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Rematerialising and revitalising synchronous distance learning with moving hands

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Abstract:

To move beyond traditional online lectures, we propose an innovative approach in which slides are replaced by real-time hand movements filmed by a camera. The moving hands manipulate objects to convey learning content. The iterative design of the course is described, and three challenges are highlighted: technical optimisation, the teacher's cognitive load and note-taking. Student evaluations conducted over three years shows a majority of satisfied learners, while also highlights the difficulties of dealing with a course without prior slides. Solutions to this problem are currently being worked on.

Keywords: Synchronous Distance Learning, Videoconferencing, Moving Hands, Innovation

Distance synchronous learning: potential and limits

Distance learning is classically divided into synchronous and asynchronous modes, depending on whether the participants can communicate in real time during an online course or whether they undertake learning activities at their own pace (Hrastinski, 2008). In the field of distance education, asynchronous distance learning is preferred, because it allows for more flexibility (Asaduddin & Maulani, 2021; Ghilay, 2022).

However, during the 2020 pandemic, synchronous distance learning suddenly became widespread, replacing traditional courses. It was easy to convert an in-person course into a videoconference course. Nevertheless, ease does not equal quality, and it received a lot of justified criticism, since distance course is not the mere transposition of a presence course but needs a specific pedagogical design (Peraya & Peltier, 2020).

While the pandemic has demonstrated the technical feasibility of synchronous learning and has largely influenced today practices (not necessary positively), it also has shown to which extent it could be poorly designed. Should distance synchronous learning be simply discarded, because it put learners in uncomfortable and inefficient learning situations?

One advantage of synchronous courses must be pointed out: it allows a more lively communication within the virtual class, between learners and between the learners and the teachers. Potentially, it can help to reduce one of the main burdens of distance learning, namely learner isolation (Hrastinski, 2008). While hybrid learning, combining presence and distance is often recognised as reducing such isolation, the inclusion of synchronous sessions within a whole distance course also has the same potential benefits, without requiring the logistic of presence courses.

In this article, we will explore one modality of synchronous distance learning that was conceived as a response to the poor quality online courses that were prevalent during the pandemic (Szilas et al., 2023). The next section will criticise the dominant model of online synchronous courses in order to introduce an innovative alternative.

Criticism of slides & talking head

The dominant model today is to present slides while being filmed by a frontal camera, with the teacher's face inserted on the screen, as a "talking head". It uses the technical functionalities of videoconferencing systems, camera streaming and screen sharing.

Split attention

Although this format may enhance learners' satisfaction, it can also impair learning (Sondermann & Merkt, 2023). Research has shown that it requires learners to split their attention between the teacher's face and the instructional content, increasing extraneous cognitive load and thereby reducing learning effectiveness (Ayres & Sweller, 2005; Mayer & Fiorella, 2014).

The excesses of immateriality

What is striking about this approach is that it stages a learning situation that is totally dissociated from any materiality. First the slides, which take up most of the space and represent the major focus of visual attention.

Then the teacher, reduced to his face. Most of the body gestures are discarded, as are any stage effect used in classroom. If the face can express emotion, the associated gaze is fixed, towards the camera. In addition, any notion of space is removed: no desk, no chairs, even no background. Particularly symptomatic of this deletion of space was the massive use of virtual backgrounds during the pandemics. Practically and officially, these virtual backgrounds enable users to keep their privacy — their home should not be exposed to the public. But we believe they express the implicit acceptance that, if a course is not in class, it must be "nowhere", in the virtual immaterial world of networks.

As we will demonstrate later, moving away from the assumption that distance learning is immaterial opens up several new horizons for synchronous distance learning.

The oddity of not projecting slides

It is enlightening to recall where the idea of sharing slides through videoconferencing software came from. First there was the blackboard (and the whiteboard), followed by overhead transparencies, whose main advantage was to facilitate the teacher's work, as most material was written in advance. Note however that it was common to write directly on the transparencies. The main characteristic of transparencies is their small format, compared to the screen on which they are projected. Then the transparencies were computerized, which not only eased their management but also largely improved the possibilities for animation: the presenter did not have to move objects or transparencies in real-time because the animation was automated, triggered only by the presenter. Finally, such a slide-based presentation is transmitted directly to the learner's digital device, as a streaming video, without being projected at all.

Therefore, a key property of digital slides and their physical ancestors (overhead transparencies) is their ability to transform a small document handled by the teacher into a large one visible to a large audience. This is no longer the case with videoconferencing. Streaming possibilities are therefore used in an old-fashioned way, by legacy, without taking into account the specificity of the distance learning situation, technically characterised by video streaming communication.

Proposed new modality: filmed moving hands

Questioning the relevance of streaming slides and wishing to re-introduce the materiality of the teacher's space, we propose the idea of supporting the teacher's discourse not with animated slides but with physical objects on a desk, manipulated in real time during the lesson.

The filmed physical objects can be of any kind: images, text labels, action figures, strings, construction kits (e.g. LEGO® elements), plants, rocks, etc., depending on the course subject. These objects are manipulated or pointed at by the teachers as s/he speaks, while the camera films the desk from a top view (see Fig. 1).

This top view alternates with two more traditional views: the camera pointing at the teacher (but not necessarily limited to his/her face) and the screen sharing, to show a website or a software.

The minimum technical requirement consists of a computer equipped with a camera capable to film from above, and another camera facing the teacher. The keyboard and mouse are only used during screen sharing.

Following an analogy with the theatre, it is interesting to structure the lesson into scenes, corresponding to one set of physical elements handled by the teacher, some of which are added/removed as the scene progresses. A scene would match with the digital equivalent of a slide with animations. Within a scene, continuing with the theatre analogy, the hands could be seen as the main (and only) character with three different functions:

- Animation: the hands can add, move, deform, and remove objects to support the teacher's explanations.
- Pointing: with the index finger (in our culture), the hands have a deictic function that accompanies speech (in expressions such as « this », « here », etc.)
- Expressivity: as in any speech interaction, the hands move to emphasise some words, producing what are called beat gestures or batons (Wagner et al., 2014).

A last important concept is the backstage, that is, all the physical that is not visible when the hands are filmed (the stage being the part of the desk in the camera field). The backstage includes the off-camera part of the desk where the unseen elements are located (the storage space): elements that will be seen and elements that have been seen. The backstage also includes all the space in front of the teacher; it is used as a prompter. In this space, it is convenient to have a computer screen displaying what the camera is filming.

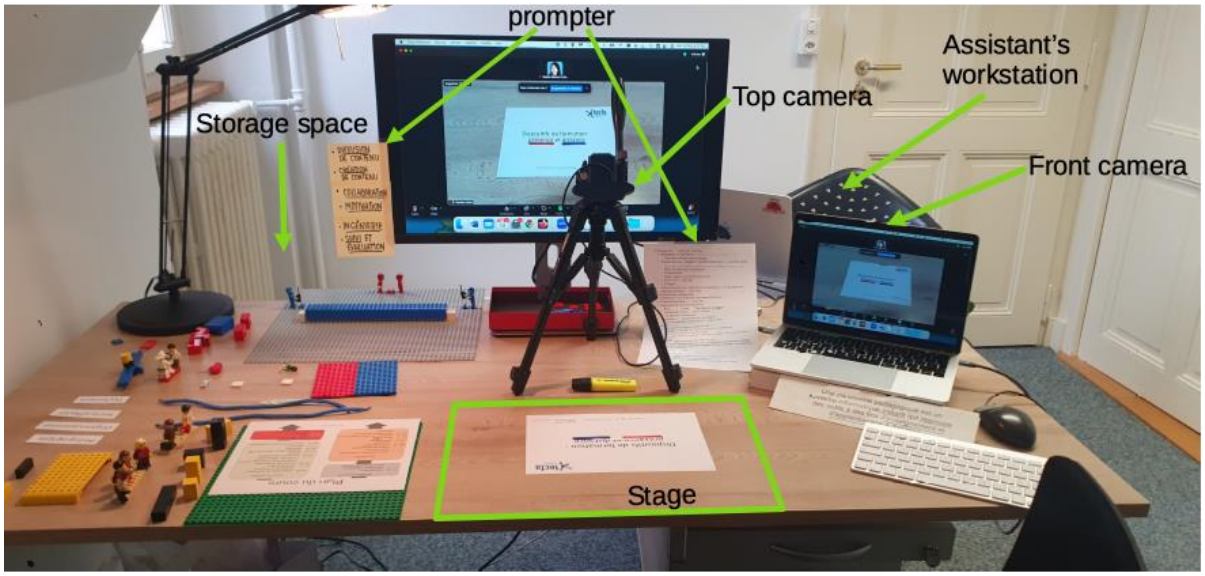

Figure 1: Workspace viewed from behind the teacher, illustrating the stage and the backstage (cameras, storage space, prompters, and feedback screens).

Challenges

Before entering into the detail of the lesson design, we would like to underline three distinct challenges that characterise the moving hand approach.

Technical optimisation: the technical apparatus is not simple. It should not suffer from technical issues that would disturb the teacher's discourse. A difficult issue is the switching between the three views (hands, face, screen sharing).

Teacher's cognitive load: even if the technical device is perfectly smooth, handling physical elements is more difficult than navigating through slides. First, the teacher needs to carry out the animation that was automatised with digital slides. This task can be compared to playing a musical instrument. Second, the comfortable linear nature of the slides, in particular in the digital format where the user can see what comes next, gives way to a more improvised discourse in which the teacher must perfectly know his/her subject.

Note taking: after the lesson, the students do not have any printout, making it difficult for them to recall the content of the lesson. They must rely entirely on their note-taking, a skill that is already challenged by the omnipresence of digital handouts (Stacy & Cain, 2015).

Iterative design of the course

The filmed hand modality has been implemented three consecutive years for a 60-minute lesson within an annual university course on educational technology. This lesson introduces the use of Learning Management Systems (LMS) for distance and hybrid learning, including concepts such as tutoring, mediatisation, and co-modality. Prior to this, the course was taught with digital slides. The following section is a description of the iterations of the course to illustrate the design space of this innovative modality.

4.1 The iterations

The first iterations consisted of transforming digital slides into the filmed hands modality, that is, translating a content from a media to another media. More precisely it consists in materialising a digital media, the opposite of the mediatisation process in digital learning (Peraya, 2008). This materialisation depends on the learning content. Specifically, the first part of the lesson describes pedagogical platforms. Interestingly, the term "platform" is a metaphor referring to a physical object. The materialisation was then straightforward: we used a large LEGO base plate on which we added bricks representing learning modules. Actors around the platform (learners, teachers, etc.) were represented as LEGO characters, while the relation between them was represented with strings. This made the first scene. The second scene represented the mediatisation of in-class activities to distance activities via a base plate with two parts. The third scene represented the time organisation of distance or presence sessions with LEGO elements sliding on a glitter (see Fig. 1). The technical device consisted of one camera on a tripod in front of the large computer screen. The teacher would rotate this camera to switch from the top view to the facing view (Fig. 2a). Two teaching assistants helped with the preparation and running of the course unfolding, in particular with backstage management.

The session went well, but the change of view was not quite smooth and the general cognitive load for the teacher was high, despite the support of the assistants. The students also complained not to have slides. So we edited the video recording to provide them with a digest summary of the course.

The second iteration used a different device. We found that a computer released in the mid-2010, the Sprout computer from HP, dedicated to multimedia was quite relevant: it is an all-in-one large screen computer with a top camera, a top projection facility, a tactile pad, and a front camera (see Fig. 2b). The existence of these two cameras were perfectly suited to our need to switch between the two views. The projection and tactile interaction features, although not used for this iteration, was also a promise of innovations for future teaching lessons. The teaching content was the same. After the course we build a-posteriori slides, based on screenshots taken from the video recording of the session.

Figure 2: Teaching device for the first three successive iterations of the course.

This second session went well, but we encountered two technical problems. First, the quality of the top camera was not as good as previously, even forcing us to rewrite some text labels with larger fonts. Second, the switching from one camera to the other was tedious, because there were more than two cameras in the camera list of the videoconferencing system (Zoom).

The third iteration will be described in the next session. It comes back to the initial design (same top camera used), but with a distinct additional camera for the facing view, placed on the side, and other slight improvements.

4.2 Final design

We will describe the design following the structure of the three challenges described above.

The **technical device** consists of a laptop computer put at the right of the desk, with its built-in camera pointed towards the teacher. In this view, the teacher is seen more globally than the usual face camera, allowing gestural communication. A mouse and a wireless keyboard are also available, used in the screensharing view. A second screen, facing the teacher, provides visual feedback from the top-camera. This latter camera is placed between the screen and the teacher, on a tripod, filming a space of approximately 50 cm wide. The backstage include 1) the left-hand part of the desk, used as storage space for physical elements (mainly pre-assembled LEGO pieces) and 2) the second screen, supplemented by various text supports sticked to the side of the screen (see Fig. 1 and 2c). The switching camera was parametrised with a keyboard shortcut on the videoconferencing software that worked fine. In addition, we used a foot pedal connected to the computer to activate this shortcut with the foot (visible on Fig. 2c). This way, the switching between the two cameras was perfectly smooth, since the hands could remain the focus of the top view.

In order reduce the **teacher's cognitive load**, we sequenced the animation steps for each scene in a very structured way. In the rehearsal phase, without the filming device, the teacher listed the precise sequence of physical elements that needed to be successively added to the. Then, in the preparation phase, the storage space was set up according to this ordered list. Visually, the teacher can see the different steps of the animation, providing a support similar to printing the slides or seeing in advance the next slide. The other supporting device is the stickers placed around the facing screen. The assistant managed the interaction with the students and helped with the management of the storage space.

In order to supplement **students' note-taking**, we decided to provide students with a-posteriori handouts, based on the recording of the session. It is expected that such handouts would be more engaging for student as they relate to the happenings during the on-line session. To this end, we implemented an innovative solution that involves the assistant as a note-taker. He or she uses the chatting tool offered by the videoconferencing system to take notes, using the screenshot functionality to capture relevant images for the slides. The note-taker prefixes the text with an underscore ("_") to specify that it is intended for the handouts. When such a text occurs just after the screenshot, it means that the text is the title of the slide with the screenshot as image, otherwise, it appears under the image (See Fig. 3). It should be pointed out that the assistant's note taking activity is also useful for the students during the course, because it highlights important notions. From the transcript outputted by the videoconferencing software, we applied a script to convert the text file into an html file using the Reveal.js library dedicated to slideshows (Reveal, s. d.). With this approach, the slides are automatically created! In practice, because it was our first attempt, we had to manually modify the initial text, to correct minor errors (e.g. shortening a title). The script was developed in Python, with the help of ChatGPT (free version).

Figure 3. Seven slides generated from the assistant's notes (slightly modified after generation).

5 Reception

Each lesson in the one-year course is provided with a short evaluation questionnaire consisting of a ternary evaluation ("cool", "ok", "not so good") and an open question asking for comments. We collected these data for the three above-mentioned iterations. The evaluation results are shown in Table 1.

Table 1: Student evaluation (multiple choice question)

	Year 1	Year 2	Year 3
Not so good	1	3	5
Ok	13	7	8
Cool	16	13	11

We are going to comment these results, without carrying out any statistical analysis, given the limited amount of data. First, we observe that more than the half of students gave the best evaluation (52% of respondents), but that unsatisfied students represent 12% of the respondents. Unfortunately, we cannot see any improvements over the years, and we even observe a growing number of students finding it "not so good".

If we look at qualitative answers, we have 24 comments over the three years. Nine of them (either "ok", or "not so good"), that is 37.5% of commenters, find it difficult to follow, usually because of the lack of slides. Twelve comments were quite positive, matching the above quantitative data. Most enthusiastic comments praised the originality of the presentation (e.g.: "The idea of Lego bricks was original and enriching from a pedagogical viewpoint", 2024; Legos were a good way for representing links. I loved it!", 2025). Three out of these 12 positive comments recognized that they were sceptical at the beginning but that after a while, they really appreciated the course.

Globally the students' feedback is rather positive, but there are still a few students who express their reservations, preferring some more classical formats. If we refer to the three challenges mentioned above, it must be pointed out that the two first challenges are not mentioned by students: no technical issue reported, nor teacher's difficulties with handling the equipment. The main focus lies in the absence of slides. Our efforts with a-posteriori slides do not solve the issue that many students appreciate slides both as guidance during the lesson and as support for notetaking. Regarding the guidance, the filmed hands modality seems to require more focus of attention from the students. This is, we believe, related to the three comments mentioning that at the beginning they were not convinced but then, when they understand that they must focus on the teacher's speech in relation to his/her hands, it gets manageable and rewarding. One of the three students who were sceptical at the beginning stated: "in the end, I really liked the concept, especially in terms of maintaining attention". This summarizes well the challenge of such a lesson: getting students to leave their long-term habits with slides for adopting an attitude requiring more attention on what is happening "there and now".

The other issue, the note-taking issue, is also related to previous students' habits. It must be mentioned that for other lesson in the same course, when slides are available, they are given after the synchronous lesson, not before, which is the subject of recurrent complaints. This is consistent with other research that confirmed that students do prefer having slides beforehand. Research also shows that the learning benefits of having slides beforehand is controversial, some results showing a learning benefit (Chen & Lin, 2008; Marsh & Sink, 2010), some showing no difference (Atarés et al., 2009; Marsh & Sink, 2010), and some showing a drop in learning performance (Worthington & Levasseur, 2015). In any case, it is a pedagogical choice made for the whole course, and the filmed-hand based lesson is aligned with the other sessions on that respect. The filmed hand modality just stresses the teacher's choice to bring students to higher their attention level during synchronous distance sessions, should it come at the price of not satisfying the student's desire to use handouts for taking notes.

Conclusion

Escaping from the excessive disembodiment of synchronous distance learning, we have designed and iteratively implemented an innovative modality of distance teaching, called the "moving hands". Three challenges have been identified, and we are progressively addressing them. Regarding the most delicate one, the lack of slides to guide students, we plan to provide them with a course plan beforehand that, combined with slides immediately created after the session, should facilitate the learning process during the course.

As demagogical and commercial discourses tend to make us believe that digital tools make learning easy, the moving hands modality reminds us that both teaching and learning require effort, to achieve quality learning.

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