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Digicampus Vaasa

STUDY OF THE LEARNING SPACE D102 WITH EYE TRACKING GLASSES

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Background

University of Vaasa is part of the Finnish government top project Digicampus within a subproject which aims to refocus learning spaces. The traditional classrooms or learning spaces in universities usually do not have the capabilities to respond to the new technical opportunities offered by digitalization. Usually classrooms and learning spaces do not support teacher-student encounters, collaborative work, and learning together.

Experience Lab, within the faculty of education and welfare studies at Åbo Akademi, conducted a study of the learning space D102 at Vaasan Yliopisto. The goal of the study was to clarify how user-friendly the learning space is and how a teacher and student make use of the space during learning situations. We also wanted to investigate how students and teacher experience the learning space D102, what works and what does not, and what to take into consideration when planning new modern learning spaces. Another focus point of the study is the teacher's use of technology and the learning space, the use of multiple screens/projectors in a learning situation compared to a student's attention during the same time.

Case description

We gathered data for our analysis from two learning occasions in the same course and with the same students and teacher. The participants were students that have enrolled to the course "English writing skills" and the teacher of the course. We used video cameras and eye-tracking glasses to follow the behaviour and attention of a student/teacher during two lectures. On the first teaching occasion (case 1) the teacher was wearing the eye-tracking glasses and on the second occasion (case 2), a student was wearing the glasses. Both teaching occasions followed the same setup: introduction, teaching subject, Q&A and group work within the time span of 2 x 45 minutes. The teacher used the same technology on both lectures: Main screen projector, second screen projector that projects on a white board, white board and both laptop and the teaching space stationary computer.

The teaching method differed from case 1 and case 2. In case 1 the teacher used the two screens simultaneously by having theory on the main screen and exemplifying the theories with examples on the secondary screen. Switching focus between the screens several times and spending an average of 01:01 minutes (01:01 interval duration and the interval count: 12) on the main screen and an average of 02:30 (interval count 12) on the secondary screen.

In case 2 the teaching method differed in the way of how long the teacher wanted the students' attention directed on different screens/boards. The same technologies were used (main screen: theory, secondary: screen examples) and in addition regular whiteboard in use, but they were not used simultaneously as in case1. The focus of the teaching situation was not switched as often as in case1, main screen average time of 08:38 (interval count: 2) and secondary screen 10:52 (interval count: 1) and whiteboard 10:37 (interval count: 1). A student wore the eye tracking glasses during case 2. A table below describes the time intervals and counts better.

From lecture start to group work start

	Technology used	Main screen	Secondary screen	Control center, tech problems, logistics	Whiteboard (2nd screen OFF)	Whiteboard 2	Instructions / introduction	Total Time of Interest Duration	Total Recording Duration
Case1	**Teachers usage of screens (mm:ss)**	**12:20,0**	**30:05,0**	**01:43,0**		**03:33,0**	**02:42,0**	**50:23,0**	**53:30,0**
	Average interval duration	01:01,7	02:30,4	00:34,3		03:33,0	00:54,0		
	interval count	12	12	3	0	1	2		
Case2	**Teachers usage of screens (mm:ss)**	**17:16,4**	**10:52,3**		**10:37,2**	**01:42,4**	**03:02,1**	**43:30,5**	**45:25,3**
	Average interval duration	08:38,2	10:52,3		10:37,2	01:42,4	01:00,7		
	interval count	2	1	0	1	1	3		

Table 1. Time distribution on teacher's usage of technology and phases of the lectures in the learning space during the study

Methods

We gathered data with a general survey (for everyone using the learning space during three weeks) about the learning space D102, interviews with students from both case 1 and case 2 and an interview with the teacher. We also recorded the lectures with two video cameras (from both the back and the front of the learning space) and eye-tracking glasses, which record the teachers/students point of view video with eye tracking data added to the video. We used both quantitative and qualitative data-gathering methods.

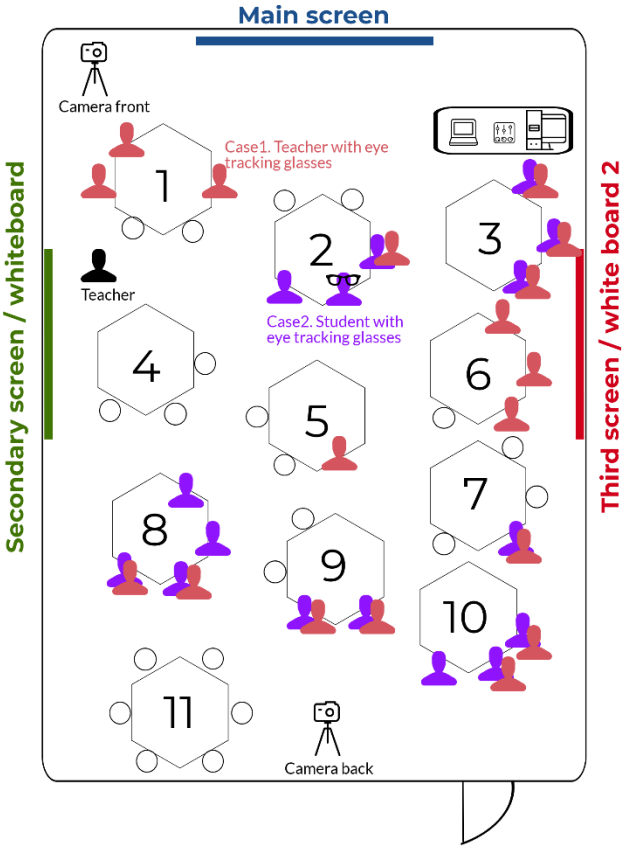

Figure 1 Learning Space D102 and study set-up

Findings

Available technological equipment in the learning space

During the period of the study and the two test occasions, we found that the students didn't miss or want any other technological equipment. According to the survey result, 10 of 22 are very satisfied with the available technologies in the learning space. 10 of 22 are satisfied and 2 of 22 were neither satisfied nor dissatisfied. From the interviews with the students, several mentioned the teachers' use of the technologies and how they manage "on stage" are the things that matter.

> *"it was good to be able to check the rules from one screen and then the answers from the other"*
>
> *"smart use of the whiteboard too – in a way new and old technology have been combined, they make a substitute for more fancy new stuff"*

Only one teacher took part in the study and he used technology available in the learning space. When asked about the technology in D102:

> *"It's useful, it allows interaction and editing and relevance that I wasn't able to do before… You know, edit them, I can draw on them and doing this sort of analysis and that was not possible before. I think that is definitely worthwhile and it shows in the students motivation. "*

Technologies this teacher felt was missing was interactive screens, smart boards, or similar to enable him to save and easily erase what he has written on the whiteboard. The whiteboard had a computer screen projected upon.

> *"… two projectors and that you can write on. I would like to be able to write on both screens. And the thing that takes pictures have that thing with a projector."*

The table below shows us data from the survey and gives us some idea of what technologies are mostly in use in the learning space.

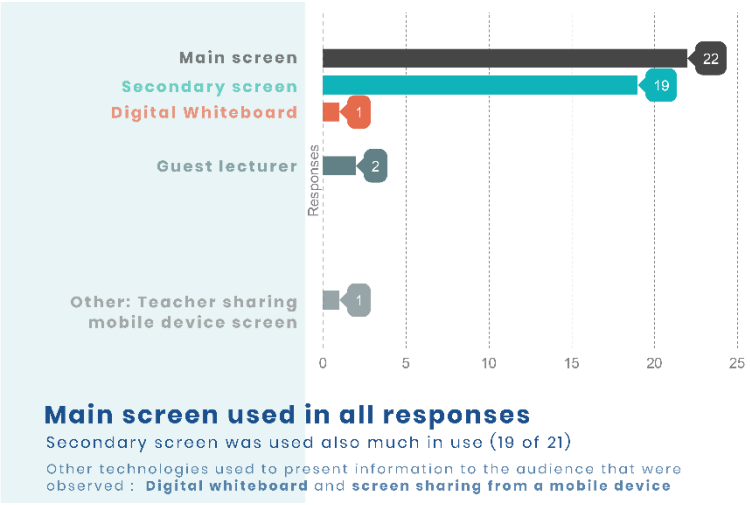

Figure 2 Surveys results of the use of the technology in the learning space

We can also see from the figure above that Main screen was used on all occasions (22 of 22) but not the secondary screen. This tells us that the learning space is sometimes used in the traditional way meaning the learning space is not used in the way it was designed to be used.

Interior design of the learning space

The learning space D102 is based upon a ~ 10-year-old standardised learning space model. The goals with these types of learning spaces are to create an active learning space that supports interaction between teacher – students and student – students.

This is to be achieved by pleasant colours, soundstage and furniture that are easy to refurbish for different activities. The learning space should also inspire teachers to use digital solutions and technologies to open up for new possibilities. When asked the students participating in the interview about the interior design, the following things were mentioned:

> *"For us all to look in the same direction, when the chairs face in all directions, it could be a challenge. Now it's kind of a strength, when there's movement in different direction in the learning space"*
>
> *"so maybe this removes or at least lessens our asocial nature in these teaching situations – in that sense this is a really cool room or class or mode of teaching – overall this is more active, we are more creative"*
>
> *"actually I quite like the colouring – it's nice. Like person two said, it does indeed bring a quite cerative atmosphere"*

The survey results also indicates that the interior design of the learning space is of very high quality (8 of 22), 10 of 22 rated high quality. 8 of 22 are very satisfied with the lightning in the learning space (12 of 22 are satisfied). 10 of 22 are very satisfied of how the soundstage (12 of 22 are satisfied). 9 of 22 are very satisfied of the flexibility if learning space, 7 of 22 satisfied and 5 of 22 are neutral.

> *"Fitting size, doesn't echo like the basic classrooms"*
>
> *"nice lighting, covers the whole space"*
>
> *"I like the furniture, it's colourful and comfortable"*
>
> *"Modern furniture and technology. Diversity."*

Two screen on different walls vs two screens on the same wall

The survey showed that placement of the screens are satisfactory (10 of 22 very satisfied, 8 of 22 satisfied). Having two screens/projectors on different walls raised an interesting discussion with both students and the teacher.

> Student 1: *"well, it was good to be able to check the rules from one screen and then the answers from the other"* Student 2: *"and then it feels like this space is being utilized. For us all to look in the same direction, when the chairs face in all directions, it could be a challenge. Now it's kind of a strength, when there's movement in different direction in the learning space"*
>
> Teacher: *"Well, yeah. I would now after being there and doing this for some time I would actually like to have both projectors/screen on the same side of the room. Because of the walking back and forth. I see the benefit there for many reasons, from a teacher's point of view it forces the teacher to walk. If you are a teacher who tends to*

stand in one place and be boring now you are a bit less boring because you have to walk and occupy the stage. I always walk a lot so I do not have that need. … Maybe if we would have one here and one there and the teacher in the centre. I don't know. Different kind of classes, different ways of organising them.

Attention

By observing the students in the videos (case 1: digicampus.21.3.ET.teachers.view.mp4 and case 2:digicampus.student.view.28.3.mp4) we can see clearly how the teacher's method of teaching with two screens and being in the centre catches the users attention and keeps students active. When the teacher is switching from one screen to another and walking around when lecturing this creates an automaticity trigger for immediate attention. Immediate attentions are short-term and are unconscious and subconscious reaction to certain sights, sounds, and other stimuli.

Short-term attention are the kind of concentration that you give when listening to a keynote speaker or reading a news article. The attention you decide to give and decide to pay attention too.

The student's visual attention measured by Tobii eye tracking glasses and Tobii's Attention-filter.

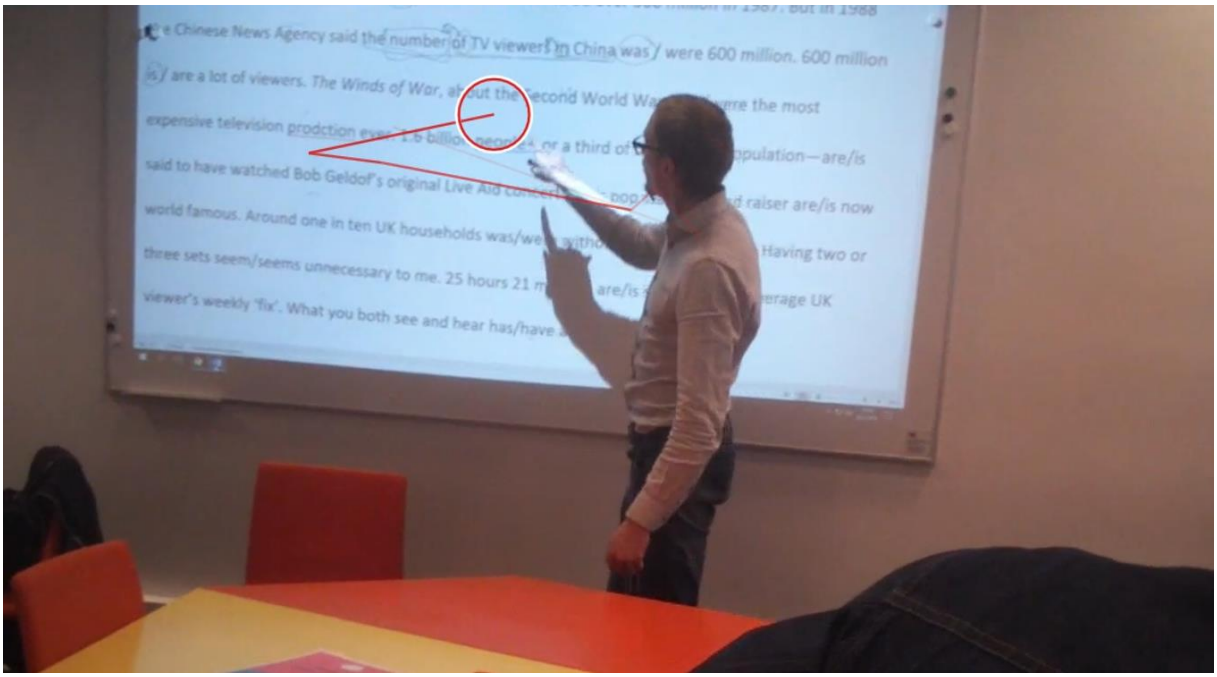

Figure 3. Screenshot from student eye tracking glasses data: Students attention to the teacher interacting with whiteboard/projector with Tobii attention filter.

The table below shows the results from case 2, it describes how much visual attention the student gave the lectures different intervals (or segments) compared to the length of lecture intervals.

Case 2. From lecture start to group work start

28.3.2019. Total Visit Duration mm:ss	Main screen	Secondary screen ON	Secondary whiteboard	Whiteboard (2nd screen OFF)	Instructions / introduction	Total Time of Interest Duration	Total Recording Duration
Teachers usage of screen time	17:16,4	10:52,3	01:42,4	10:37,2	03:02,1	43:30,5	45:25,3
	715,38	557,01	35,40	390,23	-		
Students attention to screens & teacher	11:55,4	09:17,0	00:35,4	06:30,2	-		
	69,0 %	85,4 %	34,6 %	61,2 %			

Table 2 Student attention to the lecture, measured by eye tracking glasses

The student paid much attention (85,4% of total time with the technology) to the secondary screen, when teacher was interactive (felt-tips pen) with the whiteboard with a computer screen projected upon. The interactivity with the whiteboard creates a short-term conscious concentration "what is he writing?" "What is the right answer?" "I will soon be my turn to give an answer". The secondary whiteboard was used to exemplify and give answer to a student question, the student with the glasses did not pay as much attention to that part (34,6% of the time it took to answer the question).

The attention devoted to the main screen (69% of total main screen usage time) is also less than the attention to the secondary screen with the teacher's interactivity and involvement of students.

Pragmatic aspects of the learning space

We found some potential pragmatic problems with the learning space during the study.

1. Cramped space

From the videos in case 1 and case 2 we find the teacher having problems getting to the third screen / whiteboard 2 (see figure 1). The number of tables and chairs, especially in a fully seated learning space, will hinder the use of the learning space of its full potential.

> Student: *"if there were people at all tables, it would probably change the atmosphere a little – now that we are three fourths here, it may be a bit crowded for the teacher to move around, but since we haven't moved around very much, it hasn't felt crowded to me"*
>
> Teacher *"…there is a bit too much in there now as you could see I was trying to get past students... too many tables."*

Some students find that the best place for a good overview of the teacher and the two screens (that are used the most) are at table 3 and 6 (see figure 1). This hinders the teacher to get to the screen/whiteboard behind them.

Solution: By removing three of the eleven tables and placing the remaining eight more in the centre of the room will make the learning space less cramped. It will also invite and open up for the opportunity to use all the screens/whiteboards for the teacher. (see figure 4 below)

2. Placement of control centre

The control centre: where the teacher has his laptop, the learning space's computer is located and the control unit for the projectors. The placement of the control centre can be optimised to reduce distance from the secondary screen and third screen / second whiteboard. In case 1 its clear when observing the teacher that it can be a nuisance when using the secondary screen and having to walk back and forth for small things forgotten or small technical issues. For example grabbing the wrong computer remote control.

> Teacher: *"… first thing felt pens not being where I want it and brushes being on the other side of the room. That comes first to mind.…If I could get… I use the felt tips now, now I am brushing off and I am leaving the felt tips all over so if I would have an electronic pen I could draw on the white board with and erase afterwards.*

Solution: By moving the control centre between main screen and secondary screen, the distance between the control centre and screens are reduced and the control centre become more of a hub. It

also gives a closer countertop space for felt-tips pen, remote controls etc. from the secondary screen to the control centre. See figure 4 below.

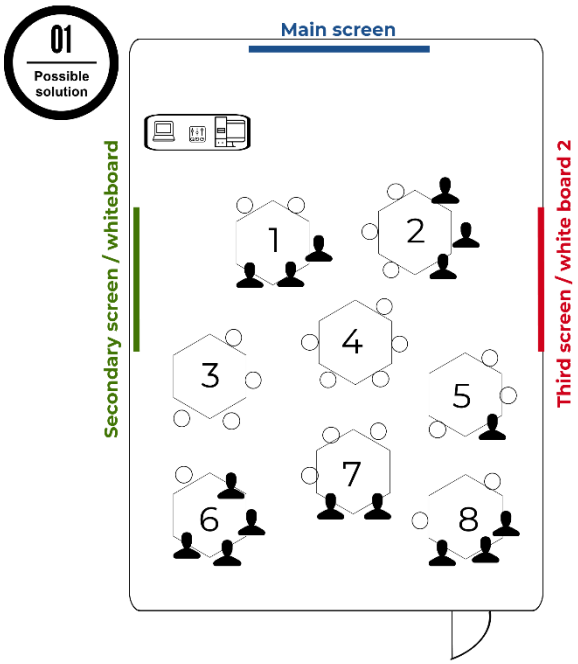

Figure 4. A possible solution for a more optimal learning space setup

3. Projector control unit

The Control unit is great for connecting different computers to different screens/projectors. In our cases the teacher, who is tech-savvy, is used to setting up his laptop and computer in the learning space and knew how the control unit works. During the teachers setup in case 2, we found a potential usability problem for teachers not as tech-savvy (see video digicampus.ET.teacher.set-up.28.3.mp4).

The user interface of the control unit does not have information about where and onto what the projectors will project their screens. By clarifying where the main projector screen and secondary projector screen is in relation to where the control unit will make it more user-friendly. IT will also make the UI of the control unit more intuitive for new teachers not used to the learning space. Figure 5 below shows us how the User Interface (UI) of the control unit looks today and during the study. During the teachers setup of his lecture, the teachers spent some time (~7 seconds) remembering / searching /figuring out which computer is connected to which projector.

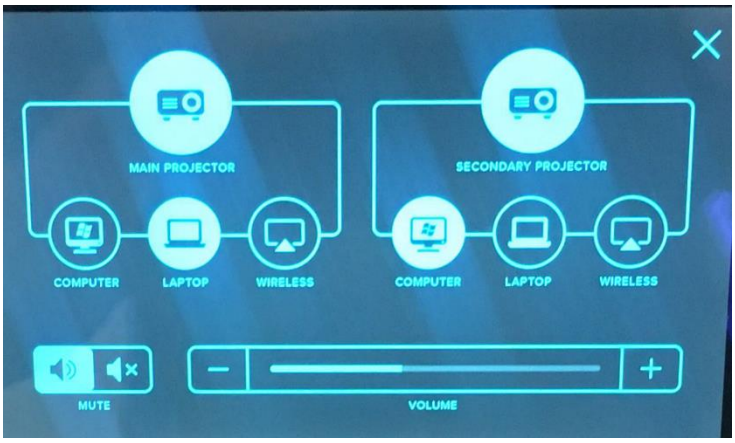

Figure 5. Control Unit UI

Solution: Adding small arrows that points at the same direction as the projector and a short description under the name of the projector will help new users to recognise which one is which. This will help users recognising graphically where the projectors will be projecting, making the actions more visible and matching the actions with the real world (Jakob Nielsen, 1994).

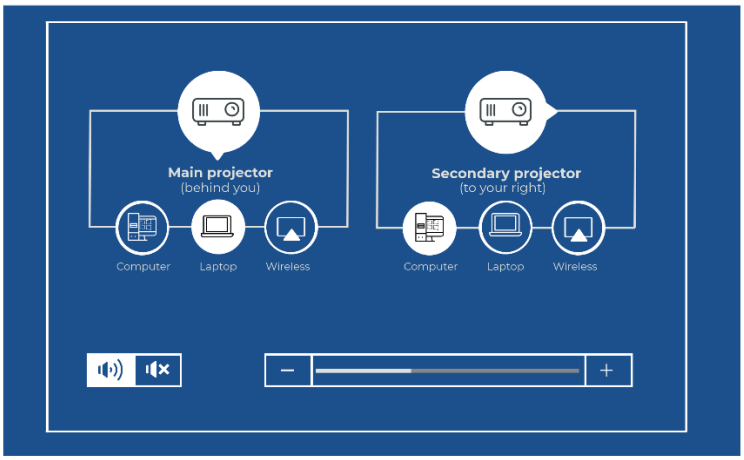

Figure 6. Improvement for the control units UI

Discussion and conclusion

Using a learning space to its full potential requires a lot from a teacher. This kind of learning spaces should support interaction between teacher – students and student – students. One of the main features of the learning space that support interaction are the methods the teachers uses in their lectures. This requires a lot from the teacher: knowledge of the technology, experience with the technology and courage to try/experiment.

We found in the study that use of two screens on different walls has its pros and cons. Having different content on the both screens may require more head/chair turning for the students (depending on where in the room they are sitting). This in combination with the teacher walking around from screen to screen and in the middle of the room captures the student attention more, activates them and keep the students more alert. Having screens on different walls also invites the teacher to walk more, take the stage and not be dormant.

> Teacher: *"… If you are a teacher who tends to stand in one place and be boring now you are a bit less boring because you have to walk and occupy the stage… For the students I can see also similar thing that watching them you see they are a find it a bit more interesting. It also kind of helps me as well because I can see where they are looking"*

When two screens are side by side on the same wall a teacher will not have to walk as much between the screens and have extra utilities (felt-tips, eraser etc.) close by. It does not invite teachers (who like to stay dormant) to walk around and activate the students which results in the learning space does not reach its goals to support interaction teacher – student and student – student. When a teacher is only standing still and talking in front of two screens, all students are likely turned towards the teacher. This may create a traditional learning space, row-seating atmosphere that may hinder student – student interaction.

> Teacher: *"… in traditional room there is the row thing, which destroys discussions, inhibits discussion."*

In conclusion, there are some options for improvements to make the learning space more pragmatic and teacher user-friendly as discussed in the findings section. The teacher participating in this study several times mentioned technology such as smartboards or similar interactive surfaces but also the possibility for large groups to be interactive on a board.

> *"Also, to have this whiteboard is great for group work, I mentioned to have all the walls painted with something you ca draw on and shelves for felt tips. Sometimes I have to do something on my computer so I walk back and forth and that is sometimes inconvenient. Maybe if we would have one here and one there and the teacher in the centre. I don't know. Different kind of classes, different ways of organising them."*

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