker, Subzero M100H Miniature Digital wireless systems and Samson Go Mic Mobile Beltpack transmitter with lavalier Microphone can be the solution for echoes.	Audio quality
29.	Online students have problems to follow classrooms	Cameras cannot detect the speaker.	To address this problem, a camera is needed which can detect the speaker and move the	Camera features: Zoom, Tilt, pan and rotation

	students` responses		camera towards the speaker. OWL LABS Meeting Owl 3 - conference camera has this option.	
30.	Teachers need training in tools and video systems	Teachers doesn't know all the technicalities of the device. So, the teacher can't solve a technical problem instantly.	A training module can be useful for both students and teachers based on frequently asked questions.	Training
31.	Teachers need user- friendly gadgets or software.	Some gadgets or software have complex functions which is difficult for a teacher who is weak in technology.	Before purchasing a gadget or software university should look at the user friendliness of that product. Training can be arranged.	Feedback and Reviews

1.3.2 Parameters for portable video-conferencing toolkit selection

Parameters are measurable factors that define the characteristics or behaviour of a system, process, or phenomenon. While selecting and ideating the selection and purchase of different hardware components of the portable video-conferencing toolkits, the parameters concerning economy, technical set-up, accessibility and others are identified. Although the parameters are identified and established during the ideation and a subsequent brainstorming session for generalizing the parameters, these are reported before the toolkits are presented. The aim was to identify 20 parameters but eventually 21 are identified.

1. **Compatibility:** Ensure compatibility with various OS platforms and devices.
2. **Portability (Size and weight):** Consider the size and weight appropriate for a backpack.
3. **Compatibility with Laptop screen and size:** Ensure compatibility with existing laptops.
4. **Ease of use:** Choose hardware that feels closest to writing on paper.
5. **Compatible file formats:** Ensure the hardware can annotate on numerous file formats.
6. **Audio Quality:** Choose hardware that can deliver crystal clear, high-resolution sound quality at an affordable price.
7. **Noise cancellation:** Consider a sound device with noise cancellation options.
8. **Wireless Connectivity:** Choose a microphone that supports Bluetooth wireless connection without disconnections for hybrid scenarios.
9. **Mute functionality:** Ensure that the hardware has a visible and easy-to-use mute option.
10. **Price:** Consider the cost-effectiveness of the hardware.
11. **Room size:** Consider the size of the room where the hardware will be used and choose accordingly.
12. **Mobile compatibility:** Ensure compatibility with mobile devices.

13. **Multiple mic support:** Ensure support for multiple microphones if needed.
14. **Webcam options:** Look for options such as rotation, pan, tilt, and zoom for better camera control.
15. **Video quality:** Ensure desired high-definition video output for clear communication.
16. **Power requirements:** Consider power requirements and ensure compatibility with existing infrastructure.
17. **Backpack length:** Consider the length of the backpack and how the hardware will fit.
18. **Power plug and socket compatibility:** Ensure compatibility with different types of power plugs and sockets (EU, AU, etc.).
19. **Lightweight:** Consider the weight of the hardware relative to the total weight of the portable toolkit items expected to fit in the backpack.
20. **Scalability:** Consider whether the computer can accommodate the different ports of additional devices.
21. **Feedback and reviews:** It is recommended to gather feedback and reviews from other users to gauge performance and reliability.

In addition, an analogue solution is included to the absence of white board at home or some laboratory context by including an adhesive-free and lightweight alternative to poster-size paper.

1.3.3 Essential parameters for Good educational practices

The initial objective was to identify 15 parameters for effective educational practices in selecting video conferencing tools. However, during our brainstorming session to dissect the pain points into distinct parameters, we discovered a total of 19 essential parameters for fostering optimal educational practices. A breakdown of these 19 parameters for ensuring excellence in educational practices are as follows:

1. **Visual Feedback from Students:** Ability for students to provide visual feedback, even when limited to a single screen (e.g., raising virtual hands, reaction emojis).
2. **Feedback Mechanism for Teachers:** Tools for teachers to receive feedback from students, such as polls, surveys, or direct messaging.
3. **Adaptability:** Ability of the platform to adapt to different teaching styles, classroom setups, and technological capabilities.
4. **Communication Style of Teacher:** Features that support various communication styles, such as screen sharing, whiteboarding, or breakout rooms.
5. **Out of Sight, Out of Mind:** Features to combat the feeling of isolation or disengagement, such as attention tracking or participation metrics.
6. **Interaction Consistency:** Ensuring consistent interaction opportunities for all students, regardless of physical location or connectivity.
7. **Familiarity/Motivation:** User-friendly interface and features that motivate both teachers and students to actively participate.
8. **Control:** Tools for teachers to maintain control over the virtual classroom environment, such as muting participants or managing permissions.
9. **Connectivity:** Reliable connectivity options and compatibility across various devices and internet speeds.

10. **Training:** Availability of training resources or tutorials to help teachers and students become proficient with the platform.
11. **Price:** Affordability of the platform, especially for educational institutions with limited budgets.
12. **Multitasking:** Ability for participants to multitask without disrupting the learning experience (e.g., split screen viewing, minimizing distractions).
13. **Flexibility:** Customization options and flexibility to accommodate different teaching styles and curriculum requirements.
14. **Feedback & Reviews:** Consideration of feedback and reviews from other educators and institutions to inform platform selection.
15. **Noise Cancellation:** Built-in noise cancellation features to minimize distractions and improve audio quality.
16. **Wireless Audio Output:** Support for wireless audio devices to enhance mobility and convenience for teachers and students.
17. **Camera Features:** High-definition video capabilities, adjustable angles, and camera settings to optimize visual presentation.
18. **Video Quality:** Consistently high-quality video streaming to ensure clear visibility of both teachers and students.
19. **Audio Quality:** Clear and crisp audio transmission to facilitate effective communication and comprehension.

By evaluating video conferencing tools based on these parameters, educators can make informed decisions that best suit their teaching and learning needs. In addition to the planned activities, further brainstorming was conducted for proposing a framework showing the concerns, parameters, items from the proposed toolkits.

1.3.3 DTU Ideation Hardware Items for the EdViCon Portable Toolkit

The hardware lineup for the two VC toolkits and the hardware selection process was driven by the following factors outlined below as indicated in Table 3:

- Evaluation based on specific parameters
- Identification of pain points addressed by the hardware
- Assessment of hardware features

Table 3. DTU ideation of hardware items for VC toolkit based on the above mentioned parameters

List of things for toolkit (To Buy: \$\$\$) (We Have: 😊)	Features	Pain Points/problem scenario	Parameters
Portable extended screen	Portability: The primary feature is the ability to carry and set up the extended screen easily. This could involve a portable	Pain Point: 1. Teachers cannot see the students while screen sharing is used for	Compatibility: ensure compatibility with various os platforms and devices.

	<p>monitor, tablet, or even a projector.</p> <p>Connectivity Options: The extended screen should support various connectivity options, such as USB-C, HDMI, or wireless protocols like Miracast or Airplay, depending on the device you're connecting it to.</p> <p>Screen Size and Resolution: The screen's size and resolution are important for a comfortable viewing experience. Higher resolutions and larger screens provide more screen real estate for multitasking.</p> <p>Touch Support: Some portable extended screens offer touch functionality, allowing you to interact with your device's interface directly on the extended screen.</p> <p>Adjustable Stand or Mount: A built-in adjustable stand or mounting options can help you position the extended screen at a comfortable viewing angle.</p> <p>Compatibility: Ensure that the portable extended screen is compatible with a wide range of devices, including laptops, tablets, smartphones, and even gaming consoles.</p> <p>Built-in Battery: Many portable monitors have a built-in battery, allowing you to use them without needing a power source for a certain period.</p> <p>Colour Accuracy and Brightness: Depending on usage, colour accuracy and brightness levels might be important, especially if you're using the extended screen for design, photo editing, or video work.</p> <p>Audio Output: Some portable screens come with built-in</p>	<p>presenting during a lecture(SC2).</p> <ol style="list-style-type: none"> Students are having difficulties with late and long responses during online sessions. late/long response time during the online session even though their camera is turned on.(SC3) Teachers are unable to monitor the online students. (SC3) Teachers usually don't interact with online students when editing online board. (SC4) In hybrid situation online students get less attention(TC2). Teachers are unable to contacting with online students during the teacher's presentation(TC2). Online classrooms are not engaging for online students (SC2). Students frequently turns off their webcam (TC2) Students who participate online they are mostly inattentive (TC2) Teachers are unable to establish a good relationship with students (TC2) 	<p>Potability (Size and weight): Consider the size and weight appropriate for a backpack.</p> <p>Compatibility with Laptop screen and size: ensure compatibility with existing laptop</p>
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	<p>speakers, allowing you to have both audio and video output in one device.</p> <p>Software and Settings: Some portable extended screens might come with software that allows customising settings like display orientation, brightness, colour profiles, and more.</p> <p>Durability and Build Quality: A sturdy build and protective case can help ensure the extended screen's longevity, especially when on the move.</p> <p>Compatibility with Stylus: If the extended screen is used for creative work or note-taking, compatibility with a stylus or digital pen might be important.</p>		
<p>iPad Pro</p> <p>Prices: iPad pro 12.9" 12000 dkk Smart keyboard folio 12,9 (6 gen) 1880 dkk Apple pencil 2 :1279 dkk</p>	<p>12.9-inch (2732 x 2048) or 11-inch (2388 x 1668) display</p> <p>M2 chip with 8-core CPU and 10-core GPU</p> <p>5G connectivity</p> <p>Liquid Retina XDR mini-LED display on the 12.9-inch model</p> <p>12MP Wide and 10MP Ultra-Wide rear cameras with LiDAR scanner</p> <p>True Depth Camera with Face ID and 12MP camera</p> <p>Thunderbolt port</p>	<ol style="list-style-type: none"> 1. Teachers cannot see the students while screen sharing is used for presenting during a lecture. (SC2) 2. Students late/long response time during the online session as the students faces cannot be seen even if their camera is turned on. (Sc3) 3. Teachers are unable to monitor the online students. (SC3) 4. Teachers usually don't interact with online students when editing online board. (SC4) 5. In hybrid situation online students get less attention. (TC2) 6. Teachers are unable to contacting with online students during the teacher's presentation. (TC2) 	

	<p>Optional Apple Pencil 2 with hover, Magic Keyboard, and Smart Keyboard Folio</p> <p>Can be used also as an extended screen to Mac or PC.</p> <p>All day battery life.</p>	<ol style="list-style-type: none"> Online classrooms are not engaging for online students . (SC2) Students frequently turns off their webcam. (TC2) Students who participate online they are mostly inattentive. (TC2) Teachers are unable to establish a good relationship with students(. TC2) Students face difficulties to get help or support from teacher. (SC2) Students face difficulties to access different tools. (SC4) 	
<p>Remarkable 2 (👍, \$\$\$)</p> <p>Price: 2790 dkk</p>	<p>E Ink Display: The Remarkable 2 features a high-resolution E Ink display that closely mimics the experience of writing on paper. The display is non-reflective, which reduces glare and makes it comfortable to use in various lighting conditions.</p> <p>Slim Design: The device is sleek and slim, resembling a large notebook or legal pad in terms of form factor. It's designed to be lightweight and easy to carry.</p> <p>Stylus Pen: The device comes with a stylus pen that supports pressure sensitivity, making it responsive to different levels of pressure while writing or drawing.</p> <p>Note-Taking and Writing: The primary function of the Remarkable 2 is note-taking and digital writing. Users can write and draw directly on the screen using the stylus, and the device converts handwritten notes into digital text.</p> <p>Convert Handwriting to Text: The device has handwriting</p>	<ol style="list-style-type: none"> Online students have difficulties to follow the blackboard or whiteboard. Online Students have difficulties in taking notes during the lecture. Due to technical issues few students cannot participate the online session and unable to get class notes(SC4). Students face difficulties to get help or support from teacher or fellow students for example during the coding class. Teachers have difficulties to explain a topic for online students on blackboard or whiteboard. Teachers need alternative to blackboard. 	<p>Ease of use: Choose the hardware that Feels closes to writing on a paper.</p>

	<p>recognition capabilities, which means that you can convert your handwritten notes into editable text. This is useful for organizing and sharing your notes more effectively.</p> <p>Cloud Sync: The Remarkable 2 offers cloud synchronization, allowing you to sync your notes and documents across devices. This makes it easy to access your content from different devices and locations.</p> <p>PDF Annotation: You can import and annotate PDF documents on the Remarkable 2, which is useful for reading, reviewing, and marking up documents.</p> <p>Battery Life: E Ink displays are known for their excellent battery life, and the Remarkable 2 is no exception. It can last for weeks on a single charge, depending on usage.</p> <p>Customizable Templates: The device provides various templates for different types of notetaking, including plain, ruled, grid, and more. This allows you to customize your writing experience to your preferences.</p> <p>Wi-Fi Connectivity: The Remarkable 2 supports Wi-Fi connectivity, which is used for cloud synchronization and software updates.</p> <p>Responsive and Lag-Free: The device aims to provide a responsive and almost lag-free writing experience, making it feel more natural and closer to writing on paper.</p> <p>Folder Organization: You can organize your notes and documents into folders for better organization and easier access.</p>		
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<p>Wacom pen tablet (😊)</p> <p>Price: 609 dkk</p>	<p>Key Features</p> <p>From learning to draw and edit photos to collaborating in online classes or completing academic assignments with natural handwriting,</p> <p>One by Wacom brings an easy to use digital pen to PC, Mac and most Chromebooks.</p> <p>Digital learning and creativity couldn't be easier.</p> <p>Size small (20 x 16 cm) is ideal for limited desk space</p> <p>Detachable USB cable has a space-saving L connector</p> <p>Wireless and battery-free pen</p> <p>4096 pressure point levels</p> <p>Three replacement nibs for the pen, nib replacement tool</p> <p>Four programmable buttons for shortcuts</p> <p>Ergonomic design for both right- and left- handed users</p>	<ol style="list-style-type: none"> 1. Teachers lack tools to show drawings. 2. Students don't have access to all drawing tools. 	<p>Compatible file formats: Annotation on numerous file formats</p>
<p>Headphone (Sony Trådløse WH-1000xm4-headphone with noise cancellation) (😊)</p> <p>Price: 2189 dkk</p>	<p>Key Features</p> <p>HD noise reduction processor QN1,</p> <p>Bluetooth Audio SoC and a dual noise sensor let you listen without distractions</p> <p>Optimization of personal noise reduction and optimization of atmospheric pressure</p> <p>High-resolution audio with DSEE Extreme™ and LDAC</p>	<p>Students are unable avoid noise of their surroundings. (SC2)</p> <p>Students have problems the audio ques as teachers use bad audio devices. (TC1)</p>	<p>Audio Quality: choose hardware that has HD quality sound.</p> <p>Noise cancellation</p>

	<p>Adaptive Sound Control automatically adjusts the ambient sound settings to suit your surroundings and behaviour</p> <p>Wireless freedom with BLUETOOTH® technology</p>		
<p>Subzero M100H Miniature Digital wireless systems (😊)</p> <p>—</p> <p>Price: 723 Dkk</p>	<p>Key Features</p> <p>Plug in and play with 2.4GHz digital connectivity</p> <p>Discreet and lightweight headset microphone</p> <p>Reliable gigging and busking system with up to 6 hours battery life</p> <p>Freedom to move and noise free on stage with 15 metre range</p> <p>Crystal clear, 24 Bit high resolution sound quality</p> <p>Pairing method: Automatic, two channels</p>	<p>Students have problems the audio ques as teachers use bad audio devices(TC1).</p> <p>During hybrid sessions students are unable to hear the teacher's audio que when teacher is away from the microphone.</p>	<p>Wireless Connectivity: choose microphone that supports Bluetooth wireless connection without getting disconnected.(for hybrid scenario).</p>
<p>Speaker (Jabra speak 2 for hybrid situation). (\$\$\$)</p> <p>Price: 902 Dkk</p>	<p>Key Features</p> <p>Good for hybrid</p>		<p>Room size: consider the size of the room where the hardware will be used and choose accordingly</p>

<p>Samson Go Mic Mobile Beltpack transmitter with lavalier Microphone 😊)</p> <p>Price: 1795 Dkk</p>	<p>Key Features</p> <p>Wireless clip microphone with transmitter for smartphones, tablets, DSLR cameras or MAC/PC.</p> <p>Note! Cannot be used without Samson's Go Mic Mobile receiver!</p> <p>Extra clip microphone with transmitter for Samson Go Mic Mobile</p> <p>Compatible with Go Mic Mobile Wireless Receiver.</p>		<p>Mobile compatible</p> <p>Multiple mic support</p>
<p>Webcam 360 rotation (\$\$\$)</p> <p>Price: 1120 DKK</p> <p>https://www.powerbuy.co.th/en/product/razer-kiyo-desktop-camera-for-streaming-gaming-razer-kiyo-webcam-262498?gclid=CjwKC-AjwyNSoBhA9EiwA5aYlb4w7gxuh3qDmqtWR_OencOj309ObLcyO2lmr_HDcdXr2xgyeDjBWjxoCDBoQAvD_BwE&~ad_set_id=&~campaign=%7CPL%3APFM%7CCN%3APerformanceMax%7CTA%3ANC%7CMIX%7C&~campaign_id=17874686150&~channel=x&~keyword=&~placement=</p>	<p>Key Features</p> <p>A 360 camera, also known as an omnidirectional camera, has a 360-degree field of view so that it captures just about everything around the sphere.</p> <p>360 cameras are needed when large visual fields need to be covered, such as shooting panoramas.</p> <p>As virtual and augmented reality (AR/VR) is rising in prevalence in video games and other forms of interactive entertainment, 360 cameras are being used more widely today.</p> <p>VR feature films that require 360 cameras are currently being explored while still photography and robotics have been utilizing 360 cameras as well.</p> <p>Some 360 camera models will let you edit footage right on the camera itself instead of having to put the footage through external software.</p>	<p>Teachers need to move cameras to give visual cues when they move Pc to blackboard during their hybrid teaching sessions.</p> <p>Teachers video quality is very bad.</p> <p>Teachers missing the panorama view of his large classroom</p>	<p>Webcam options: Look for options such as Rotation, pan, Tilt, and zoom for better camera control</p> <p>Video quality: Ensure the desired high definition video output for clear communication.</p>

<p>OWL LABS Meeting Owl 3 - conference camera</p> <p>Price 8898 Dkk</p>	<p>Key Features</p> <p>360-Degree Video and Audio: The Meeting Owl offers a 360-degree panoramic view of the room, ensuring that everyone in the meeting space is visible on camera without the need to pan or zoom. It uses multiple cameras and microphones to capture video and audio from different angles.</p> <p>Automatic Speaker Focus: The Owl uses its audio technology to detect and highlight the active speaker in the room. As someone starts speaking, the camera automatically focuses on them, giving them a more prominent presence in the virtual meeting.</p> <p>Intelligent Audio: The Meeting Owl employs echo cancellation and noise reduction to enhance audio quality. It can distinguish between different voices in the room and emphasize the person speaking, providing clearer and more natural conversations.</p> <p>Remote Participant Inclusion: The 360-degree view helps remote participants feel more engaged in the meeting by allowing them to see the entire room and everyone present. This can contribute to a more inclusive and collaborative meeting environment.</p> <p>Easy Setup and Integration: The Meeting Owl is designed to be user-friendly and easy to set up.</p>	<p>Teachers need to move cameras to give visual cues when they move the Pc to the blackboard during their hybrid teaching sessions. (SC1)</p> <p>Teachers video quality is very bad. (SC3).</p> <p>Teachers missing the view of his large classroom. (TC4)</p> <p>Online students are not engaged. (SC2)</p> <ol style="list-style-type: none"> 1. Students get bad audio ques because of echoes. (TC1) 2. Online students have problems to follow classroom students' response. (TC4) 3. Teachers need training for tools and video systems. (TC3) 	
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	<p>It can be connected to popular video conferencing platforms like Zoom, Microsoft Teams, and Google Meet, making integration into existing workflows seamless.</p> <p>Multiple Device Compatibility: The Owl can be used with various devices, including laptops, tablets, and room displays. This versatility enables flexibility in how teams conduct their meetings.</p> <p>Intuitive Controls: The Owl typically comes with a remote control that lets users manually adjust camera angles and settings. Some versions may also offer app-based controls for added convenience.</p> <p>Upgradeable Software: Owl Labs has released firmware updates to enhance the Meeting Owl's capabilities over time. This means that even after purchasing the device, users can potentially benefit from new features and improvements through software updates.</p> <p>Compact Design: The Meeting Owl has a compact and sleek design, making it suitable for various meeting spaces without being obtrusive.</p> <p>Analytics and Insights: Owl Labs provides a dashboard that can offer meeting analytics and insights, such as meeting</p>		
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	frequency, duration, and usage patterns. This information can be helpful for understanding team collaboration and optimizing meeting schedules.		
<p>Camera Stand (Tuff stands CS-12 kamera-stativ, 1,5 m). (\$\$\$)</p> <p>Price: 99 Dkk</p>	Key Features		Backpack length
<p>Bluetooth Mouse & Keyboard (\$\$\$)</p> <p>RAPOO 9300M Multi-Mode Wireless Keyboard Set, Black</p> <p>Price 298,75 dkk</p>	Key Features		
<p>Multiplug Aukey Universal travel adapter with USB ports, 65W - Black</p> <p>Price: 326 Dkk</p>	<p>Key Features</p> <p>Universal Compatibility: The travel adapter is designed to work with a wide range of international plug types, allowing you to use your devices in various countries and regions.</p> <p>Multiple USB Ports: The adapter likely features multiple USB ports, enabling you to charge multiple devices simultaneously without the need for separate chargers.</p> <p>High Power Output: With a 65W power output, the adapter can provide sufficient power to charge laptops, smartphones, tablets, and other devices efficiently.</p>		<p>Power plug and socket compatibility</p> <p>Power requirements: Consider power requirements and ensure compatibility with existing infrastructure.</p>

	<p>Compact and Portable: Designed for travel convenience, the adapter is compact and lightweight, making it easy to carry in your luggage or backpack.</p> <p>Voltage Conversion: Some travel adapters offer voltage conversion capabilities, allowing you to safely use your devices in regions with different voltage standards.</p> <p>Built-in Safety Features: Look for features like surge protection, overload protection, and short-circuit protection to ensure the safety of your devices during charging.</p> <p>Interchangeable Plug Heads: The adapter might come with interchangeable plug heads that can be swapped out to match the outlet types in different countries.</p> <p>LED Indicator Lights: LED lights can indicate when the adapter is properly connected to a power source and when devices are charging.</p> <p>Compatible with Various Devices: The adapter should be compatible with a wide range of devices, including smartphones, tablets, laptops, cameras, and more.</p> <p>Colour Options: The "Black" colour option provides a sleek and professional look.</p>		
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	<p>Travel Pouch: Some adapters come with a travel pouch for convenient storage and organization while on the go.</p> <p>Fast Charging: The USB ports may support fast charging technologies like Qualcomm Quick Charge or USB Power Delivery (PD), allowing your devices to charge quickly.</p>		
Permanent Marker (😊)			
<p>Leitz 7050 Easyflip Foil (😊)</p> <p>Price:29€</p>	<p>Key Features Roll of foil (PP) for Leitz EasyFlip,</p> <p>Self-adhesive through static electricity, 20 m long, 60 cm wide, plain white. For use with commercially available permanent or whiteboard markers.</p> <p>Dimensions (W x H x D mm) 60 x 60 x 630</p>	<p>1. Teachers need alternative to blackboard/whiteboard</p>	<p>Adhesive free and light weight alternative to poster size paper.</p>
<p>Mobile stand/mobile holder Practical stand to mobile/tablet</p> <p>Price: 79Dkk</p>	<p>Key Features Practical stand for smartphones and tablets that allows one to use own mobile device hands-free.</p> <p>The holder itself can be rotated 40 degrees, so you get the right viewing angle to use your device most conveniently.</p> <p>The mobile holder itself, in which the device must be placed, has a rubber coating, which ensures that the tablet or smartphone</p>		<p>Lightweight: Consider weight of the hardware with reference to the total weight of the portable toolkits items expected to fit in the backpack.</p>

	<p>does not get scratched during use.</p> <p>The stand is made of aluminium bearing, which gives this mobile phone a cool look at the same time that it is durable, while the bottom of the foot and the back of the head are made of white plastic, but a pleasant surface.</p> <p>As mentioned, the upper part of the stand is made so that it can tilt up to 40 degrees, so one can create the perfect angle. With the two feet that stick out, one can place any mobile device in the stand, which is extremely practical, as one don't need separate holders for smartphones and tablets.</p>		
<p>Satechi Slim USB-C MultiPort adapter V2</p> <p>Price: 519 Dkk</p>	<p>Key Features</p> <ul style="list-style-type: none"> 2x full-size USB 3.0 ports - 1x reversible USB-C PD (power delivery) port with 49 watt charging - 1x HDMI 2.0 port with up to 4K at 30 Hz - 1x reversible USB-C male output cable - 1x SD card reader - 1x microSD card reader <p>Compatible with: 2016/2017/2018 MacBook Pro, 2015/2016/2017 MacBook, Microsoft Surface Go, ASUS Transformer 3 Pro, Dell XPS 12 9365 or later, HP Elite X2, Specter x360 13, 15, Pro Convertible, Huawei Matebook, Lenovo IdeaPad 720s, ThinkPad T470, T570, X1 Yoga, 720, 920,</p>		<p>Scalability: consider whether computer can connect with accommodate the different ports of additional devices</p>

	Razer Blade Stealth, Samsung Galaxy Tab Pro S and many other devices.		
Light 749 DKK https://www.elgiganten.dk/product/computer-kontor/computertilbehor/webkamera/razer-kiyo-streaming-webkamera/RAZKIYOWEBLIG https://www.mobilcovers.dk/products/4smarts-video-light-loomipod-m-sugekop-sort?gclid=CjwKCAjwp8OpBhAFiEiwAG7NaErs2Kcwpj-xvY0aaz8lekz_jUwYJz-WEnIwmqK3e1FEegaHfFkSvchoCbvMQAvD_BwE			Feedback and reviews : from other users to gauge performance and reliability

1.3.4 Final list of Items proposed/ combinations of Toolkits/List of Items Purchased

The two portable toolkits for VCS for the two general contexts and scenarios of live teaching (hybrid and online) are presented below.

Toolkit 1 Hybrid (face2face+online students): Laboratories/Traditional Classroom

1. Laptop
2. Extended screen
3. Mobile Stand (mobile as a screen)
4. Light
5. Headphone: Sony WH-H910Nw
6. Multiport adapter with USB C
7. Remarkable 2
8. Wacom Pen Table
9. Logitech c 920 HD

10. Camera Stand
11. Power Strip
12. Samson go mic mobile lavalier system
13. Jabra Speak 2 55

Toolkit 2 Online (no face2face student): Home/Other

<ol style="list-style-type: none"> 1. Laptop 2. Extended Screen 3. Mobile Stand (mobile as a screen) 4. Light 5. Headphone: Sony WH-H910Nw 6. Multiport adapter with USB C 7. Remarkable 2 8. Wacom Pen Tablet 9. Logitech C920 HD 10. Camera Stand 11. Easyflip Foil and Flipchart/Permanent Marker 12. Universal travel adapter with USB ports 	<p>Software for annotated content presentation of alternative to writing on a whiteboard/blackboard.</p> <ol style="list-style-type: none"> 1. Xournal++ (free software) for pdf editing using Wacom 2. Microsoft PowerPoint 3. One Notes
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Officially, DTU decided to use the online platform **Microsoft Teams** which ensures access to Microsoft products, screen mirroring and other facilities. In addition, DTU also offers the full service of **Zoom**. The list of online applications for engaging students during live teaching sessions are presented separately as a summary of finding from all partners and therefore excluded from this part of the report.

Chapter Two: NTNU EdViCon Toolkits

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2.1 Introduction

Designing an all-in-one, low-cost, universal mobile VC system for all variations of learning environments and -scenarios is impossible but can be compared with an analogy to a Swiss army knife. Many tools are available for various small tasks; one does not have to bring a whole toolbox to do the job. However, even if the Swiss Army knife fixes the problem, using a tool dedicated/built to do the job would be better and often faster. It is about finding the right tool for

the job. We must define the job (pedagogy and methodology) and the best tools to do the job in the learning environment or physical/hybrid/online space.

Many local and external factors influence the quality and functionality of a portable VC system, ranging from the instructor user interface and technical flexibility, the ability to deliver and monitor an interactive session, to the experienced quality of the session/activity seen from the end user viewpoint. The two first factors influencing the

quality of the VC experience are, firstly, the location where the portable VC system is applied and, secondly, the surroundings of the receiving end of the VC, concerning the location and the available end equipment.

Then, the third factor is defined by the interconnecting fixed/wireless or radio-based network, which defines the quality of service/experience of the transmission between locations of the portable VC and the end users. In other words, there are factors that are not controlled by the VC system directly. There are, of course, features within the various VC components and services provided through companies working within UCC (unified communication and collaboration, like Microsoft Teams, Zoom ++) that automate and adjust certain features depending on external factors like acoustics, light, sound and image qualities, bandwidth etc. However, these automated features are often not compliant with various types of end equipment and the software used in the videoconferencing activities. Some hardware has an "approved by" Teams or Zoom, but this does not guarantee a seamless connection without hardware or software artifacts and automated features working against each other.

The important problems, or pain points are investigated, when applying video conferences in higher education, and how conscious choices of both hard - and software might mitigate these difficulties that arises?

2.2. The Norwegian University of Science and Technology (NTNU)

NTNU is the largest university in Norway today, with a history dating back to 1910, and a tradition going back to 1767 and the Royal Norwegian Society of Sciences and Letters (DNVVS). It is headquartered in Trondheim, with campuses in Gjøvik and Ålesund, and is divided in eight faculties in addition to units such as the NTNU University Museum and the

NTNU University Library. With approximately 43000 students and 9000 staff members, the organization is large and equipped for delivering high quality research and education.

NTNU has the main responsibility for higher education in technology in Norway and is the country's premier institution for the education of engineers. The university offers several programmes of professional study and a broad

academic curriculum in the natural sciences, social sciences, teacher education, humanities, medicine and health sciences, economics, finance and administration, as well as architecture and the arts. NTNU's vision is Knowledge for a better world, and the University aims to create the basis for the development of knowledge and to create value – economic, cultural and social. NTNU also has a social mission; to conduct research; provide a research-based education; share research results; be a culture bearer and contribute to innovation. More specifically NTNU will develop the technological foundation for tomorrow's society, as well as participate in the public debate, engage in solving global challenges and promote human rights and cross-cultural dialogue. Together with a strong focus on interdisciplinary work and technology enhanced learning approaches, NTNU is a strong actor in the advancement within technologies and also equips the staff at NTNU with good access to innovative and high end solutions when it comes to both

hardware and software. This is important to remember when considering results found when researching also Educational VC, which is the main thematic area for this report.

Of course, also NTNU's work has a context, and in Norway the development of ICT-strategies is defined from the government, with a high degree of institutional autonomy. To ensure proper implementation, the government issues new strategic developments every five years, called strategy for digitalization of Higher Education in Norway. The Government relies heavily on a department for digital implementation and expertise, Norwegian Agency for International Cooperation and Quality Enhancement in Higher Education (HKDir), to ensure quality in all parts of the digitalization of the Norwegian Educational System. HKDir delivers reports on the digital conditions every three years, valuable insight into the Norwegian situation.

In the strategies, one can generally see that there are high aims for the digitalization of Norwegian Higher Educational Institutions. The students are supposed to meet academic fellowship of staff and students where digital opportunities are being exploited in activating and varied learning- and assessment methods. The student should also have access to a modern, personalized learning environment that facilitates for individual learning experiences, efficiency, collaboration and flexibility in the studies. This naturally includes access to VC solutions of quality and excellence, and this is also offered to the academic staff involved in the educational practices. The strategy also defines aims and measures for the institutions connected to digitalization. There are measures in the strategy especially directed towards the strengthening of infrastructure, both teachers and administrations competence and incentives for developing these digital improvements. The strategy does allow for strong institutional autonomy when it comes to implementation of the measures. This is both positive and negative. It allows the institution to develop and integrate the system, solutions and tools they find fit, and allows the teacher at a micro-level to exploit the digitalization in a way that suits the class/group/single student in the way best for this institution. It also creates some difficulties, due to a lack of standardization and equal access to the competence. It is also a problem that delegating the responsibility down at institutional level might lead to different implementation strategies, for example considering funding allocated. It is necessary to anchor the strategy also in local strategies, as an example from NTNU.

NTNU has its own strategy, lasting until 2025. Even if there are no direct reference or link to the governmental strategy, it functions as a foundation somewhere. There are few places where the process of digitalisation is mentioned at all in the strategy, as in some places. Concerning Education and learning environments it is stated: "Students are involved in developing content and learning processes in a tailored learning environment. New technology enables stimulating and varied approaches to learning and assessment and facilitates access to lifelong education." [p. 19]. New technologies are also explicitly mentioned concerning campus development: "Develop sustainable technological solutions" [8, p.34]. The latter reference is especially interesting for EdViCon. More general ICT-skills and infrastructure is important to achieve and reach the high aims being focused in NTNU's strategy. NTNU actually points at digitalization as the most important point concerning the development of the whole institution:

NTNU'S CAPACITY FOR DEVELOPMENT NTNU sets priorities for resources to ensure high quality in our core activities and develops a leading position in our disciplines so that we can meet society's changes, needs and expectations. NTNU has user-friendly and effective support systems. Future-oriented digital services focused on user needs are available to students and staff. NTNU has robust systems to meet the need for information security, emergency response capacity and protection of privacy. DEVELOPMENT GOALS NTNU will: Have resource management that contributes to increased productivity and creates room for manoeuvre in terms of strategic priorities and renewal at all levels. Launch digitalization initiatives and improvements that support integrated, standardized procedures and work processes.

Still the main actor for implementing these digital solutions at a micro-level is the single teacher or teachers' environment. The need for EdViCon is therefore large, even if NTNU is set up with good access to high quality VC- and other digital tools and systems.

2.3. Four different scenarios

To investigate further, four different scenarios were chosen. These can illustrate some of the solutions, and also provide insight into different possible solutions, both considering hard- and software. The scenarios in this report are:

- Normal online lecture (one-way/monologue), with a PowerPoint or other shared pre-processed material, with the option of getting participants' questions afterward through VC or chat.
- Production of material or live online lecture with “moving” teacher and several sources to be shown in addition to teacher, like whiteboard.
- Physical Lab demonstrations with hybrid attendance/observation.
- Podcast production with high-quality audio (and video, to test the features of a 360-camera, like autocropping and live mixing of video of the podcast presenters.

The interaction, collaboration, and control grade, concerning complete hybrid editions of these scenarios will contain many challenges and barriers. Nevertheless, training and testing and developing the teacher and students' attitudes, engagement, and interaction one step at a time, we might develop new pedagogical scenarios compensating for various hybrid hurdles.

2.4. The learning scenario and the technological solution

The recommended equipment type and some tips and tricks around the above-suggested scenarios is shown in Table 1.

- Online presentation sitting in front of PC. The type of VC software defines the way the content can be shared. There is a difference between Teams, Zoom and Google!

Table 1: Recommended equipment

Mic and (loudspeaker)	Podcast mic/all-in-one system, like Jabra/Yamaha	It has the best audio quality from the Podcast mic, but it could be in the way of the camera. The setup needs additional loudspeakers to get audio from participants. The all-in-one is okay as long as it is placed as close as possible to the person talking.
Camera	Use an internal camera on PC or tablet or an external normal webcam	The image from fixed camera or PC/tablet depends on the angle and distance of the talking person. Put the camera in eye height. This position can challenge the handling of the presentation and typing. It's the same rule for external webcam. Putting the webcam on a small tripod is the best. The PC/tablet can then be on the table, with the best work angle and distance. EYE-CONTACT is crucial.
Lights	Put a Led light above the camera as a minimum. (long led list or mobile light) Add lights (flexlite) at 45 degrees on each side of the camera and a light on top/back of the person to optimize image quality (ring).	The number of lights in various positions will extract the person from the background and give a high-quality image of the facial expressions and torso.
Background	Either use a direct virtual background or a green screen.	The direct virtual background will struggle under bad light conditions. Greenscreen works best but depends on good lights and their placement to avoid shadows on the greenscreen. May be used to present slides as a whole or part of a background.
VC software features	Need self-view and view/control of presentation. Will also need the	The views or combo of views depends on the total amount/size of screens and how they are set up

	view of participants before and after the presentation.	physically and in the VC software. Might be a challenge to switch between various activities and planned layout of VC elements, views, camera, presentation, self view, audio levels and viewing students with chat.
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- b. Online presentation moving around, using a whiteboard or similar, drawings on the table, showing objects as content as in Table 2. The type of VC software defines the way the content can be shared simultaneously as one can see the teacher (two video sources). There is a difference between Teams, Zoom and Google!

Table 2: Online presentation moving around, using a whiteboard or similar, drawings on the table, showing objects as content

Mic And (loudspeaker)	Prefer a necworn mic, but we can use tie/clip mic as an okay substitute. Best with wireless transmission	The necworn mic gives a constant audio level and speech indelibility, A moving head will change the audio coming into a tie mic. Need separate powered loudspeaker or an all in one Jabra just acting like a loudspeaker.
Camera	Use a multifunctional camera with tracking of the teacher, possibility to film whiteboard or drawing, like insta360 or Huddly System without tracking could be a doccam/webcam lpevo Separate static camera on whiteboard can also be an option. Huddly or Logitech, which will digitize the content of whiteboard for later reuse. Could then use 2 cameras simultaneously (allowed by zoom and a special software called edumeeet.	The Insta360 must be placed in a good position to get the teacher and/or the whiteboard with the right angle, and optimal view of the teacher's face and gestures and what is done on the board. Finding the right positions and distance is also crucial for the doc. Cam. Pc should be placed so that the teacher can monitor his placement and movement and see what is being sent on the various camera outputs. Define a set of positions which looks good (can be set as camera presets in some cameras/software) Expect some time to change camera placement/settings between various planned activities in the session: Like filming the whiteboard to filming a drawing on a table. It depends again on the VC software, the number of inputs, and switching between them.
Lights	Put a Led light above the camera as a minimum. A ring in front of the person to optimize image quality (out of camera view, but also covering the writing surface) General good diffuse lights in the room helps as well.	The number of lights in various positions will extract the person from the background and give a high-quality image of the facial expressions and torso. Set the lights (physical placement, colour, intensity) according to the one's movements and the objects one want to show in the VC. Often problems with lights filming a whiteboard or projection and person at the same time.
Background	Clean, without too much clutter an mess.	Control the natural light coming in the view of the camera. Avoid backlight.
VC software features	Need self-view and view/control of presentation. Will also need the view of participants before	The views or combo of views depends on the total amount/size of screens and how they are set up physically and in the VC software. Might be a challenge to switch

	and after the presentation, if they should be active. Could also be a lecture recording without audience.	between various activities and planned layout of VC elements, views, camera, presentation, self-view, audio levels and viewing students with chat.
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c. Physical Lab demonstrations with hybrid attendance/observation

This setup gives all online students a first-row seat in the demonstration. The scenario is a multi-camera setup using a [Blackmagic video mixer](#) with 4 HDMI inputs, 2 audio inputs and one USB output, which act as one USB-camera input in the conference. In principle, the mixer can be used to make transitions between sources, picture in picture, show graphics. A whole broadcast system in a tiny unit (also controllable by software).

This system requires cameras or equipment with HDMI out. Many units in the VC bag are USB, so to have full flexibility, units with a combo of USB/HDMI out should be sought for. However, many old cameras, document-cameras, PC, DVD-players etc. have HDMI out, or a converter can be used. This is a sustainable way of using older equipment.

Table 3: Physical Lab demonstrations with hybrid attendance/observation

Mic And (loudspeaker)	Prefer a neckworn mic, but we can use tie/clip mic as an okay substitute. Best with wireless transmission	Can be connected directly to the VC system or via the ATEM mini pro video mixer. Need separate powered loudspeaker or an all-in-one Jabra just acting like a loudspeaker.
Camera	Use up to 4 various cameras or sources with HDMI at the same time. Set separate static cameras on various parts of the demo and one overview showing the whole table and teacher.	Teacher or TA can control and switch between the video sources and choose the video layout being sent to the VC (as a USB cam input) One screen should monitor the output to the VC, either directly in the VC pc or a screen connected through HDMI to the mixer output
Lights	Put a general light on the teacher and table with equipment. Have separate light on small parts shown by cameras.	One way of doing this very cheap is to use dimmable led strips around the table.
Background	Clean, without too much clutter and mess.	Control the natural light coming in the view of the camera. Avoid backlight.
VC software features	Need self-view and view/control of presentation. Will also need the view of participants before and after the presentation, if they should be active. Could also be a lecture recording without audience direct to a USB-disc.	The VC software gets one mixer USB camera input and can use another input as well for a presentation or other source (VC dependent).

d. Podcast production with high-quality audio (and video)

Using a standard PODCAST set up around a table with participants talking into their own MIC with a boom connected to, for instance, a RødeCaster Pro. This system can be connected to a VC system or just used for recordings and production of material. If we place a 360 Camera in the middle of the table, at eye height, we can send a 360 video stream or separate images of participants but using the audio from the podcast audio part.






As long as the participants look at each other when talking this will look natural on the video coming out of the 360 camera. When participants look at a screen in front of the table to see remote part, they will look away from the 360 camera.



2.5. Suggestions of equipment in the VC bag



The recommendations of tools to include in the VC-toolkit when designing for the different scenarios defined in Part 3 are made. Table 4 shows recommended/necessary equipment, cost of suitable equipment, features that should be found in these, a short discussion on pros and cons, and a connection to the pain points the equipment are meant to aid. There are also included links to some examples of recommended equipment, for further investigation.

Table 4: Recommendations of tools to include in the VC-toolkit

Equipment	Features	Pros and cons
General Portable PC 1000-2000 Euro	Portable with USB-C and many in/outs. Enough processing power to record and edit videos. Options to add and run multiple screens.	A PC is compatible with most software VC systems like Zoom, Teams, Google, Webex and eduMEET. Fig 1. Expensive/heavy/battery?
Best Portable PC as a writing surface: Microsoft studio Pro Using an attached Wacom board/screen or another tablet used as an "external" writing surface in a VC, might be an option (like Apple sidecar functionality with Mac and pad.) But it does not have the same quality experience as a Studio Pro for producing teaching material and exporting this to various formats for an LMS or live session.	Good battery, a variety of optional equipment. 2 in one. Act as a normal PC with keyboard or as a standing presentation/VC surface 	Excellent writing surface. Flexible but expensive. Need another screen for VC when using for drawing although it has a built-in camera, mic, and speakers. 
Microphones		
1)Nec-worn 27-250 EUR for mic. Needs transmitter and receiver.		Best option for good audio while moving around. Needs charging.

<p>2) Tie/clip As above. A complete wireless set with 2 senders 1 receiver and 2 Tie mic is from 540EUR (Røde) DJI from 340EUR</p>		<p>Okay when moving around but can cause audio level/frequency variations depending on head movement. Need battery charging.</p>
<p>3) Table (all-in one) Jabra 100-300 EUR Yamaha 250 EUR Loudspeaker and mic in one system.</p>		<p>Okay for movement in small areas, but best for static placement. Quality of audio depends on software and local conditions as background noise, acoustics, number of persons talking at the same time etc. Various connection to VC. Bluetooth, USB, audio cable etc. Battery?</p>
<p>4) podcast Blue YETI with boom From 200USD</p>		<p>Best for high quality audio recordings for production of teaching material. Static position. Require stand or boom. USB or XLR.</p>
<p>Cameras</p>		
<p>Small PTZ cameras like OBSBOT TINY 4K 269 EUR or INSTA360 LINK 4K 415USD</p>		<p>Flexible, with many features and functions. AI. NB !Short USB cable. These companies also deliver AI gimbal for controlling mobile phones/tablets for tracking of persons (teachers moving around)</p> 

		
180-360 cameras IPEVO TOTEM 820EUR OWL 3 1100 EUR	Test with a" unexpensive "model from IPEVO like the TOTEM 360 	Most are Expensive. Various compatibility issues with the software. Low image quality due to resolution, changing light conditions and low-quality stitching. It is hard to find a learning scenario that works with these cameras. (might be as a POV student view or telepresence robot like the AV1
Document or object/microscope From 170 EUR		Flexible and multiuse. There are various image and mechanical construction qualities, but a wise and portable alternative with USB cabling. Check IPEVO for examples
Grabber/converter 390 EUR	Systems to convert and import video from various sources like cameras, doc cams, and Videomixers with HDMI/SDI into VC via USB.	These units provide a smart way to bring a variety of cameras and other video sources into the VC (sustainable). Require USB 3 and good PC processing power. It needs software like Zoom that allows switching or using multiple video sources within the VC.

		
<p>Lights</p> <p>Lumecube webshop US from 80-190 USD for workspace light. Flexlite 270USD. Mobile light 200USD and cordless ring light 270USD</p>	<p>Flexible and adjustable solutions for various scenarios</p>  	<p>The system is easy to carry, has a battery option, is controllable, and supports many learning scenarios. See products from</p>  <p>LUMECUBE</p> 
<p>HUB/docking for connecting various equipment</p> <p>60Eur-420Eur</p>	<p>Example:</p> <p>EZQuest's 8-port USB-C hub</p> <p>Satechi M1 USB-C Multiadapter 1</p> <p>Or others</p> <p>HUB Ugreen triple display</p>	<p>The choice depends on the types and number of equipment to connect to the VC. Some have 2-4 HDMI out, some have 3 USB-A 3 etc.</p>

		Also, be aware of charging and power needs through USB-C. It should not need drivers to make it work.
Videomixer 300 Eur ATEM MINI Expensive alternative Share2U 2236 EUR	Low cost multi camera live production Like the ATEM MINI also for streaming 	Can be used to control various camera/sources inputs in production for a lab demo, interviews, lectures etc. Connect to pc as a webcam or HDMI out.
Programmable Controller for workflows on PC/IPAD/Mobile Elgato stream deck mini From 70 Euro		This company, Elgato, has various smart solutions for every part of production. Workflows, audio, video, lights, greenscreens etc.

2.5. Microphones:

In the old times with ISDN videoconference systems, we always said that the audio was the most crucial thing concerning the quality of the video conference. This statement is still valid; the choice/type of microphone(s) is crucial and depends on the learning scenario and the teacher's physical activity. Four "types" or placements of microphones can be defined.

Head/neck worn microphones

These are usually high-quality microphones with a wireless belt-pack transmitter and often a multichannel receiver with antennas. The advantage of these microphones is that they are in a fixed position/distance to the mouth, independently of head position or movement. This solution delivers the same audio level and quality independently of the speaker's physical (head) movement. It is also highly resistant to ambient noise and other sound sources near the speaker. The mechanical noise in the fixture is low, and there is a low "handling" noise compared to handheld microphones or tie/clip lavalier microphones.



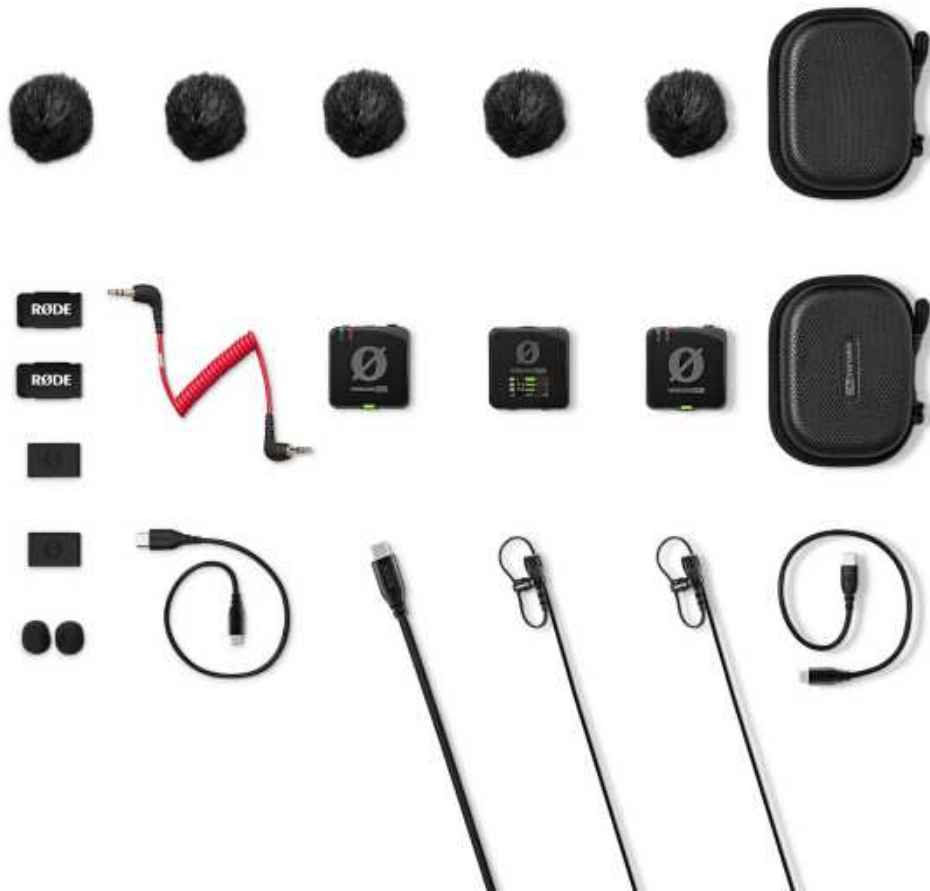
The disadvantage with these microphones is that not everybody knows how to put them on and adjust the mic to get optimized sound without too much air from the mouth coming into the microphone. Where to put the belt-pack transmitter? Furthermore, the wireless belt-pack transmitter might be complex to turn on, and whether it works (battery flat, charging, correct transmission frequency, mute button on/off)? The professional neck-worn microphones with charger, wireless transmitter, and receiver must be configured correctly and connected in one way or another to the rest of the VC system. The interconnection in such a professional setup often requires other types/standards prepared for scalability than a small compact (all-in-one) USB-based VC-system.

CLIP/tie lavalier microphone

These small microphones typically attach to a collar or a part of a dress close to the head. These microphones come in a professional edition, with a connection similar to the neck worm microphone, via a battery belt pack transmitter and a receiver at the Audio/video rack or VC station. The quality of the picked-up audio is excellent, and various types of Lavalier mics can be interchanged/connected to the receiver, depending on the learning scenario or activity: Lab, discussion, interview, or, for instance, a presentation. These systems are mainly for professional use. They are used in broadcasting, theatres or conferences and have a relatively high price level and quality with standard interfaces for connecting to other professional devices.



More simple-to-use and more versatile systems are coming into the semi-pro market to cover education, video-blogging, and podcasting business. Easy to connect to a variety of products. Below is a sample set of the Røde Pro:

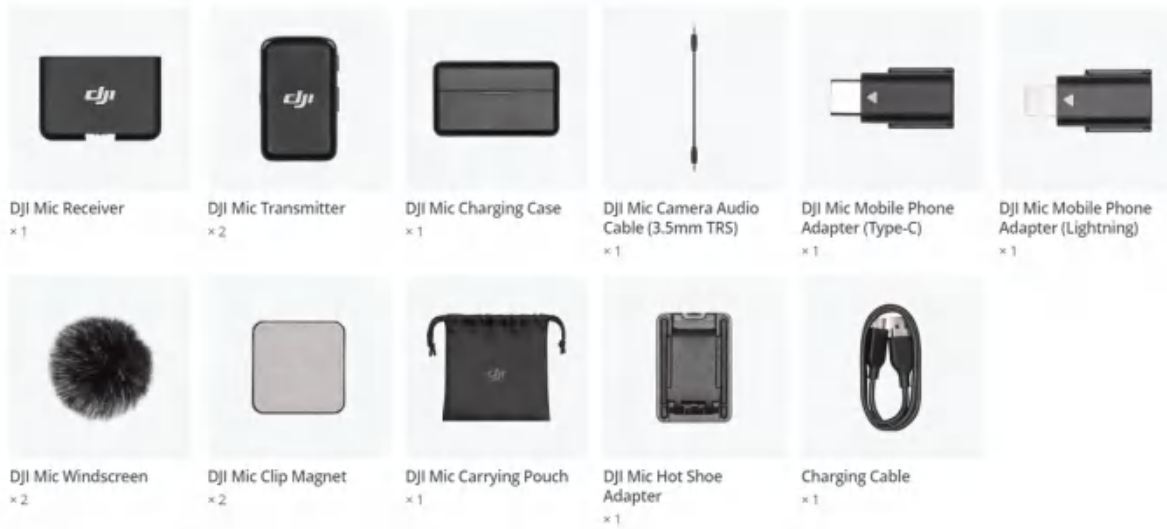


Lately, a new type of easy-to-use system has popped up and offers an all-in-one package with a combo transport and charger receiver part and small clip-on microphones with built-in battery and transmitter. These systems have various connectors and cables for cameras, phones, and other portable devices (drones), just like the RØde Pro. The system in the picture is the DJI wireless microphone system all in one box.

The advantage of small semi-professional systems is that they are small, easy to set up, use, charge, and work right out of the box with many devices. One example is the [DJI mic](#) system with two transmitters one receiver, as shown.



In the Box



However, there are some limitations of these smaller new systems.



The distance between the microphone and the mouth is longer than with a neck-worn system. This means that the voice level will be lower, and external sounds might be so high that they interfere with the voice. In other words, the microphone picks up more unwanted sounds. These sounds might be airborne and caused by mechanical noise between the fabric and the microphone. In addition, the head position relative to the mic's placement changes the sound level and frequency content of the picked-up sound. One often hears this artifact when the presenter turns their head, looks at the presentation on the back wall, and talks. (turning their head away from the mic.)

2.6. Ceiling, table, built in microphones

Many large VC rooms have microphones in the ceiling, using various techniques, like beamforming, to pick up sound from the conversation in a class or meeting space. Some use fixed boundary table microphones in addition to pick up sound. These microphone inputs are then processed and mixed into the conference VC system. From being standalone microphones in ceilings and tables, the microphones now integrate into web cameras, but even more often into a sound/video bars or a similar hub for connectivity.



These bundles/bars or hubs deliver more or less complete VC systems with cameras, loudspeakers, microphones, and options for connecting external devices through wireless or USB.

The advantage of these included/built-in microphones is that most of the setup is automatic, and the systems adjust the sound levels on the fly. One often finds microphones in an array, making it possible to "point toward the wanted sound" by using digital signal processing (DSP), AI or machine learning. However, these processing tools cannot do wonders, and sometimes the room's acoustics reduce the speech intelligibility and quality of the general audio signal.



The drawback of the microphone in these devices is that the distance between the microphone and the person talking might be several meters. Hence, the microphone will pick up more of the room's acoustics, and other sounds will significantly impact the sound quality. (This will also be challenging when several people talk simultaneously). Even though the systems use advanced technologies like array mics, and noise reduction, the processed voice sounds strange and compressed. We miss a lot of the dynamics of the human voice (level, intonation), and it is more tiresome to listen to over more extended periods.

Monotonic

Another drawback of microphones built into cameras is that they are often of low quality and are omni, meaning they pick up sound from everywhere, not just in front of the camera. Unwanted sounds are then entering and distorting the audio quality. If the camera has a PTZ motor the noise of this being used often induces mechanical noise into the microphone. Many of these systems will also be too expensive for our portable VC system, but might be an alternative for specific learning scenarios, with groups working together.

A good, inexpensive USB microphone with an adjustable arm is best for a single-person podcast, videocast, or lecture production, like the blue Yeti MIC with an optional pop filter. Of course, this can expand to an audio podcast package like the Røde podcast set with a dedicated mixer and mics or a set for 2 persons called Gigacaster. Then it can be expanded with cameras and lights to create a video podcast system. See next page for examples.





2.7. Cameras

Today, cameras have excellent quality regarding resolution, low light handling and general image quality. Several types of cameras offer a range of unique functionalities or features. However, sometimes, the applied VC software does not support this, whether it is about a 360-degree image or 4K/8K image resolution at 120Hz, Splitting the video image of a group into separate streams of each person in the group, video/voice tracking, AI controlled features like people count, automated video mixing of various sources and people talking, auto-framing/tracking of persons. Furthermore, if one VC software supports a feature, it does not mean it will work on another connecting software. We will get back to the choice of VC software later. Most portable units like phones, tablets, and computers have a built-in camera and microphone, which might be sufficient for one-on-one VC conversations or a one-many presentations. However, this is not good enough in noisy environments, various light conditions, multiple video sources, added presentations, or multiple people engaging simultaneously at the receiving and transmitting end of the VC. Of course, the VC software platform can connect several portable units in a meeting, but this depends on the software and the quality experience will still be challenged by the environments and situations mentioned above.

Sometimes, cameras are integrated into sound/video bars, 360-degree loudspeaker solutions, and group systems. At first sight, this seems like a good idea, with an all-in-one integrated fast-configured clutter-free solution, but sometimes artifacts and challenges appear during use, depending on the applied VC software and the physical factors like acoustics and light, placement of people and equipment.

2.7.1 General webcams

Various small USB cameras have a clamp/base to connect to a screen or tripod/holder. The specifications of these cameras vary a lot, and one needs to know which features are helpful to do the job as well as possible. (framerate,

angle of view, resolution, frames per second, light/backlight and colour correction, image stabilization. The camera's VC or dedicated control software can adjust many of these settings. Often, it is wise to have a set of different webcams that can be used as a second camera in lab experiments or filming close-ups to exhibit an object. Alternatively, to show a drawing/white/blackboard. The USB cable can use an extender to move the camera around in a learning space more easily.

2.7.2 360-degree cameras

Several standalone cameras with 360 degrees are available for streaming, recording, and sometimes as a camera feed in a videoconference. These cameras are often bundled(built) with loudspeakers and microphones as a centre-of-the-room/table-placed VC solution. These all-in-one solutions offer a variety of modes for sending separate video streams (framing) of a limited number of participants and an overview of the whole room simultaneously. Other features may be tracking of the person speaking. Often, these systems may include audio enhancements like echo cancellation and other "intelligent" functionality, claiming they are all easy to use and set up (plug and play).

Some examples of these cameras are from the OWL labs, like the Owl 3, a centre-of-the-room solution. Similar solutions are available from several companies like Kandao, Ipevo and Logitech.

The Owl 3	Kandao meeting	Ipevo Totem 360
		

At first sight and use, these 360 cameras seem easy to set up and use and have a lot of exciting features. First, challenges must be considered with these systems. The camera's features are sometimes not supported by all the brands of VC software. It has particular limitations in the space it covers concerning audiovisual aspects: Distance to the microphones (audio quality), camera resolution, focus, lens distortion, and stitching influence the output video quality.

2.7.3 Yealink smartvision 60

As mentioned before, other factors will also impact the experienced quality of the output from these devices—various light conditions in the area, acoustics, and background noise. The built-in automated functions might get disturbed by the various conditions of the learning space and introduce artifacts like losing track of who is talking. (tracking features). Losing sync between sound and video causes latency or delay due to more internal processing. However, where how and why should we use them in a VC setting to support our pedagogical approach in the scenarios we define? What features can be utilized in teaching and learning to improve or enhance the learning experience? Engagement, interaction, eye contact.... And at what cost?

Initially, these cameras were designed for huddle spaces and small meeting rooms (later supporting Microsoft Teams front row concept and recently the 21:9 screen aspect ratio) to deliver simple standard setups for ordinary meetings and occasional presentations. In larger and more complex spaces, 360 cameras can be seen as a building block for creating a more engaging, flexible and immersive VC environment. One example is the combination of a video bar in front of the room, a 360 camera on the table, and the possibility of adding extra cameras for whiteboard, extra microphones, sharing capabilities, smart switching. These combos make a fuller experience and can cover more interaction and collaboration within the meeting space.

2.7.4 Owl Labs ecosystem



2.7.5 The Kandao meeting ultra



Logitech front and center combo called Sight



Auto-framing persons and tracking features are also available with other cameras (often supporting wide-angle views up to 180 degrees), whether inside a video bar or standalone. These tracking features can be a combination of digital signal processing of the video (AI cameras) or a physical/motorized camera function often called PTZ (pan, tilt zoom). The advantage of these standalone cameras is that they are easy to place and cost less than most 360 cameras. However, the cost of a video bar with a camera is similar to a 360 camera with microphones and loudspeakers.

2.7.6 Wide angle and PTZ cameras

The focus here will be on the standalone cameras due to their price/performance ratio and the unit size (inside a VC portable system). Some cameras have built-in microphones, but we recommend using a separate system for audio. But once again, many features of auto framing/tracking ,filming whiteboards etc are proprietary functions and often

depend on extra software and are not always compatible with ordinary VC software. Examples of these types of cameras are the [Jabra PanaCast](#) 180 degrees camera.



The Jabra cameras offer software features like filming and sharing a whiteboard as content, framing participants, etc.

2.7.7 Jabra bundle Meet Anywhere

They also offer a bundle package called Meet Anywhere, which contains a mic/loudspeaker, stand, cables, camera, and a carrying bag.

It can be connected to a pc/mac with USB and extended features of extra screens and other VC components by adding a hub/dock with, for instance, USB-A/C, HDMI, and other in/outs.



2.7.8 Obsbot

Products from Obsbot combine the PTZ functions with AI, which means that some cameras move lens around to track, and some use digital tracking and framing. Certain hand gestures can control many features, such as increasing zoom and stopping tracking. Two examples. The tiny series with PTZ and 4K meet series:



These series have many accessories like tripods, magnetic mounts, remotes, carry cases, cables etc.



OBSBOT Tiny Smart
Remote 2



OBSBOT Tiny 2
Adjustable Mount



OBSBOT Tiny 2
Storage Case



Extendable Tripod

2.7.9 INSTA360

With similar functions and with 4K resolution, we find the Insta360 Link, which has a 3-axis gimbal (PTZ) and can used to



- track persons
- Overhead mode: film from above like a document camera
- desk view mode
- film and frame a whiteboard
- gesture control

This camera is Zoom-certified but compatible with VC software like Teams, Cisco, and Google. Many of the features are helpful in a teaching situation through VC. This company has a [large variety of cameras](#) for any activity and might be relevant to specific learning environments or activities.

2.7.10 Huddly

In the high price range of these tiny cameras, Huddly, is without the PTZ, but offers many AI functions like framing, people count, and other analytics. One feature is multi-camera AI-directed live mixing between network-connected cameras as an alternative to using AI on a single 180-360 camera image. All these tiny cameras are easy to connect to the VC system/software. They have multiple mounting and positioning options, deliver high resolution, and have a lot of excellent features. In addition, they are not too expensive.

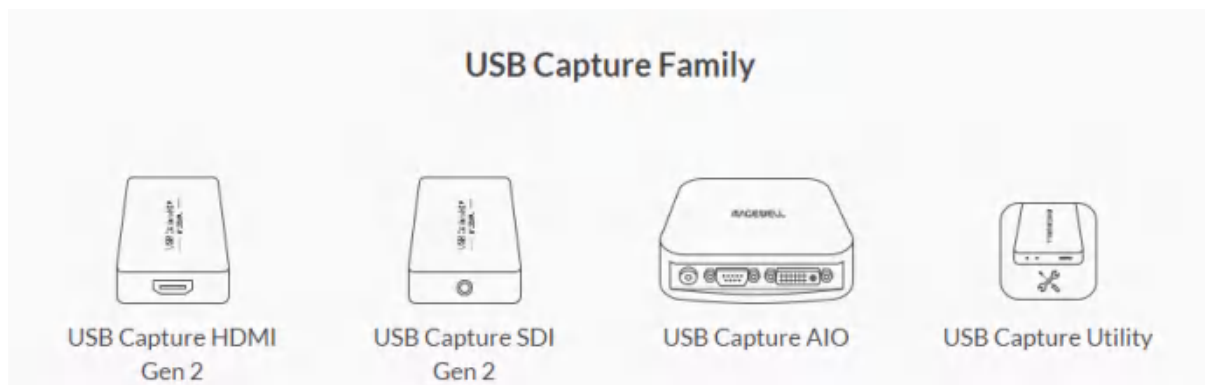
2.7.11 General cameras

Due to their size and cost, other more expensive and professional cameras for VC will not be presented here. However, one should remember that other types of professional/broadcast/home video cameras can connect to the VC portable system, by using interfaces converting the signal from analogue/SDI/HDMI into USB or using USB directly from the camera if it is supported. Some of these interfaces or converters also support camera control, so the VC interface controls the camera like the Inogeni. Here are two examples of these converters:



Inogeni 4KxUSB3S

2.7.12 Magewell USB capture



2.7.13 Document/microscope camera

Although some of the previously mentioned small cameras, like the INSTA360 LINK, can be used as a document or overhead camera, there are also some companies delivering dedicated cameras for these functions, like IPEVO, which has a portable and foldable [doc cam](#) which can be used as a web cam as well.



They also deliver a [combo product](#) to be used for Handheld(microscope), webcam, and doc cam.



Handheld

The handheld demo is a literal point of view, hands-on demonstration of objectives from anywhere. Effortlessly showcase small objects, artwork, or specific parts with precision and clarity while on the go.



Webcam

With a 100-degree field of view (FOV), P2V ULTRA broadens your view, ensuring hassle-free online meetings and learning, as well as live streaming with the Camera Clip



Document Camera

Multi-jointed stand with a magnetic design is an optional accessory, ideal for demos, presentations, teaching, and scanning/digitizing documents up to Tabloid (A3) size using the IPEVO SnapCapture OCR software.



2.8 Writing Surface

First of all, there is a need to define the type of writing surface and how it should be incorporated in the VC. Physical blackboard/whiteboard/glassboard/paper-roll/wall/table paper/flipover etc. In most cases, a system must be used to digitize the content and send it as a source of information into the conference. Whether it is presented as a static image, real-time video, or a document for sharing/cowriting depends on the system. Some systems deliver trackable pen systems to make whiteboards and projections on whiteboards interactive, like the mimeoCapture and mimeoTeach.



Usually a camera is used pointing toward the writing surface, and the quality obtained depends on the light conditions, the contrast, the pen colors, and the size of the area to be captured. Some systems like the [Huddly Canvas Kit](#), [Kaptive](#) and [Logitech Scribe](#) are dedicated solutions to be mounted above the whiteboard. These cameras have software/AI features supporting several types of analysing, sharing, and storing the captured content.



A drawback for these systems is that they must be fixed above the whiteboard and that they have a limitation in the size of the whiteboard (view of camera). In principle, any camera can be used to film a whiteboard, but it would be advisable to use a document camera like IPevo or the INSTA360. This choice is because having a camera can cover several functions simultaneously (showing drawings on a table/paper, objects, and whiteboard and acting as a regular VC cam. Another option is to use a dedicated writing screen/surface like Wacom, a PC with a writing screen or a writable tablet (iPad/ Remarkable). Depending on the learning space/scenarios/activities applied, the various solutions need evaluation and testing to find the right tool for the job (price, performance, usability, functionality and compatibility with the portable VC hardware and software in the F2F/Hybrid/online environment.

2.9 Loudspeaker

The microphone and loudspeaker are often found to be integrated into the same unit , whether a table unit or a headset with a mic. Easy to use solution, but often it has limited coverage on audio distribution and microphone, like the:

YVC-200 Unified Communications Speakerphone

Portable USB & Bluetooth speakerphone

- Yamaha's professional quality DSPs
- Super wideband audio (Fs 32 kHz) for ample, clear sound
- 360 degrees and maximum radius 2 m (6.6 ft) microphone pick up range
- Maximum 88 dB loudspeaker volume
- USB connection for laptops
- Bluetooth / NFC connections for phones and tablets
- Rechargeable battery for up to 10-hour use (or longer with USB)
- Headset outlet for private listening
- User-friendly touch sensor buttons
- Stylish design with choice of white/black colors



Usually, cameras come with built-in mics as well. Once again, the choice of audio system depends on the learning scenario and the activities the teacher is planning. As mentioned earlier, minimizing the distance between the

talker and the mic is vital. Using a combo system with a mic and loudspeaker implies that the system should be placed as close to the talking person. This loudspeaker type and placement is okay in small rooms, with a few participants sitting close to the loudspeaker/microphone. However, in larger rooms or noisy environments, we need larger and better loudspeakers strategically placed to produce high speech intelligibility and good sound coverage for all participants.

A portable system should be easily set up and scalable to cover various room sizes and environments. The connection to the VC is then an essential factor concerning the physical placement and scalability of the loudspeakers (mic/ loudspeaker combo).

Using USB cables between VC and loudspeakers often limits the distance and flexibility of placement. Some systems use regular audio cables or network cables for connecting a soundcard/mixer/VC audio out to loudspeakers, while others use a wireless connection, which might cause dropouts in the audio. In principle, when talking about a backpack VC system, it has natural limitations regarding functions and scalability, and hence, the connectivity to existing or extra existing local equipment should be a focus from a scalable and sustainable viewpoint. In one-to-many scenarios online, this is not important. However, in larger rooms, moving activities, labs, and hybrid approaches, access is needed to various equipment to support an entire interactive hybrid session with local and remote participants working together with audio, video, and shared workspaces, using chat and other types of social parallel channels like discourse, to have a private stream amongst the students in addition to the supervised chat conducted by the teacher.

Chapter Three: AMU EdViCon Toolkits

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3.1 Introduction

This report delineates the developmental process of two video conferencing toolkits within the framework of the Edvicon project. Prior to the procurement of these toolkits, a discernment procedure was undertaken, grounded in the analysis of data obtained from AMU. Additionally, it was imperative to consider criteria such as portability, lightweight design, cost-effectiveness, and lendability for both toolkits. Conducting a comprehensive study to aim at the selection of video conferencing (VC) toolkits, the chosen toolkits are delineated as follows:

1. Toolkit One: Online (no face2face): Home/Other
2. Toolkit Two: Online (no face2face student): Home/Other

It includes the methods applied and participants involved for collecting data and the method applied for analysing the data. The study encompasses three distinct target groups (TG) as participants or sources of information:

- (1) academics and administrative personnel,
- (2) E-learning consultants, IT support, and teacher trainers, and
- (3) students.

3.2 Context

In French, the School of Education called INSPE (*Institut national supérieur du professorat et de l'éducation*) intervenes in the teacher education. With its 163 teachers and 103 administrative and technical staff, the INSPE welcomes its students to train them according to the latest methods and advances in education research to which it contributes in a project of articulation between research, training, and fieldwork.

Specifically, the INSPE is responsible for the master's degree which trains primary school teachers, secondary school teachers, chief education counsellors (CPE) and various other teachings, education, and training professions. Also, the INSPE offers the 2nd year of the bachelor's degree pre-professionalization teaching units (UE) for these professions. More, the INSPE offers the possibility of pursuing a thesis within the doctoral school ED 356 Cognition Language Education.

The INSPE is associated with various partners who together contribute to the same research and training project. The expertise of the INSPE, recognized internationally, is based on the skills of teacher-researchers, teachers, and professionals in the field who are involved in the training and work of the laboratories of the SFERE-Provence research federation that develops research in education. With the Faculties of Science; Arts, Letters, Languages, and Human Sciences (ALLSH); and Sports Sciences, as well as with Avignon University, the INSPE trains secondary school teachers. It covers the disciplines of middle school, general and technological high school, and vocational high school. Its close partnership with the rectorate leads the INSPE to intervene in the continuing education of teachers of the National Education in the academy.

The INSPE is present in Aix-en-Provence, Avignon, Digne-les-Bains, and Marseille. The organization of the training is based on internships and the acquisition of knowledge and professional skills. It allows obtaining the MEEF Master's degree while preparing for the recruitment competitions of the National Education: CRPE, CAPES, CAPET, CAPLP.

MASTER MEEF

The INSPE trains future teachers as well as students aiming for other careers in education and training. Teaching locations: Aix-en-Provence, Avignon, Digne-les-Bains, and Marseille.

- Mention 1: Primary education on all INSPE sites and remotely.
- Mention 2: Secondary education in Aix or Marseille, depending on the discipline.
- Mention 3: Educational supervision in Aix.
- Mention 4: Training practices and engineering.

This mention trains for other careers in education and training:

- Pathway in Research and Expertise in Education in Marseille.
- Pathway in Training Management in Aix.
- Pathway in Professional Writing in Aix.
- Pathway in Design and Management of Training in Hygiene, Safety, and Development in Aix through apprenticeship.
- Pathway in Digital Pedagogical Engineering through distance learning.
- The contents of the MEEF master's program contribute to the acquisition of knowledge and skills defined in the professional reference framework (teachers, teacher-librarians, and CPE).

The MEEF master's program is linked to university research in the following fields:

- The disciplines taught in primary and secondary education: fundamental reference knowledge; knowledge taught in schools.
- Didactics and other related fields (ergonomics, psychology of learning and development, etc.): didactic and pedagogical knowledge.
- Psychology, sociology of education, history of education, philosophy of education, ergonomics, digital technologies, etc.: knowledge about the teaching profession.

The master aims at providing both academic and professional training for teachers and other education and training professionals. It allows for the development of a common culture among all teachers, integrating mechanisms for acquiring skills in foreign languages and the use of digital tools. The master's program is open internationally:

- Certificate of Aptitude for Teaching French Abroad (CAPEFE).
- Internships abroad, study semesters.
- "Professorship of schools" track in English in Marseille.

Data Collection and Analysis

As part of previous activities of the project, data were collected in the form of observations, workshops with the different target groups, and interviews. The analysis resulted in identifying the different scenarios of using video-conferencing systems during the contact hours of courses, the pain points from the perspectives of educators and students, and the differences in pedagogy and didactics.

Brainstorming

A brainstorming exercise or a brainstorming session by the researchers was conducted to identify existing and potential hardware components to be purchased for relieving the pain points. The outcomes of the

brainstorming sessions are presented in a tabular manner. In the process of identifying the hardware components, some of the pedagogical factors were also identified. Brainstorming as an ideation method was also applied for identifying the criteria for selecting the hardware components towards developing to portable VC toolkits. The criteria, corresponding pain points and hardware components as potential pain relievers are presented as a table, which was the intended matrix for identifying best practices/best tools planned in the project.

3.3 Two scenarios and corresponding toolkits

Two toolkits proposed by AMU, including all the hardware items.

Scenario: Planning a Professional Development Session via Video Conference

Context:

A teacher educator wants to organize a professional development session for its teacher-students to discuss the implementation of a new teaching methodology related to the Thinking Design. The session will be conducted via a video conference.

Toolkit One: Online (no face2face): Home/Other
Collaborative writing

Toolkit Two: Online (no face2face student): Home/Other
Conceptual maps

3.4 The hardware items for the two scenarios

Table 1 shows the 11 hardware items.

Table 1: Hardware items for the 2 scenarios for online (no face2face): Home/Other and (no face2face student): Home/Other

No	Item
1	Laptop
2	Extended Screen
3	Light Headphone: Sony WH-H910Nw
4	Multiport adapter with USB C
5	Remarkable 2
6	Wacom Pen Tablet
7	Extended Webcam with Rotation Option

8	Camera Stand
9	Power Strip/Multiplug
10	Wireless Microphone System
11	Universal Travel Adapter with USB Ports

The list of hardware that would be useful for the scenario of organizing a professional development session via video conference:

1. Desktop or Laptop Computer: Teachers will need a computer with a webcam, microphone, and speakers or headphones to participate in the video conference.
2. Webcam: A high-quality webcam is essential for clear video transmission during the conference. Built-in webcams on laptops are sufficient, but external webcams may offer better image quality.
3. Microphone: A reliable microphone ensures that participants' voices are clear and audible during the conference. Headsets with integrated microphones can help reduce background noise and improve audio quality.
4. Speakers or Headphones: Good quality speakers or headphones are necessary for listening to other participants and the presenter during the video conference. Headphones with noise-cancelling features can help minimize distractions.
5. Internet Connection: A stable and high-speed internet connection is crucial for seamless video conferencing. Teachers should have access to a reliable internet connection to avoid disruptions during the session.
6. External Monitor: An external monitor or dual monitor setup can provide additional screen real estate for viewing the video conference, accessing shared documents, and navigating the Coggle (or Google Drive) mind map simultaneously.
7. Keyboard and Mouse: A comfortable keyboard and mouse facilitate navigation within the Coggle mind map (or Google Drive) and interaction with other conference participants.
8. Document Camera (Optional): A document camera or webcam with document-sharing capabilities can be useful for presenting physical documents or handwritten notes during the conference.
9. Lighting Equipment (Optional): Good lighting enhances video quality and ensures that participants are clearly visible during the conference. Soft, diffused lighting sources or ring lights can help improve visibility.
10. Power Backup (Optional): To prevent interruptions due to power outages or battery failures, teachers may consider using a UPS (uninterruptible power supply) or ensuring that their devices are fully charged before the conference.

By ensuring that teachers have access to the necessary hardware equipment, the professional development session can proceed smoothly, allowing participants to fully engage in the discussion and collaborative activities facilitated through Coggle and the video conferencing platform.

3.5 Video Conferencing Software

Zoom

It was selected because it is the main reference for Aix Marseille University. The university provides professional account to all the teacher educators. Zoom is a video conferencing software that allows groups of people to see and talk to each other over the internet using their computers, tablets, or smartphones. It is a brand name for a popular video calling and online meeting platform.

Zoom has exploded in popularity during the COVID-19 pandemic as people turned to video conferencing software for remote work, online classes, and virtual social gatherings. Zoom offers a wide range of features to enhance video conferencing and collaboration.

Some of the key features of Zoom software:

Collaboration Features

- Screen sharing - Presenters can share their entire desktop or specific applications with meeting participants.
- Annotation tools - Participants can use drawing tools to annotate shared screens.
- Whiteboarding - Zoom provides a collaborative whiteboard for brainstorming and visual collaboration.

Chat - Meetings include a group chat for text communication.

- Breakout rooms - Hosts can split meeting participants into separate small rooms for discussions.
- Reactions - Participants can use non-verbal feedback like raise hand, thumbs up/down, etc.
- Meeting Features
- HD video and audio - Zoom supports high-definition video and audio for clear meetings.
- Virtual backgrounds - Users can blur or replace their background with an image or video.
- Waiting rooms - Hosts can enable a waiting room to control when participants join.
- Recording - Local and cloud recording options to capture meetings.

Transcripts - Automatic transcripts can be generated for recorded meetings.

- Polls - Create polls to gather feedback from participants during a meeting.
- Telephony and Messaging
- Phone audio - Participants can join via phone audio in addition to computer audio.
- Zoom Phone - A cloud phone system with call routing, voicemail transcription, etc.
- Team chat - Persistent chat channels for messaging before, during and after meetings.

Administration and Security

- Role-based user management - Assign scheduling, co-host and host privileges.
- SSO and HIPAA compliance support.
- Waiting rooms, passwords, and lockdown options to secure meetings.

3.6 List of Annotation software

3.6.1 Google Drive

Google Drive is a cloud-based file storage and synchronization service developed by Google. It is selected because at the moment the only French good alternative is FRAMAPAD, that is increasing use but for now is more spread Google Drive.

The key points about Google Drive:

- It allows users to store files in the cloud (on Google's servers), access them from any device with an internet connection, and share files with others. (1)
- Google Drive provides 15GB of free storage space which is shared across Google Drive, Gmail, and Google Photos. Users can purchase additional storage through Google One subscription plans. (123)
- It offers apps for Windows, macOS, Android, and iOS devices that allow offline access and automatic syncing of files across devices. (123)
- Google Drive is integrated with Google's productivity suite including Google Docs, Sheets, Slides, etc. allowing collaborative editing of documents, spreadsheets, and presentations. (123)
- It supports a wide range of file formats including Microsoft Office files, PDFs, images, videos, and more. (12)
- Key features include file sharing with granular access controls, real-time collaboration, version history, search within files, optical character recognition (OCR) for scanned documents, and offline access. (123)
- For businesses and enterprises, Google offers Google Drive Enterprise (formerly Drive for Work) with advanced admin controls, audit reports, unlimited storage (paid), and enhanced security/compliance features. (1)
- Google Drive for Education provides unlimited storage and support for individual files up to 5TB for educational institutions using Google Workspace for Education.

3.6.2 Coggle

Coggle is a web-based collaborative mind mapping tool that allows users to create, share, and work together on hierarchical diagrams and flowcharts in real-time. It is selected because well-known by Aix Marseille University educators.

Key Features of Coggle

- Free to use with unlimited mind maps and real-time collaboration.
- Hierarchical branching tree structure for organizing ideas and information visually.
- Real-time collaboration allowing multiple users to edit the same mind map simultaneously.
- Ability to share mind maps with individuals, organizations, or via private links.
- Version history to view and revert to previous versions of a mind map.
- Support for adding images, links, comments, and formatting text with Markdown and LaTeX.
- Export options including PNG images, vector PDF, FreeMind file format, and plain text outlines.
- Mobile apps available for iOS and Android devices.
- Paid subscription plans with additional features like flowchart shapes, private maps, and enterprise support.
- Coggle aims to provide a simple and clean interface for mind mapping, making it easy to visualize, organize, and share complex information collaboratively.

Its real-time collaboration capabilities and integration with services like Google Drive have made it popular in educational settings and among teams working on projects together. While praised for its simplicity, some critics have noted that Coggle's minimalist design can make it difficult to discover advanced features. Nonetheless, Coggle has been well-received as a user-friendly and powerful mind mapping solution, particularly for its collaborative aspects.

3.7 List of student engagement tools

The list of student engagement tools is:

1. Kahoot!
2. Socrative
3. Mentimeter
4. Padlet
5. Edpuzzle
6. Poll Everywhere

Some student engagement activities and corresponding tools that can be incorporated into the professional development session for teachers are:

1. Kahoot!: Conduct a fun and interactive quiz or trivia game related to the topics discussed during the session using Kahoot! Teachers can create multiple-choice questions, and participants can join the game using their smartphones or computers.
2. Socrative: Use Socrative to create real-time quizzes, assessments, and exit tickets to gauge teachers' understanding of key concepts covered in the session. Participants can respond to questions using their devices, and the results are instantly displayed for discussion.
3. Mentimeter: Encourage active participation and feedback from teachers by using Mentimeter to create interactive presentations with live polls, quizzes, word clouds, and Q&A sessions. Teachers can anonymously respond to questions and provide input in real-time.
4. Padlet: Foster collaboration and idea-sharing among teachers by using Padlet as a virtual bulletin board for brainstorming, sharing resources, and posting reflections on session topics. Participants can contribute text, images, links, and videos to the Padlet board.
5. Edpuzzle: Create engaging video-based lessons or tutorials using Edpuzzle, where teachers can embed questions, quizzes, and discussions directly into educational videos. Teachers can assign Edpuzzle activities to participants and track their progress and understanding.
6. Poll Everywhere: Use Poll Everywhere to gather instant feedback, opinions, and responses from teachers through live polls and surveys. Participants can submit their answers via text message, web browser, or mobile app, and the results are displayed in real-time.

Incorporating these student engagement activities and tools into the professional development session can enhance teacher participation, facilitate interactive learning experiences, and provide valuable insights into teachers' understanding and perspectives on session content.

3.8 Experience of trial use

Focus on Toolkit Two: Online (no face2face student): Home/Other

Conceptual maps

Steps Using Coggle:

1. Preparing the Agenda:
 - The organizer creates a Coggle mind map outlining the agenda for the professional development session.
 - Each agenda item is represented as a branch on the mind map, allowing for easy visualization and organization of topics.
2. Collaborative Planning:

- The organizer invites key stakeholders, such as department heads and curriculum coordinators, to collaborate on the agenda in real-time.
 - Using Coggle's collaborative features, participants can contribute ideas, suggest changes, and add additional agenda items as needed.
3. Structuring Discussion Topics:
 - Within the mind map, each agenda item can be expanded to include detailed information, discussion points, and relevant resources.
 - Teacher-students can access the mind map before the session to review discussion topics and prepare any materials or questions they may have.
 4. Integrating Multimedia Resources:
 - Coggle allows users to embed multimedia resources directly into the mind map, such as instructional videos, slide presentations, or PDF documents.
 - The organizer includes links to relevant resources within each agenda item to provide additional context and support for discussion topics.
 5. Setting Up the Video Conference:
 - Once the agenda is finalized, the organizer schedules the video conference using the AMU university's preferred platform, such as Zoom.
 - The link to join the video conference is added to the Coggle mind map, making it easily accessible to all participants.
 6. Conducting the Session:
 - During the video conference, the organizer shares their screen to present the Coggle mind map, guiding participants through each agenda item.
 - Teachers can interact with the mind map in real-time, adding notes, comments, and ideas as the discussion progresses.
 - The structured layout of the mind map keeps the conversation focused and ensures that all agenda items are addressed.
 7. Post-Session Follow-up:
 - After the session, the Coggle mind map serves as a visual summary of the discussion, capturing key insights, decisions, and action items.
 - Participants can refer back to the mind map to review meeting outcomes and follow up on any tasks assigned during the session.

By utilizing Coggle for planning and organizing the video conference, teacher-students can engage in a collaborative and structured professional development session, fostering meaningful discussion and promoting effective implementation of new teaching strategies. A final assessment activity that can be incorporated into the professional development session for teachers is a reflective journaling exercise using Google Forms.

Activity: Reflective Journaling

Objective: To allow teachers to reflect on their learning throughout the professional development session, consolidate key takeaways, and identify areas for future growth.

Tool: Google Forms

Instructions:

1. Before the session ends, distribute a Google Forms link to all participants.
2. In the Google Form, include a series of reflective questions related to the session content, such as:
 - What were the most valuable insights you gained from this professional development session?
 - How do you plan to apply the knowledge and skills acquired in your teaching practice?

- Were there any concepts or topics that you found challenging or unclear? If so, please explain.
 - What additional support or resources do you feel would enhance your understanding of the session topics?
 - How do you envision incorporating the strategies discussed into your classroom instruction?
2. Encourage teachers to take some time to reflect on their responses thoughtfully.
 3. Once completed, teachers can submit their responses through the Google Form.
 4. After reviewing the submissions, provide personalized feedback or follow-up resources to address any questions or concerns raised by the participants.

Benefits:

- Allows teachers to reflect on their learning journey and articulate their thoughts and insights.
- Provides valuable feedback to facilitators on the effectiveness of the professional development session and areas for improvement.
- Encourages ongoing professional growth and development by fostering a culture of reflection and self-assessment among teachers.

By incorporating this final assessment activity using Google Forms, educators can engage in meaningful reflection, reinforce their learning, and set actionable goals for implementing new strategies and techniques in their teaching practice.

3.9 Matrix of the scenario

Table 2 shows a matrix outlining the scenario with hardware, software, and assessment components.

Table 2: Matrix outlining the scenario with hardware, software, and assessment components

Aspect	Hardware	Software	Assessment
Video Conferencing Setup	<ul style="list-style-type: none"> – Computer with webcam and microphone – Stable internet connection – Headset or speakers 	<ul style="list-style-type: none"> – Video conferencing platform (e.g., Zoom) – Screen sharing software 	<ul style="list-style-type: none"> – Observation of technical setup – Feedback from peers or facilitator
Student Engagement Tools	<ul style="list-style-type: none"> – Interactive whiteboard – Digital document camera – Tablet or touchscreen device 	<ul style="list-style-type: none"> – Kahoot! – Socrative – Mentimeter – Padlet – Edpuzzle – Poll Everywhere 	<ul style="list-style-type: none"> – Participation rates in interactive activities – Student feedback surveys

Final Assessment	<ul style="list-style-type: none"> – Computer or mobile device – Stable internet connection 	<ul style="list-style-type: none"> – Learning management system (LMS) – - Assessment tools integrated with LMS (e.g., quizzes, assignments) 	<ul style="list-style-type: none"> – Completion of online quizzes or assignments – Performance on summative assessments – - Peer or self-assessment reflections
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This matrix provides an overview of the hardware, software, and assessment components involved in the scenario, facilitating effective implementation and evaluation of the professional development session for teachers.

3.10 Concluding Remarks: Scope of Future Work

This scenario is considered innovative pedagogy because it integrates various technological tools and assessment strategies to enhance teaching and learning experiences.

1. **Integration of Video Conferencing Setup:** By utilizing video conferencing platforms like Zoom, teachers can conduct interactive sessions remotely, breaking geographical barriers. This fosters collaboration and engagement among participants who may not be physically present in the same location. Additionally, the observation of technical setup and feedback mechanisms ensure that participants are equipped with the necessary skills to utilize these tools effectively, promoting digital literacy and competency.
2. **Student Engagement Tools:** The incorporation of interactive tools such as Kahoot!, Socrative, Mentimeter, Padlet, Edpuzzle, and Poll Everywhere enhances student engagement and participation. These tools facilitate active learning by enabling real-time interaction, collaborative problem-solving, and instant feedback. Moreover, tracking participation rates and gathering student feedback through surveys allows educators to gauge the effectiveness of these tools in capturing student interest and promoting deeper understanding.
3. **Final Assessment:** Moving beyond traditional assessment methods, the use of online quizzes, assignments, and integrated assessment tools within a Learning Management System (LMS) offers flexibility and convenience for both educators and learners. It allows for the customization of assessments to suit individual learning needs and provides timely feedback to guide further learning and improvement. Additionally, incorporating peer or self-assessment reflections encourages metacognitive skills development and promotes a reflective approach to learning.

Overall, this integrated approach leverages technology to create dynamic and interactive learning environments, catering to diverse learning styles and preferences. It empowers educators with the tools and resources needed to engage students effectively, assess learning outcomes comprehensively, and promote continuous improvement in teaching practices.

Chapter Four: ANNU EdViCon Toolkits

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4.1 Objective: Integrated portable toolkits for ANNU

The toolkit included selection of video conferencing system, additional hardware as personalize tools for teachers and other software to engage students during classroom teaching. Examples are:

Video Conferencing System

Zoom - Higher Education

4.2 ANNU scenario

ANNU moves between onsite and online teaching due to sudden circumstances. Currently, eLearning centre resources cannot be borrowed by the teachers. The portable video-conferencing toolkit can be borrowed by the teachers for teaching from regular classrooms that do not currently have a video-conferencing setup. So, the objective is to equip eLearning centre with several tools the teacher can borrow and to get support for any technical issues in the classroom or elsewhere for live teaching.

4.3 Equipment to purchase:

The equipment to acquired is shown in Table 1.

Table 1: Equipment to acquire

No.	Item	Cost
1.	Laptop	1600\$ (1488 €)
2.	Teamgee Portable Monitor for Laptop, 12" Full HD IPS Display, Dual Triple Monitor Screen	340\$ (317€)
3.	Speaker and Microphone (Jabra Speak2 55 MS)	124\$ (115€)
4.	Internet extender	60\$ (56€)
5.	UPS power	180\$ (167€)
6.	Webcam (Logitech C920 HD Stream Webcam)	87\$ (81€)
7.	Remarkable 2	280\$ (261€)
	Total + Tax and Exchange Rate	2845€ + 248.5€ = 2733.50€

4.4 Description of targeted equipment:

4.4.1 Laptop (Dell suggested)

Processor: Intel® Core™ i7-12700H
Display Card: NVIDIA® GeForce RTX™ 3060 6GB GDDR6
Memory : 16GB DDR5
Storage: NVMe-1TB.SSD integrated
Display : 15.6 2560x1440 165Hz
windows 11 Pro
Audio and Speakers: Dual stereo speakers
Including original laptop bag



4.4.2 Wireless headset with mic

Headset

- Height: 7.20 in (183 mm)
- Width: 6.68 in (169.7 mm)
- Depth: 0.2 ft (73 mm)
- Weight: 6.52 oz (185 g)

Ear pad

- Height: 3.88 in (98.6 mm)
- Width: 2.97 in (75.4 mm)
- Depth: 0.76 in (19.3 mm)

USB-A Receiver

- Height: 0.85 in (21.5 mm)
- Width: 0.54 in (13.6 mm)
- Depth: 0.24 in (6 mm)

USB-A to USB-C Adapter

- Height: 0.99 in (25.2 mm)
- Width: 0.65 in (16.5 mm)
- Depth: 0.37 in (9.5 mm)

Technical Specifications

Microphone

- Type: Dual omni-directional MEMS mics with directional beamforming and DSP
- Frequency Response: 100 ~ 8 KHz

Speakers

- Frequency response (music mode): 20 ~ 20 KHz
- Frequency response (talk mode): 100 ~ 8 KHz
- Sensitivity: 118.0±3 dB at 1mW @1 kHz
- Driver size: 1.57 in (40 mm)

Battery

- Built-in battery (Lithium ion)
- Battery life (talk time): Up to 18 hrs 1Battery life may vary based on users and computing conditions.
- Battery life (listening time): Up to 20 hrs 2Battery life may vary based on users and computing conditions.

Charging cable length

4.4.3 Teamgee Portable Monitor for Laptop

<https://www.amazon.com/TeamGee-Portable-Monitor-Display-Extender/dp/B09NLKWDMP?th=1>



4.4.4 Speaker and Microphone (Jabra Speak2 55 MS)



4.4.5 Internet Extender

Xiaomi, 300 Megabits Per Second

4.4.6 UPS

Portable UPS

Simran UPS500 Power Backup System 220 Volt 50hz For Export

- 300 Watts max
- Continuous Power Supply protects your data by supplying battery backup when power fails
- Input Voltage: Overseas AC 220V
- Input Frequency: 50Hz
- Input Voltage Range: AC 165V - 275V
- Output Voltage: AC 220V +/- 10%
- Output Frequency: 50Hz +/- 5%
- Charge Time: Approximately 8 hours
- Fuse protection against overload or short circuit
- Power Switch for power on-off, battery test and buzzer on-off
- High quality maintenance free battery
- Automatic Detection performs an inspection of the battery capacity
- Automatic Voltage Regulation corrects over-voltage and under-voltage without draining the battery
- Surge protection shields hardware from damage
- UPS charges its battery automatically whenever it is connected to the power
- Output Socket to connect with load equipment
- Input Power Cord to connect to the 220 AC power
- Dimensions: Depth 327mm x Width 96mm x Height 172mm approx.
- Weight: 6.5 kg. approx.
- Model: Simran UPS

4.4.7 Logitech C920 HD Stream Webcam



4.4.8 Remarkable 2

(<https://remarkable.com/store/remarkable-2>)



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Chapter Five: MFU EdViCon Toolkits

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5.1 Introduction

This guide explores how educators can leverage technology to create dynamic and engaging learning environments. Two key areas are delved:

1. MFU Tool Kits: Exploring how a specific set of hardware tools can address common challenges faced in various classroom settings, from IT classes to foreign language instruction.
2. Online tools: Looking at how video conferencing platforms, annotation software, and student engagement tools can empower educators and enhance the learning experience for students.

Through practical examples and explanations, this guide aims to equip teachers with the knowledge and resources to transform their classrooms into spaces that foster deeper engagement and effective learning.

5.2 Two scenarios and corresponding toolkits

Table 1 shows the 2 key areas, and their corresponding toolkits required.

Table 1: Two scenarios and corresponding toolkits

Scenario/Courses Investigated	Pain point	Tools	To be solved
IT Database system	<ol style="list-style-type: none">1. When a teacher goes to the presentation mode, s/he cannot see students' cameras2. The microphone's moved is limited to the length of the wire.3. Students using personal device for presentations in the class require long setup time for troubleshooting various hardware compatibility issues.4. Low quality of recorded videos.	<ol style="list-style-type: none">1. iPad2. Portable monitor3. Wireless mic for teacher4. Good Webcam5. Trackable tripod6. Lighting7. Screen casting connector	<ol style="list-style-type: none">1. A portable monitor will extend the view and let the teacher see the audience's camera2. Wireless microphone will allow free movement for teachers and group presentations.3. Easy share will allow students to show their screen from any device to a projector4. Light, webcam, tracking tripod will help teacher when goes online or recording to make a better video5. iPad will let teacher to present and record the teaching easier

Medical Aroma Therapy	<ol style="list-style-type: none"> 1. Learner Engagement 2. Request for class recordings 3. Student presentation is difficult (mic and visualization connection) 4. Recorded video low quality 	<ol style="list-style-type: none"> 1. Portable monitor 2. Wireless mic for teacher 3. Good Webcam 4. Trackable tripod 5. Lighting 6. Screen casting device 	
Secondary Language Chinese Sound System	<ol style="list-style-type: none"> 1. Learner engagement 2. Class is big size, number of assignments is huge 3. Microphone is fixed. 4. Recorded video low quality 	<ol style="list-style-type: none"> 1. Portable monitor 2. Wireless mic for teacher 3. Good Webcam 4. Trackable tripod 5. Lighting 6. Screen casting device 	
Digital Business Customer Behaviors and Experience	<ol style="list-style-type: none"> 1. In-field learning activities are necessary, often requiring complex setups and disrupting natural behaviour. 2. Authentic scenarios are crucial for accurate analysis. Lack of access to diverse customer segments and their specific usage contexts. 3. Real customer behaviour and experience analysis often relies on self-reported data, which can be biased and incomplete. 	<ol style="list-style-type: none"> 1. Wireless microphone/sp eaker set 2. Portable monitor and speaker 3. Eye tracking for analysing customer experience 4. Green screen, lighting and tripod set 	<ol style="list-style-type: none"> 1. Utilize lightweight, wearable devices for active in-field tasks. 2. Analyse visual attention and customer emotions for deeper insights into their experience. 3. Interact virtual scenarios and create compelling visuals.

5.3 List of devices

1. For classroom enhancement
 1. Laptop 32,000THB 1000.00 USD
 2. 15 inches Portable Monitor 4500THB 140.00 USD
 3. Bluetooth mic/speaker 600THB 20.00 USD
 4. HD Web Camera with light 3000THB 100.00 USD
 5. Trackable tripod for mobile 500THB 15.60 USD
 6. Mirror cast device 300THB 10.00 USD

2. For recording		
1. Laptop	32,000THB	1000.00 USD
2. 15 inches Portable Monitor	4500THB	140.00 USD
3. Bluetooth mic/speaker	600THB	20.00 USD
4. HD Web Camera with light	3000THB	100.00 USD
5. Trackable tripod for mobile	500THB	15.60 USD
6. Ring-light	500THB	15.60 USD

This set of devices can transform a regular classroom into a versatile and engaging learning environment.

5.3.1 Laptop

The foundation for most of the technology, the laptop allows one to:

- Create lesson plans and presentations: Use word processing, presentation software, and mind mapping tools to design interactive and visually appealing lessons.
- Access educational resources: Find countless educational websites, online textbooks, simulations, and educational videos to supplement your teaching.
- Develop online assessments and quizzes: Use online tools to create quizzes and track student progress.

5.3.2 15-inch Portable Monitor:

- Dual-screen setup: Extend the laptop screen for better organization and multitasking.
- Share content with the class: Display presentations, websites, or student work on a larger screen for better visibility.

5.3.3 Portable Wireless Microphone:

- Amplify the voice: Ensures everyone in the class can hear clearly, especially in larger rooms or outdoors.
- Increase mobility: Move around the classroom and interact with students freely without being tethered to a podium microphone.

5.3.4 Movable/Trackable Web Camera & Trackable Tripod for Mobile

- Create engaging video lessons: Record lectures, demonstrations, or experiments for flipped classrooms or remote learning.
- Live stream lessons: Connect with students virtually and offer remote learning options.
- Interactive presentations: Use the camera to show close-up details of objects or experiments.
- Student presentations: Allow students to use the mobile tripod to record presentations or demonstrations.

5.3.5 Lighting (for Recording Session)

- Professional-looking recordings: Enhance the quality of your video lessons with proper lighting.
- Reduce glare and improve visibility: Eliminate distractions and ensure students can see everything clearly on screen.

5.3.6 Mirror Cast Device

- Wireless screen sharing: Share your phone or tablet screen directly onto the projector or monitor.
- Display student work: Allow students to showcase their work wirelessly from their devices.

By combining these devices, a dynamic and interactive learning environment can be created that caters to different learning styles and keeps students engaged.

5.4 Video Conferencing Software

The various teleconferencing tools available for use in classrooms at Mae Fah Luang University (MFU) are discussed with some additional context.

5.4.1 Zoom

A popular option for online classes and meetings. While MFU has a subscription, the number of accounts is limited. This creates a situation where some teachers need to wait for availability (maintain queues) or use the free version with its time constraints.

5.4.2 Microsoft Teams: MFU provides access to Microsoft Teams through its subscription to Microsoft services. Teams is designed for various functionalities like lectures, group projects, and communication. However, its complexity and lack of user-friendliness compared to other options discourage some teachers from using it in classrooms.

5.4.3 Google Meet: This user-friendly and lightweight tool is a part of the Google Education suite that MFU subscribes to. It doesn't require installation, making it a popular choice among teachers for online classes and meetings.

5.4.4 Cisco WebEx: MFU offers Cisco WebEx, another video conferencing tool suitable for online classes, especially large general education courses. Unlike Google Meet, not all teachers are automatically registered for WebEx. They need to contact the admin for activation. Despite this additional step, some teachers prefer it for its user-friendly interface and lightweight functionality.

Considerations for MFU:

- Account limitations: Zoom's limited accounts might pose challenges for scheduling online classes or meetings.
- User-friendliness: The complexity of Microsoft Teams might be a barrier to adoption for some teachers who prefer simpler tools.
- Registration process: The additional registration step required for Cisco WebEx could be a hurdle for some teachers.

In conclusion, MFU offers a variety of teleconferencing tools, but factors like account limitations, user-friendliness, and registration processes can influence teachers' choices. Perhaps promoting user training sessions on Teams or simplifying the WebEx registration process could encourage wider adoption of these tools.

5.5 List of Annotation software

The following shows how each application supports annotation for learning and teaching.

5.5.1 Microsoft OneNote:

- **Free-form organization:** Create digital notebooks with flexible sections and pages for organizing notes, images, web clippings, and audio recordings.
- **Multi-device access:** Access and annotate notes across various devices (computer, tablet, phone) for seamless learning on the go.
- **Collaboration:** Share notebooks with students for collaborative projects, real-time feedback, and group brainstorming sessions.
- **Handwriting recognition:** Integrates with OneNote Class Notebooks for teachers to easily convert handwritten student notes to text for faster feedback.

5.5.2 Microsoft Word:

- **Document annotation:** Students can highlight, add comments, and reply to teacher feedback directly within Word documents.
- **Track changes:** Teachers can track edits and revisions made by students, providing specific feedback throughout the drafting process.
- **Version control:** Review and revert to previous versions of documents, ensuring students can track their progress and avoid losing work accidentally.
- **Limited free-form capabilities:** While not ideal for extensive notetaking, Word allows basic annotations like text boxes and drawings.

5.5.3 Google Docs:

- **Real-time collaboration:** Students and teachers can work on documents simultaneously, fostering interactive learning experiences.
- **Comment & suggestion tools:** Similar to MS Word, allows adding comments and suggestions with inline replies for clear communication.
- **Version history:** Tracks changes made to the document, enabling revision history and easy recovery of previous drafts.
- **Limited free-form capabilities:** Similar to MS Word, annotations are primarily focused on text edits and lack features for elaborate drawings or mind maps.

5.5.4 Acrobat Reader:

- **PDF annotation powerhouse:** Provides a robust set of annotation tools for highlighting, adding comments, creating sticky notes, and drawing shapes on PDFs.
- **Feedback tools:** Offers features like text stamps and drawing tools for teachers to provide specific feedback on student work submitted as PDFs.
- **Fillable forms:** Allows creating fillable forms within PDFs for assignments, quizzes, or surveys with easy digital submission.
- **Limited collaborative features:** While annotations can be shared, real-time collaboration on document editing is not a primary strength.

5.5.5 Apple Notes:

- **Basic annotation on iPad:** Using Apple Pencil, students can highlight, draw, and add handwritten notes directly on PDFs and images within the Notes app.
- **Simple organization:** Organize notes into folders for basic categorisation of learning materials.
- **Checklist creation:** Create checklists within notes for students to track tasks or learning objectives.

- Limited collaboration and features: Primarily for individual note-taking and lacks advanced annotation features or real-time collaboration tools.

5.6 List of student engagement tools

A list of student engagement tools are identified.

1. Moodle - An LMS platform used for online courses, hosting learning materials, and facilitating student-teacher interactions.
2. Google Classroom - Used by teachers to share assignments, materials, and announcements with students.
3. Padlet - Used for class engagement and collaboration, allowing students to post questions and ideas.
4. Google Docs - Used for collaborative work, brainstorming, and note-taking during lectures.
5. Muarl - An app used for brainstorming and idea generation in-class activities, particularly for problem definition before prototyping.
6. H5P - Used to add interactive questions to recorded videos on LMS platforms.
7. Kahoot - An engagement tool used for interactive quizzes and games in the classroom.
8. Gather Town - An engagement tool used for virtual spaces and interactive activities.
9. Edpuzzle - A platform used to create and share interactive video lessons.
10. Mentimeter - Used for interactive presentations and real-time audience engagement.
11. Classpoint - A class engagement tool used for activities and gamification.
12. Quizziss.com - Used for creating quizzes and managing scores.
13. Slido - A tool used for interactive presentations, audience engagement, and real-time Q&A.
14. LabView - A simulation software used for practical courses, particularly in the field of circuit engineering.
15. Tinkercad - A free simulation tool used for practical courses, allowing students to try circuits and devices virtually.
16. Google Forms - Used for creating quizzes, surveys, and collecting feedback.
17. Tutorials and training resources - Provided by IT support staff to help teachers and students learn and use the various tools effectively.

Chapter Six

UiTM EdViCon Toolkits

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6.1 Introduction

In Malaysia, Google Meet and Microsoft Teams are commonly used by educators as video conferencing tools, among other tools such as Zoom meetings, Webex Meetings and Skype for teaching and learning. This is due to the subscription of the two video conferencing tools by the Minister of Higher Learning Institution of Malaysia. The common features of video conferencing tools include instant group video calls, video recording, screen and file sharing, access to the desktop, and editing during the virtual meeting. These bring teaching and learning closer to the face-to-face environment, thus achieving both students' and educators' teaching and learning goals. These were revealed through a study exploring existing practices of using video conferencing tools in teaching and learning, the didactics involving other tools conducted by the Universiti Teknologi MARA team members of the ERASMUS+ EdViCon Project. Utilising an exploratory method with 3 target groups (TG) from Malaysia Higher Learning Institutions: TG 1, academicians or researchers; TG 2, E-learning consultants and IT support staff; and TG 3, the students. Data gathered via focus group discussions and in-depth interviews developed from the four elements of the PACT framework: People, Activities, Contexts, and Technologies (Benyon, 2019) with the target groups. The PACT framework was utilised to understand the PACT dimensions from the three targeted groups, and the findings were used to identify the UiTM EdViCon Toolkits.

Ling SE, Chan, MKY, Md Saifuddin Khalid, Ling SC & Engkamat, A. 2024. Identifying Issues of Video Conferencing Tools for Teaching and Learning Using the PACT Framework. *Electronic Journal of e-Learning*: 91-102.

6.2 Two scenarios and corresponding toolkits

UiTM practises both conventional face-to-face and fully online teaching and learning. The fully online teaching and learning is conducted during the “Weeks without Walls” fixed in the academic calendar. Besides this, hybrid classes are carried out when some students cannot attend the physical classes. These are the driving forces of UiTM ideating two portable video conferencing toolkits for online and hybrid classes and online tools for engaging students. The prototypes are transferable, considering the diversity of teaching environments.

Issues arising from online teaching and learning are also experienced in hybrid classrooms; however, the second scenario highlights additional issues in hybrid classrooms (Table 1).

Table 1: Issues arising from online teaching and learning experienced in hybrid classrooms

Scenario	Issues	Solution	Context
Online Teaching and Learning			
1. Unable to monitor the students while screen-sharing	<ul style="list-style-type: none">A single screen can only display	<ul style="list-style-type: none">Use extended screens	<ul style="list-style-type: none">Display of different window layouts on different screens

	<p>visual teaching materials</p> <ul style="list-style-type: none"> • The visual presence of students does not display • Not able to know which students press the “hand-up” button” for attention 	<ul style="list-style-type: none"> • Use other tools like WhatsApp to get attention from the lecturer 	<ul style="list-style-type: none"> • Manage the online classroom management
2. No interaction with students	<ul style="list-style-type: none"> • Continual delivery of lectures • Passive Students • Declining attention • Interruptions by all popups from social media or emails 	<ul style="list-style-type: none"> • Introduce online tools for engaging students in live teaching sessions 	<ul style="list-style-type: none"> • Maintain their attention • Foster active participation
3. Turning off video by students	<ul style="list-style-type: none"> • Limited data for Internet access • Background not conducive 	<ul style="list-style-type: none"> • Use the background screen change option 	<ul style="list-style-type: none"> • Reduce distractions from surrounding
4. Noise from surrounding	<ul style="list-style-type: none"> • Distraction 	<ul style="list-style-type: none"> • Use headphone 	<ul style="list-style-type: none"> • Noise cancellation
5. Difficulties in taking notes	<ul style="list-style-type: none"> • Language barriers • Latent internet connectivity 	<ul style="list-style-type: none"> • Use recorded session 	<ul style="list-style-type: none"> • Recorded sessions can be replayed by students
6. Lack of educator skills in the use of conferencing technology	<ul style="list-style-type: none"> • Basic video conferencing features used • Not having the knowledge to adopt online tools 	<ul style="list-style-type: none"> • Follow training using video manuals 	<ul style="list-style-type: none"> • Independent learning due to time constraints
7. The problem of invigilation during examination/ proctoring	<ul style="list-style-type: none"> • Not possible to monitor students referring to resource materials • Plagiarism of answer scripts • Not turning on the video due to limitation of data 	<ul style="list-style-type: none"> • Compulsory to turn on the video 	<ul style="list-style-type: none"> • Not to conduct online examination/test





Hybrid Teaching and Learning (Additional to Online Classes)			
1. Less attention is given to online students	<ul style="list-style-type: none"> • Difficulty in contacting online students because cannot see online students on a single screen • Not following up with the chat box or “Hand-up” • Attention through eye-contact 	<ul style="list-style-type: none"> • Use extended screens • Can see visual cues of online and face-to-face students 	<ul style="list-style-type: none"> • Display of different window layouts on different screens • Manage the online classroom management
2. Technical hiccups	<ul style="list-style-type: none"> • Immediate technical support is not available 	<ul style="list-style-type: none"> • Use external recording devices 	<ul style="list-style-type: none"> • Recorded sessions can be replayed by students
3. Lack of social interaction between online and face-to-face students	<ul style="list-style-type: none"> • No panorama view of the classroom by online students • Miss out discourse among students 	<ul style="list-style-type: none"> • Use 360 camera 	<ul style="list-style-type: none"> • Capture of an omnidirectional view of the classroom • Detect speakers
4. Audibility of lectures	<ul style="list-style-type: none"> • Distorted educators’ audio ques because of low-quality audio devices • Devices teachers without noise cancellation option • Echoes 	<ul style="list-style-type: none"> • Use of portable or clip microphone 	<ul style="list-style-type: none"> • Allow movement around the class
5. Immobility of educator	<ul style="list-style-type: none"> • Inbuilt cameras and microphones limit movement 	<ul style="list-style-type: none"> • Use 360 camera • Use of portable or clip microphone 	<ul style="list-style-type: none"> • Allow movement around the class

6.3 Parameters for portable video-conferencing toolkit selection

The parameters for portable video-conferencing toolkit selection are shown in Table 2.

Table 2: Parameters for portable video-conferencing toolkit selection

Category	Equipment	Picture
Students	Tablet & stylus pen	
	Headset with speaker & mic	
Lecturers	Tablet/ stylus	
	Headset and speaker	

360 conference camera	 <p>The image shows a sleek, black, cylindrical 360-degree conference camera on the left. To its right is a screenshot of a 360-degree meeting view, showing a group of people in a meeting room with a green screen overlay. The text "360° Meeting without Blind Spot" is visible at the top of the screenshot.</p>
Portable extended screen	 <p>The image displays two different portable extended screen setups. On the left, a laptop is shown with a large, flexible screen extended from its side. On the right, a desktop monitor is shown connected to a multi-monitor setup, with a black carrying case visible below.</p>
Wifi Booster	 <p>The image shows three different types of Wi-Fi boosters. At the top left is a white, wall-mounted booster. At the top right is a white, desktop-sized booster with four external antennas. At the bottom is a white, portable booster with a carrying case and a blue Wi-Fi signal icon.</p>
Cover stand for tablet	 <p>The image shows a tablet mounted on a silver, adjustable stand, which is designed to hold the tablet in a vertical position for viewing.</p>

Two modules were developed based on the outcome of two studies: 1) Exploring existing practices of using video conferencing tools in teaching and learning and 2) Need Analysis.

6.4 Video Conferencing Applications

The five video conferencing applications used at UiTM are:

1. Google Classroom

2. Google Meet
3. Webex
4. Zoom
5. Microsoft Teams

They are incorporated into the web-based UFuture platform of UiTM, a learning management system that supports, complements, and enriches face-to-face classroom teaching and learning for both on-campus and distance learning programs.

6.5 List of Annotation software

It should be encouraged to use Annotation software for digital reading to avoid printing. Annotation Tools allow educators and students to highlight and comment on digital text collaboratively. The features are:

- offers built-in annotation tools
- extensive annotation and organisation of lecture content
- facilitates real-time annotation during online lectures
- collaborative digital whiteboard environment.

The list of Annotation software is as follows.

6.5.1 Microsoft 365

The university subscribes to Microsoft 365, a package that includes various software such as Word, Excel, PowerPoint, OneNote, and Microsoft Teams, plus additional classroom tools. The software enables educators and students to share documents in different formats based on their needs.

6.5.2 Adobe Acrobat Pro

Adobe Acrobat Pro, subscribed by the university, allows educators and students to share, open, annotate, edit, and markup documents. It works well across devices and operating systems, making digital reading more active. Its standard features range from functions that highlight, underline, cross out, or add text to engage with the texts when reading actively.

6.5.3 Canvas

Canvas is not subscribed by UiTM but by many individual educators. It can be used as a course management system that supports online learning and teaching. Canva has various features to help educators design teaching and interactive and interesting learning activities.

6.6 List of student engagement tools

For students, iPads, tablets and stylus pens are recommended. A headset with a speaker & microphone is also recommended to eliminate distractions. The features are:

- an affordable option for precise annotation
- direct on-screen annotation
- allows for precise and natural drawing
- capture real-time images of physical documents.

UiTM focuses on 4 engagement tools.

1. Kahoot!: Create interactive quizzes, surveys, and discussions to gamify learning and encourage participation.
2. Mentimeter: Conduct live polls, quizzes, word clouds, and Q&A sessions to instantly interact with students and gather feedback.
3. Google Quiz - Practice Set in Google Classroom: turn both new and existing material into assignments that are fun and interactive, enabling real-time feedback on their answers with performance insights and snapshots of student progress
4. Online Whiteboard: Allow writing and interacting with students in real-time via the Internet through transforming collaboration by letting people share ideas instantly, regardless of where it helps creativity flow and makes teamwork easier.

Chapter Seven: ULAB EdViCon Toolkits

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7.1 Introduction

In the domain of hybrid education, providing educators with suitable tools is essential to ensure smooth communication, effective teaching, and enhanced learning encounters. The two proposed video conferencing toolkits encompass a well-thought-out compilation of equipment and considerations, meticulously crafted for specific educational scenarios. Moreover, the design of these toolkits aligns with the recognized best practices from R2. Thus, two different toolkits have been identified based on the unique dynamics of a Programming Lab Course and a Theory Course.

For a Theory Course, where concepts take the spotlight, the toolkit focuses on making things clear. An interactive whiteboard helps illustrate ideas for both in-person and online students. A good camera captures the classroom, and a special microphone ensures everyone can hear well. On the other hand, in a Programming Lab, where students get their hands dirty with code, the toolkit helps create a smooth learning experience. Computers are set up with the software needed for coding. Two screens make it easy to work on code while seeing instructions. An interactive whiteboard helps explain complex coding stuff. A good camera lets everyone see what is happening, and a special microphone ensures clear explanations. Both toolkits encourage interaction. In the Programming Lab, tools like sharing code and working together on screens help. In the Theory Course, microphones capture class discussions, and a flexible camera lets students see the instructor and class activities. When teaching both online and in-person, the toolkits adapt. Tablets and styluses aid teaching in both cases. Recording lectures helps students who miss class.

7.2 Two scenarios and corresponding toolkits

7.2.1 Effective Hybrid Teaching in a Theoretical Classroom

Table 1 shows the scenario of an effective hybrid teaching in a theoretical classroom.

Table 1: Effective hybrid teaching in a theoretical classroom

Aspect	Essential Equipment	Description
Visual	High-Quality Webcam	Provides clear and wide-angle video of the classroom.
Audio	Clip-On Microphone	Ensures clear audio capture even when moving around.
Sound	Classroom Speakers	Delivers clear and loud audio for in-person and online students.
Presentation	Projector or Interactive Whiteboard	Presents slides and content to both sets of students.
Tech Setup	Laptop or Computer	Manages the video conferencing session and content sharing.
Connectivity	High-Speed Internet Connection	Essential for smooth video and audio streaming.
Audio Capture	Classroom Microphone	Captures classroom discussions for online students.
Visual Display	Classroom Camera	Allows online students to see you and classroom activities.

Aspect	Essential Equipment	Description
Interaction	Chat Feature and Q&A Management	Enables interaction and question-handling with online students.
Multitasking	Dual Monitors Setup	Enhances multitasking by displaying conferencing and content.
Session Record	Recording Feature	Records the session for later review or absent students.

7.2.2 Effective Hybrid Teaching in a Programming Lab Course

Table 2 shows a scenario of an effective hybrid teaching in a programme lab course.

Table 2: Effective hybrid teaching in a programme lab course

Aspect	Equipment	Description
Lab Setup	Computer Workstations	Equipped with necessary software for programming exercises.
	Dual Monitors Setup	Enhances multitasking during coding and instruction.
	Interactive Whiteboard	Displays coding examples and instructions for in-person and online.
Interaction	High-Quality Webcam	Provides clear views of lab demos and coding demonstrations.
	Clip-On Microphone	Ensures clear audio during coding explanations.
	Jabra Speak 2	Enhances audio clarity for both in-person and online participants.
	Classroom Camera	Allows online students to see both the instructor and lab setup.
Internet Connectivity	Reliable Internet Connection	Crucial for smooth streaming of coding sessions.
Online Collaboration	Collaboration Software	Enables real-time code sharing and collaborative debugging.
	Screen Sharing Tool	Shares instructor's screen for code walkthroughs.
Programming Tools	Integrated Development Environment	Utilized for writing, compiling, and debugging code.
	Cloud-Based Development Environment	Allows remote access to the coding environment.

7.3 Design Considerations for Two Scenarios and Corresponding Toolkits

Design considerations pertain to two scenarios and corresponding toolkits.

7.3.1 Toolkit 1 (Theory Classroom)

Table 3 shows the design considerations for toolkit 1 for theory classroom.

Table 3: Design considerations for toolkit 1 for theory classroom

Consideration	Equipment	Description
Camera	High-Quality Webcam (Model: XYZ123)	Provides clear and wide-angle video of the classroom.
Microphone	Clip-On Microphone (Model: ABC456)	Ensures clear audio capture even when moving around.
Speaker System	Classroom Speakers (Model: SoundMaster 2000)	Delivers clear and loud audio for both in-person and online students.
Display System	Interactive Whiteboard (Model: EduBoard Pro)	Presents slides and content to both sets of students.
Laptop or Computer	Laptop (Model: ThinkPad X1)	Manages the video conferencing session and content sharing.
Internet Connectivity	High-Speed Internet Connection (Provider: FastNet)	Essential for smooth video and audio streaming.
Microphone for Classroom	Classroom Microphone (Model: MicPro 300)	Captures classroom discussions for online students.
Camera for Classroom	Adjustable Classroom Camera (Model: CamFlex 500)	Allows online students to see you and classroom activities.
Interaction	Wireless Clip Microphone (Model: MicLink 100)	Clear audio communication.
Interaction	360° Rotating Webcam (Model: Cam360)	Facilitates video communication with versatile angle adjustments.
Display and Presentation	Portable Extended Screen (IRGOTECH Tri Screen Display)	Dual Portable Monitor Laptop Extended display for enhanced teaching experiences.
Hybrid Teaching Tools	Tablet & Stylus (Model: iPad Pro + Apple Pencil)	Enhances teaching experience and interaction quality.
Recording Option	Video Recording Feature (Platform: VidCapture)	Records the session for later review or for absent students.

7.3.2 Toolkit 2 (Lab Classroom)

Table 4 shows the design considerations for toolkit 2 for lab classroom.

Table 4: Design considerations for toolkit 2 for lab classroom

Consideration	Equipment	Description
Lab Setup	Computer Workstations (LabMaster 500)	Equipped with necessary software for programming exercises.
	Portable Extended Screen	Provides additional screen space for hybrid teaching and presentations.
	Interactive Whiteboard (EduBoard Pro)	Displays coding examples and instructions for in-person and online.
Interaction	High-Quality Webcam (XYZ123)	Provides clear views of lab demos and coding demonstrations.
	Clip-On Microphone (ABC456)	Ensures clear audio during coding explanations.
	Jabra Speak 2 (SpeakMaster 800)	Enhances audio clarity for both in-person and online participants.
	Classroom Camera (CamFlex 500)	Allows online students to see both the instructor and lab setup.
Reliable Internet Connection	Reliable Internet Connection	Crucial for smooth streaming of coding sessions.
Online Collaboration	Collaboration Software (CodeCollab)	Enables real-time code sharing and collaborative debugging.
	Screen Sharing Tool (ScreenSharePro)	Share the instructor's screen for code walkthroughs.
Programming Tools	Integrated Development Environment (IDE)	Utilized for writing, compiling, and debugging code.
	Cloud-Based Development Environment (CodeCloud)	Allows remote access to the coding environment.
Hybrid Teaching Tools	Wacom Pen Tablet	Suitable for drawing, content creation, and annotations.
	Apple Pencil (2nd Generation)	Enhanced interactivity and annotation tools.
	Moft Z Laptop & Tablet Stand	Ultra-thin and portable stand, with adjustable angles.
	D-LINK DRA-2060 AC2000 Wi-Fi Extender	Enhanced Wi-Fi coverage with MU-MIMO, beamforming.
	Mouse	Enhances computer navigation and interaction.
	Tuff Stands CS-12 kamera-stativ, 1.5 m	Sturdy stand camera positioning.
	Permanent Marker and	Writing and marking on surfaces.
	Jabra Speak 2 (Speaker for the hybrid situation)	Enhances audio clarity and volume for hybrid teaching scenarios.

7.4 Video Conferencing Software

7.4.1 Zoom

Zoom is a popular choice for online classes in Bangladesh due to its user-friendly features and reliability. With tools like screen sharing and breakout rooms, it facilitates seamless virtual learning experiences. Its compatibility across devices ensures accessibility for students, addressing challenges in traditional education. It promotes engagement and interaction, making it an effective platform for remote learning in Bangladesh.

7.4.2 Google Meet

Google Meet is a preferred platform for online classrooms due to its accessibility with a Google account, seamless integration with Google Workspace, robust features like screen sharing and real-time captions, and strong security measures. These features enhance the learning experience, promote collaboration, and ensure the safety of participants, making Google Meet an ideal choice for hosting virtual classes. In Bangladesh, challenges in traditional learning, offering access to quality resources and flexibility in scheduling. It bridges geographical gaps, ensuring students in remote areas can interact with teachers and access materials.

7.4.3 Webex

Webex offers HD video conferencing, screen sharing, interactive whiteboarding, and other features ideal for online classes. In Bangladesh, it provides a reliable and secure platform for educators to conduct engaging virtual sessions, ensuring accessibility and fostering collaboration among students with diverse technological setups.

7.5 Collaborative Whiteboard/Annotation Tools

7.5.1 Jamboard

Jamboard is a collaborative whiteboard tool that allows users to brainstorm, draw, and annotate together in real time. It offers features such as sticky notes, shapes, and handwriting recognition, making it ideal for interactive online classes in Bangladesh. With its intuitive interface and seamless integration with Google Workspace, Jamboard enables educators to facilitate dynamic and engaging lessons that encourage student participation and collaboration. Its accessibility and versatility make it a valuable tool for fostering creativity and enhancing the learning experience in the digital classroom.

7.5.2 Zoom (with annotation tools)

Zoom provides a built-in whiteboard feature that allows participants to collaborate in real time by drawing, annotating, and brainstorming together during online classes. With its simplicity and accessibility, Zoom's whiteboard tool promotes active engagement and fosters interactive learning experiences among students and educators. Its seamless integration with other Zoom features such as screen sharing and breakout rooms enhances the versatility of online teaching, making it an ideal platform for facilitating collaborative activities and visual learning in the digital

7.5.3 Google Meet

Google Meet offers a collaborative whiteboard feature that allows participants to draw, write, and brainstorm together in real time during online classes in Bangladesh. With its integration with Google Workspace, including Google Drive and Google Docs, Google Meet provides seamless access to

collaborative tools for educators and students. The easy accessibility and user-friendly interface make it a valuable platform for collaborative annotation and visual learning activities, contributing to a more dynamic and effective online education environment in Bangladesh.

7.5.4 Remarkable

Remarkable is a digital note-taking device that offers a natural writing experience with its paper-like display and stylus pen. Its features include annotation, drawing, and document-sharing capabilities, making it suitable for collaborative whiteboarding in online classes. Remarkable's portability and ease of use enable educators and students to engage in interactive annotation and brainstorming sessions, fostering creativity and enhancing learning experiences. Its compatibility with various file formats and cloud storage options further enhances its utility in virtual classrooms, making Remarkable a valuable tool for collaborative annotation and visual learning activities in Bangladesh.

7.5.5 Xournal

Xournal is a free and open-source software for annotating, sketching, and marking up PDF files and images. It offers a user-friendly interface with a range of tools, including pens, highlighters, erasers, and shape tools, making it ideal for online classes in Bangladesh. With Xournal, teachers and students can easily annotate documents, draw diagrams, and collaborate in real time, facilitating better understanding and engagement during virtual lessons. Its cross-platform compatibility and lightweight nature make it an accessible and efficient tool for educational purposes, particularly in regions where internet connectivity and hardware resources may be limited.

7.6 Collaborative Document Editing Tools

7.6.1 Google Docs

Google Docs for collaborative document editing tools include its ease of access and real-time collaboration features, allowing multiple users to work on the same document simultaneously. It also offers version history and commenting features, facilitating effective communication and revision tracking during group projects or online classes. However, there are also disadvantages to consider. These may include potential privacy concerns, as documents are stored on Google's servers and may be subject to their privacy policies.

7.7 Student Engagement Tools

7.7.1 Polling and Quizzing

Quizizz

Quizizz enhances engagement through gamification, offering features like memes and music. Its self-paced format accommodates various learning styles, while instant feedback promotes active learning. With accessibility from any device, Quizizz ensures convenient participation for both educators and students, fostering an interactive and enjoyable online learning experience. However, Limited question types and distracting gamification elements could detract from educational goals, and technical glitches might disrupt classes.

Google Form

Google Forms offers a range of features such as customizable surveys, quizzes, and assessments, making it an ideal tool for online classes in Bangladesh. Its user-friendly interface and integration with Google Workspace streamline the assessment process and enable seamless collaboration among educators and

students. With support for offline data collection, Google Forms ensures accessibility even in areas with limited internet connectivity, contributing to a more interactive and engaging learning experience.

7.7.2 Interactive Presentation

Prezi

Prezi is a dynamic presentation tool with zoomable canvases and multimedia integration, ideal for engaging online classes in Bangladesh. Its interactive features promote active learning and enhance student engagement, offering educators a user-friendly platform to deliver impactful lessons tailored to diverse learning styles.

7.7.3 Engagement and Feedback Tools

Tricider (for brainstorming and voting)

Tricider offers collaborative decision-making features such as idea sharing, voting, and discussion threads, making it an ideal tool for online classes in Bangladesh. Its interactive platform fosters student engagement and encourages participation in group activities and discussions. By facilitating collaborative decision-making, Tricider promotes critical thinking skills and enhances the learning experience, enabling educators to create dynamic and interactive online classrooms that empower students to contribute ideas and opinions.

7.7.4 IDEs

Microsoft Visual Studio Code

Microsoft Visual Studio Code is a versatile and feature-rich code editor that offers advanced functionalities such as syntax highlighting, IntelliSense code completion, and built-in Git integration. Its lightweight yet powerful nature makes it ideal for online and hybrid classes in Bangladesh, as it allows students to write, debug, and collaborate on code seamlessly across different programming languages and platforms. With its extensive library of extensions and plugins, Visual Studio Code can be tailored to suit the specific needs of various programming courses, enhancing the learning experience and productivity of students in virtual and hybrid learning environments.

CodeSandbox

CodeSandbox is a cloud-based integrated development environment (IDE) that offers a comprehensive set of features for coding, testing, and sharing web applications. Its key features include instant setup, real-time collaboration, and support for popular front-end frameworks such as React, Vue.js, and Angular. CodeSandbox is particularly well-suited for online and hybrid classes in Bangladesh due to its accessibility and simplicity, allowing students to write and run code directly in the browser without the need for complex setup or configuration. With its collaborative capabilities and support for a wide range of technologies, CodeSandbox promotes interactive learning and facilitates hands-on experimentation, making it an invaluable tool for teaching web development and programming concepts in virtual and hybrid learning environments.

7.7.5 Simulators

Cisco Packet Tracer

It offers a comprehensive simulation environment for networking concepts, enabling students to design, configure, and troubleshoot virtual networks. Its user-friendly interface and extensive library of networking devices make it an ideal tool for hands-on practice and experimentation. In online or hybrid classes in Bangladesh, where access to physical networking equipment may be limited, Packet Tracer

provides an invaluable platform for students to gain practical experience in network configuration and troubleshooting, preparing them for real-world networking challenges.

Multisim

It offers advanced circuit simulation capabilities, allowing students to design and analyse complex electronic circuits with precision and efficiency. With its intuitive interface and extensive component library, Multisim facilitates hands-on learning in circuit design, analysis, and testing. In online or hybrid classes in Bangladesh, where access to physical laboratory equipment may be limited, Multisim provides an invaluable virtual environment for students to explore circuitry concepts and develop essential skills for electronic engineering courses.

Psim

A powerful simulation software designed for power electronics and motor control applications. With its user-friendly interface and comprehensive library of power components, Psim enables students to model and analyse various power systems efficiently. In online or hybrid classes in Bangladesh, where access to physical equipment may be limited, Psim provides an invaluable platform for students to gain practical experience in designing and simulating power circuits. Its ability to simulate real-world scenarios enhances learning outcomes and prepares students for careers in electrical engineering and related fields.