Optimizing Video-Conferencing for Education: A Framework of Good Practices and Toolkit Parameters

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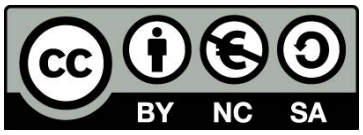
Abstract:
This report presents a structured framework of technological and pedagogical good practices for enhancing the effectiveness of video-conferencing systems in educational contexts. Based on interviews, problem-based brainstorming, and iterative ideation, 31 common challenges in hybrid and online learning environments were identified and addressed through practical solutions. The document further outlines 21 essential parameters for selecting portable video-conferencing toolkit components—considering compatibility, usability, connectivity, and cost-effectiveness. Additionally, it proposes 19 core parameters for ensuring high-quality educational practices in virtual settings. Together, these guidelines offer actionable insights to support educators, institutions, and instructional designers in creating engaging and inclusive video-mediated learning experiences.



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Good Practices

1. General Parameters applicable for hardware items of the Portable Video Conferencing toolkit

Table1 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 1. Essential Parameters for Good Educational Practices Using Video Conferencing Systems

	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.	***Visual feedback from students is absent when tied to single screen (Technological)***
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.	***Feedback Mechanism*** ***Adaptability*** ***Communication Styles*** ***Out of Sight, Out of Mind (Technological & Pedagogical)***
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.	***Adaptability of Communication Styles*** ***Interaction Consistency Across Channels Chatbox and Raised Hand (Pedagogical)***
4.	Teachers are unable to contacting 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.	***Adaptability of Communication Styles*** ***Out of Sight, Out of Mind (Technological & Pedagogical)***

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 ques.	***Visual feedback of students is absent when tied to single screen (Technological)***
6.	Students are having difficulties with late and long responses during online sessions eventhough their camera is turned on.	Late and long responses is interpreted as: 1. Due to sharescreen 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. Whatsápp or other massaging app can be a option to send message.	***Out of Sight, Out of Mind (Technological & Pedagogical)*** ***Visual feedback of students is absent when tied to single screen (Technological)***
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	***Familiarity/Motivation*** ***(Technological & Pedagogical)***
8.	Students frequently turns off their webcam	turns off their webcam 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.	***Control*** ***Familiarity/Motivation. (Technological & Pedagogical)***
9.	Students who participates 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	***Familiarity/motivation Pedagogical***
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.	***Communication Familiarity***
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.	***Communication Visibility***

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	4. .	***Connectivity*** ***Training*** ***price***
13.	Online students have difficulties to follow the blackboard or whitebord.	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 student. Recorded lectures can be a option.	***Multitasking***
15.	Due to technical issues few students cannot participate the online session and unable to get classnotes	Students cannot participate is interpreted as: 1. Due to sickness 2. Due to bad internet connection 3. Due to distorted audio ques.	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*** ***Adaptibility of Communication Styles*** ***Training***
17.	Teachers have difficulties to explain a topic for online students on blackboard or whiteboard.	difficulties to explain a topic interpreted as: 1. Teachers need to move laptop, camera and use microphones to explain a topic for online students on blackboard.	A camera with 360 view can used to avoid shifting. A good headphone can be used which had noise cancelllation mode. Teachers can also use clip microphone which	***Flexibility*** ***visibility/visual ques***

			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 acces 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 ques as teachers use audio devices	Teachers audio ques 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 que when teacher is away from the microphone.	Teacher doesn`t carry the microphone.	Subzero M100H Miniature Digital wireless systems and Samson Go Mic Mobile Beltpack transmitter with lavalier Microphone can be used so that in hybrid teaching situation online students can hear teacher`s audio ques clearly.	***Wireless audio output***
24.	Teachers need to move cameras to give visual ques when they move PC to	Too much movement of cameras can be disturbing for online students.	Mobile stand, logitec 360 camera or OWL LABS Meeting Owl 3 - conference camera can be used to avoid the too much of moving of	***Camera features: Zoom, Tilt, pan and rotation***

	blackboard during their hybrid teaching sessions.		cameras.	
25.	Teachers' video quality is very bad.	The video cameras pixel quality id very bad.	logitech 360 camera or OWL LABS Meeting Owl 3 - conference camera gives hd 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 class room.	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 ques interpreted as: 1. distorted audio caused by internet interruption 2. Latency. 3. Teacher`s end audio output is bad 4. Teachers 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 echos.	***Audio quality***
29.	Online students have problems to follow classrooms students` responses	Cameras cannot detect the speaker.	To address this problem we need a camera which can detect the speaker and move the camera towards the speaker. OWL LABS Meeting Owl 3 - conference camera has this option.	***Camera features: Zoom, Tilt, pan and rotation***
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 softwares 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***

2. Parameters for portable video-conferencing toolkit selection

Parameters are measurable factors that define the characteristics or behavior 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, we included an analog solution to the absence of white board at home or some laboratory context by including an adhesive-free and lightweight alternative to poster-size paper.

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. Here's a breakdown of these 19 parameters for ensuring excellence in educational practices:

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, and items from the proposed toolkits.