TRANSFORMING EDUCATION SPACES TO SUSTAIN PEDAGOGICAL CHANGE

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Abstract

Many universities maintain campuses with multiple buildings, which are housing different faculty departments. Often the independent departments are in charge of the lecture halls and classrooms situated within their building. Hence, over the years a variety of audio-visual information technologies (AV-IT) and interior arrangements have been installed into the teaching and learning spaces. Unfortunately such arrangements and applied projection systems dictate the pedagogy that can be applied therein, for instance a lecture hall with fixed tables and chalkboard can only facilitate frontal instruction.

In the last decade student numbers have grown drastically. Due to this massification lecturers were timetabled in larger halls located in other faculty buildings. As a result of such interchanges it became clear that our education spaces over the different buildings were divergent and often outdated. Moreover, problems arose because of different AV operation and teacher support resulting in delayed lectures and complaining staff.

Divergent systems and massification together with pressing developments, such as blended practices and flipped classrooms, confronted Delft University of Technology (DUT) with a situation that curricula are to be converted into active education practices but in outdated education spaces.

This very situation urged DUT to start streamlining the current lecture halls and classrooms in order to facilitate the education practices of tomorrow and to support those of today. A special workgroup Transforming Education Spaces is charged with classifying the required education spaces to facilitate sustainable education practices for today and tomorrow, with designing its appropriate technologies and arrangements, with mapping the current university situation, with composing a Cookbook Education Spaces and with proposing a transformation plan for the coming five years.

This paper describes how the Cookbook Educational Spaces came into existence, which content is addressed and how the multiple disciplines of pedagogy, interior design, construction, infrastructure, AV-IT and ergonomics have been working together.

Keywords: cookbook education spaces, frontal pedagogies, mixed pedagogies, lecture hall, classroom

1 LECTURE HALLS ARE IN DISPUTE

Lecture halls have been dominating higher education for a long time. Halls and amphitheatres were build following the pedagogy that transmits knowledge from teacher to student. The lecturer situated at the front elaborates on a subject, shows a presentation on the screen or chalks a complicated formula on the board while explaining its structure. Such lecture practices are still going strong, but under dispute. Literature have been coming forward with arguments that classroom settings facilitating interactive and collaborative work should be prioritised above lectures because learning happens better within such practices and would lead to better student results. Thus far, little evidence is available. Moreover, comparing the learning on itself within lecture halls or within interactive classes is not fair.

Lectures are given in halls or classrooms where an expert explains or elaborates about knowledge. The real learning happens during homework and other ex-situ (out of place) assignments. Lectures expect a “practice and drill” follow-up to internalise the subject matter while interactive classes practice Bloom’s “understanding” and “application” levels directly in class [1,2].

Flipping the classroom practices on the other hand help to homogenise the knowledge level of participators about the topic before class starts. It is unknown if such flipping came forth due to the heterogeneous classes of today with their students' divergent backgrounds and study efforts. Still, lecture capture and video snippets certainly have earned their place within education and training, either for preparation beforehand, missed lectures or online classes.

Lastly, economic reason is probably feeding the discussion for more interactive classes too. From occupation and utilisation figures it became clear that lecture halls remain empty during considerable time. With estimated costs between € 250,- to € 500,- per square metre such unused education space is an unaffordable waste of resources. At our university less than half of the lecture halls were occupied with only one third of the seats taken [3]. As a result an institutional advice came up to dispose lecture halls in favour of interactive classrooms, but the teaching force objected and were asking the opposite: more lecture halls.

2 CURRENT LECTURE HALLS ARE DIVERGENT

In the last decade student numbers have grown enormously. Cohort sizes overgrew the seat capacities of several buildings. As a consequence classes were timetabled in other buildings on campus resulting in a centrally managed pool of lecture halls and classrooms. Lecturers were not happy when they had to move to another building because of the time loss. Moreover, they do not prefer to go to another building because of the arrangements and possibilities of those unfamiliar lecture halls. Finally, they have experienced a lack of teacher support when they have petty user problems in those other unfamiliar environments. They had rather made reservations in a far too large hall for their small student classes. Such is one explanation of low utilisation figures. A second explanation for the low average of occupation and utilisation figures [3,4] is the curriculum shift from mostly lectures to group work and project assignments. At the beginning of the academic year introductory courses are concentrated while the group assignments are scheduled in the second semester leading to an irregular distribution of learning space occupation. Making learning spaces flexible in order to facilitate more than one education practice would help to influence such figures.

The situation of education spaces at our campus has grown divergent due to decentralised policies in the last decades. Both interior arrangements and audio-visual information technologies (AV-IT) have a spread from simple to advanced and from unstructured to supported in different ways. Where once dedicated assistants or faculty staff were available for every practice we now see shattered services resulting in lecturers in despair. This undesirable situation urged Delft University of Technology (DUT) to streamline the current lecture halls and classrooms university-wide in order to facilitate the practices of today and at the same time the upcoming practices of tomorrow where blended settings and online programmes will take their place. As a consequence the departments of Education and Student Affairs, Facilities Management and Real Estate, and the Shared Service Centre of ICT found each other to set up a cooperative strategy. A special workgroup Transforming Education Spaces was founded and charged with classifying the required education spaces to facilitate sustainable education practices for today and tomorrow, with designing its appropriate technologies and arrangements, with mapping the current university situation, with composing a Cookbook Education Spaces, and with proposing a transformation plan for the coming five years. With this cooperate strategy automatically the different disciplines were addressed and interdisciplinary communication started to thrive. Henceforth construction, interior design, infrastructure, pedagogy, AV-IT and ergonomics converges when new education buildings and spaces are built and retrofitting takes place.

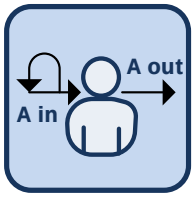
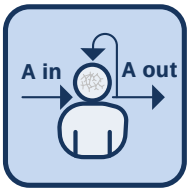
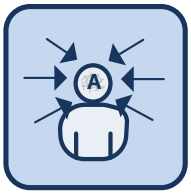
3 LEARNING CONCEPTS AS PRESCRIPT FOR EDUCATION SPACES

There is no need for a new building to arrange educational transformation. One can equip education spaces in order to facilitate the practices of today and those of tomorrow at the same time, however, there is not a cookbook available yet. Hence, we start from basic but broad terms. Which pedagogy must be followed for the desired learning objectives, how are these facilitated and with which technology is subject matter to be taught?

The definition of learning and how it occurs has significant implications for the way education is facilitated. Many researchers have been posing as many education practices, but one may agree that there are five main learning theories to distinguish: 1) Behaviourism, 2) Cognitivism, 3) Constructivism, 4) Social Constructivism and 5) Connectivism. These main concepts are complex scientific

interactions between psychologists, neurobiologists, sociologists and educationalists. We want to take these five theories as indicators for our education spaces as they are briefly presented in Table 1 [5].

Table 1: Five Learning Theories or Concepts

	**Behaviourism** was very popular in the beginning of the 20th century. The learning goal of behaviourism aims at automating certain actions due to repetition and external stimuli. Drill, practice, instructional cues and training are the keywords just until automatic execution is taking over without any thinking. It is not only for the mind but also for motor movements. Examples are solving a math problem, applying mechanical formulae, hitting a ball, taking a penalty, driving a car, or even the training in a flight simulator.
	**Cognitivism** was very popular in the middle of the 20th century. Learning occurs when a knowledge state of the mind changes. It is a mental activity encoded and structured internally by the learner while one can observe the change of outside behaviour. Observation is fed back to the learner, so that he or she knows about the progression. Especially Computer Based Training is based on Cognitivism. If learners can apply certain rules, concepts and knowledge, of for instance procedural steps in different scenarios than the transfer of such knowledge has occurred.
	**Constructivism** became very popular since the 1960s. A learner actively constructs his or her own understanding through reflection on individual experiences. Knowledge is not transferred from one individual to another but the learner orchestrates, selects and transforms information, formulates hypotheses and makes decisions to construct knowledge in the own way with own rules and own mental models. Learning is building a unique personal construct based on experiences and interactions from authentic realistic situations. Constructivism is accepted to apply for education practices with cognitive harder subjects and ill-structured problems in project situations.
	**Social Constructivism** elaborated on Constructivism from the 1980s on. Social constructivism is applied for assignments to groups of students where problem solving is done over for instance different disciplines in which constructs are built together and reflected with peers. Learning is building a construct through understanding and interaction that occurs by intentional human activities within society, politics, culture and environment. Interdisciplinary projects help to develop and practice communication skills over different methodologies, vocabularies (jargon), ontologies and conceptions.
	**Connectivism** has been becoming popular since the last decade. Connectivism argues that learning is meaning making and connection forming of information between specialised communities in networks, it happens through people and machines. It is the skill for collecting valid knowledge in the ever-growing amount of information through synthesising, recognising patterns and selecting. Information and Communication Technologies (ICT) enhance new ways of learning that are only possible with such technology. The former theories on the other hand seem to thrive just by the use of these educational technologies.

Learning theories are start for instructional design, but we can use them also to imagine spaces where such learning concepts thrive. D. Christopher Brooks have indicated that form of the space influences the behaviour of instructor and student, different spaces are better suited for some types of activities and conducive to students' time-on-task. Brooks even stated the following syllogistic terms: 1) space shapes instructor behaviour and classroom activities; 2) instructor behaviour and classroom activities shape on-task student behaviour; therefore, 3) space shapes on-task student behaviour [11].

Literature shows frameworks that support the idea of dedicated learning spaces, such as the Pedagogy-Space-Technology (PST) Framework for designing and evaluating learning places [6] and the Technological Pedagogical and Content Knowledge Framework (TPACK) for teachers and teacher educators [7]. But thus far no specific description of the teaching and learning spaces was found that we could use for our cookbook education spaces. We wanted to bring it a bit further, a bit more tangible. With the learning theories as fundamental principles in combination with conducive spaces to instructor and student behaviour we came to a classification of teaching and learning spaces dependent on AV-IT technologies, interior arrangements and pedagogy.

4 COOKBOOK EDUCATION SPACES FOR APPLIED PEDAGOGIES

The purpose of our cookbook is to describe education spaces based upon applied pedagogies. The current campus situation has been mapped and upcoming developments for higher education were studied. Following the syllogistic terms of Brooks and frameworks we have distinguished four different types of teaching and learning spaces necessary to facilitate the several pedagogical modes at our university. Each class type is differentiated into a basic format for AV-IT installation and interior design and an advanced format. The distinguished class types are 1) frontal pedagogies, 2) mixed pedagogies, 3) meet & collaborate, and 4) (digital) exams & computer practices.

It is very important that the appropriate technology and furniture arrangements are available before education change can take place. Pedagogy can only be applied when the situation is there, no facilities available means no change at all. Thus, the change strategy must comprehend all teaching and learning spaces, a complete overhaul is at its place. Of course it takes time to carry out such a grand project, knowing that pedagogy by affordances will not change overnight either [8,9,10]. Yet, it is important that timetabling needs to be adapted immediately to be able to schedule teachers, lecturers and instructors in the right spaces [4]. When they have changed their practice they must be timetabled in learning spaces that support their new pedagogy.

4.1 Frontal Pedagogies

Frontal pedagogy is teacher-centred and focuses on explanation of basic and complex subjects, especially natural sciences where writing formulae and their derivation at the frontal chalkboard is presented next to drawings and sketches. Behaviourism is leading concept for this teaching. Frontal pedagogies have a high rate for time-on-task [11].

Frontal pedagogy is only one part of the learning objective. Students listen to the lecturer and take notes about a subject. The explanation within the lecture hall is for the students' comprehension. The second part of the learning objective, which is even more important, is to internalise the discoursed method or technique. They need to practice and drill the subject matter during homework or practical until automatic execution is achieved.

Current situation

Lecturers argue that they want to practice frontal pedagogy for the more fundamental courses, such as mathematics, physics, chemistry, construction, mechanics, statics and dynamics. The course content is to be written and explained in front of the hall, preferably on several chalkboards. Together with the chalkboard they need a computer to accompany their writings with for instance a PowerPoint presentation, or to demonstrate a certain situation on the Internet, or picture dedicated circumstances or show an online book. Since lecturers are more and more timetabled at other buildings for capacity reasons they bring along their laptop to be less dependent on the affordances of the scheduled lecture hall or classroom. Projectors are available, but the specifications differ widely.

Students following such scientific lecture classes on the chalkboard prefer sitting straight to the board [12]. As a consequence the rows of seats must all point to the front where the teacher is standing. The lecture is still mainstream within our institution and is practiced in both lecture halls and classrooms. Wireless networks are available but power sockets are seldom offered.

Future situation

A contemporary but pressing development for universities is open and online learning. DUT has chosen to strategically invest in massive open online courses (MOOC) and to do acquisition with companies to serve their post graduate courses. Next to the twenty thousand on-campus students DUT would like to acquire a permanent base of forty thousand online students. Such online practices are to be facilitated with an additional collaborative learning environment.

In order to prevent derailment of the frontal chalkboard pedagogy we want to apply virtual chalkboards to bridge the gap between on-campus and online practices. Lecture capture as such will not do, because chalkboard derivations are encapsulated within the video codecs and subsequently unable to be worked with any further; no copy and paste possibilities remain for students. With a virtual chalkboard or interactive whiteboard such content matter is certainly editable to copy and paste in other ICT applications without manual transcription.

Many computer applications have been coming into the lessons for in-between demonstration, animation, simulation or presentation. For such reason we want to present multiple video signals simultaneously, not just one presentation next to the board but four video signals in parallel. This means that a classroom computer must be available and is to be used instead of the own laptop. If the lecturer wants to use just one video signal then the laptop will do or the classroom system presents only one signal in full-screen mode.

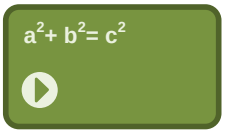
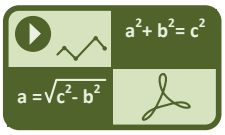
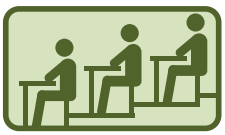
The 4-quadrant system with SMARTboard for presenting multiple video signals has been tested within practices for three years now. It is important for the teacher to conduct the course following his or her own pedagogy. Therefore the feel and touch of the interactive whiteboard must be close to normal chalk experience. Exchanging the normal chalk for virtual chalk should be as natural as possible.

Teachers using chalkboard pedagogy write their formulae in a fast rhythm on the board. Meanwhile they explain the purpose and position of the written characters. These virtual written characters must appear without delay or parallax at the very spot where the virtual chalk is moving. Lecturers use the pen to write and sketch, they use their finger to select and navigate, and they use the back of their hand to erase. The three main functions “write”, “select” and “erase” make it really easy for lecturers to turn over from real chalk to virtual chalk. The small writeable surface of the used SMARTboard was overcome also with the introduction of the four parallel video signals. More details about the use and valuation of this system is available at http://pietvanderzanden.weblog.tudelft.nl/ and “Advanced Teaching with Four Parallel Video Signals” [13].

Pictograms to Indicate Affordances of the Education Space

Pictograms will be used to simplify the present affordances of an education space. Early designs of the pictograms are presented in Table 2 with alongside description. Such pictograms are to be used within communication between timetable agent and teacher, for indication in the information system of facilities management and real estate, and for indication next to the learning space entrance including the number of seats. The pictogram’s colours indicate the pedagogy. Additionally, similar colours can be used for signage at the building’s main entrance to indicate the direction to its education spaces. The spaces themselves may carry multiple pictograms dependent on the actual situation.

Table 2: Frontal Pedagogy Pictograms

	The standard lecture hall offers a bridging installation between current and future situation with an interactive whiteboard (84”) already in place next to the present chalkboards and whiteboards. A classroom computer is available for full screen presentation. Connecting the own laptop is possible too. The projection screen surface is at least 10 m^2.
	The advanced situation offers the 4-quadrant pedagogy. The installation includes a classroom computer with a 4-output video card, video processor, AV matrix switch and controlling hardware and software. The projector supports WQXGA (2560 * 1600/1440 pixels). Projection screen surface is about 10 to 16 m^2.
	At least 100 attached seats are available in amphitheatre or space with multiple tiers, up to a capacity of over 350 seats. Power socket is available for every seat. Wireless connectivity is available for about 40 concurrent users.
	Special situations offer extra attractiveness for special occasions, guest lecturers and inaugural events, such as luxurious furniture, special lighting and interior upgrades. They offer lecture capture, teleconference and in-room recording. Some special spaces can have furniture on semi-tiers, i.e. two rows of chairs on casters and tables per level to facilitate mixed practices too or Flexstool® with facilities built in, see http://homepage.tudelft.nl/9c41c/flexstool/Revolving_Furniture_for_Interactive_Classes.pdf

4.2 Mixed Pedagogies

Mixed pedagogies focus on classes with alternating practices, such as frontal introduction about a topic and subsequently tutoring student groups while working in teams on the assignment. Of course it facilitates frontal pedagogies such as instruction about subject matter, discourse and problem-based learning scenarios.

Student-centred pedagogies have an all-in-one learning objective. Students have to understand a certain criterion, method or technique and have to apply it within or for their assignment. Almost all of the learning theories serve the practices with emphasis on Cognitivism and Social Constructivism.

Learning spaces for mixed pedagogies are often flat-level classrooms, with easy access to the separate table-groups. Tables and chairs can be arranged in different set-ups dependent on the education practice.

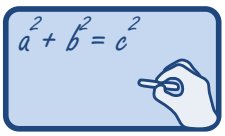
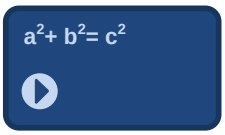
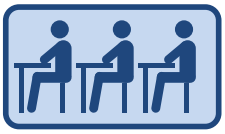
Current situation:

Lecturers use the flat-level classrooms for similar practices as in lecture halls. Instructors and tutors on the other hand use only classrooms where the furniture is easily to revolve or already arranged for group work. Thus far we have little provision of flexible learning spaces. Hence, most of the time the classroom's arrangement is already in group set-up when problem-based learning is practiced. During such practice students turn their back when listening to the introduction or in-between instructions at the front.

Future situation

In an increasingly way lecturers prefer interior arrangements where students work in groups in an active way on their assignments. Dependent on the subject matter students must learn in teams, play different roles in management games, battle in front of the classroom about a topic, or argue from different views when designing equipment, interfaces, buildings or other constructions. The instructor start with explanation of an assignment, sometimes deepening the difficult parts. At that moment all student chairs are facing the classroom's front. When the frontal part has ended the students work in groups on their tasks with their chairs and tables aimed to each other. Henceforth the instructor changes role and acts as coach or tutor to visit every group for further guidance and reflection.

Table 3: Mixed Pedagogy Pictograms

	The standard situation offers chalkboards or whiteboards with a writing surface of 8 m^2 or more. A classroom computer is available. Connecting the own laptop is mainstream. Projection screen surface is about 6 m^2. The projector supports WXGA (1280 * 800/720 pixels) or above.
	An advanced situation offers an interactive whiteboard (84") as second screen presentation or as virtual writing medium. The learning space gets erasable whiteboards all over that can be used for break-out sessions or poster hang-outs.
	The number of seats in the flat-level classroom is about 60. Tables are unattached and chairs are on casters for easy rearrangement, shifting and revolving. Semi-movable tables with power socket per seat. Wireless network connectivity for 25 concurrent users.
	The advanced situation facilitates group work next to frontal instruction practices. The furniture can be arranged with for instance table rows alternately placed with wide and small tabletops and chairs on casters. A special situation is equipping the learning space with professional revolving furniture such as the Flexstool® with all facilities built in, see http://homepage.tudelft.nl/9c41c/flexstool/Revolving_Furniture_for_Interactive_Classes.pdf

4.3 Meet & Collaborate

Meet and collaborate practices focus on team work and group assignments. To date most of the faculty buildings offer meeting rooms for staff only. These spaces have an average capacity of ten seats. It seems obvious to make use of such staff meeting rooms for the increasingly problem-based scenarios as part of modernised curricula.

Students apply for a job after graduation, thinking that they are ready with the acquired degree. Once at work they experience an unexpected lack of skills. For instance they have to communicate with professionals talking in dedicated jargon, they have to understand instantly the on-going methodologies and procedures, and they must operate in teams. Newcomers have to spend several months up to a year dependent on the job to learn the ropes before they can operate on their own.

When two or more disciplines collaborate to work out a concept or design, they have to adjust their methodologies and techniques to fit. Learned skills and knowledge are taken for granted much too often and discrepancies only show themselves at the end of a product line, demonstrated in accidents caused by human errors. For example, due to differences in dimensions and parameters, such as using degrees Centigrade in one discipline and Fahrenheit in another, or centimetres being confused with inches, caused the loss of the Mars Climate Orbiter [14]. More hidden discrepancies come from vocabularies where the same word carries different nuances or meanings in different disciplines. Even more discrepancies occur as result of deviated design approaches.

Especially Social Constructivism and Connectivism enable educational practices where these skills are mastered through communication, shared ideas and joint projects. At DUT new practices were brought into the curricula. It comprises real-world problems where you can learn team-skills. Teams of master students from multiple disciplines work together on projects such as low energy cars, non-friction boats, domestic robotics, medical tools, stronger plant seeds, solar driven heating, autarkic biotopes, easy cleaning water supplies, etcetera. The number of what we call “dream teams” is rapidly growing. Those teams need laboratory space to work on their prototypes and collaboration space for constant communication and review. Ideally, teams may use dedicated space for longer periods, but also student groups during mixed-pedagogy terms need spaces for longer time.

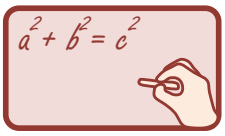
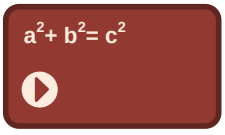
Current situation:

Today the meeting rooms are for staff only.

Future situation:

Larger office spaces can be provided with cubicle-like spaces to facilitate team-spaces for longer periods. Meeting rooms should also be timetabled centrally, just as the lecture halls and classrooms.

Table 4: Meet & Collaborate Pictograms

	Standard situation is the availability of whiteboard and flip chart for instant discussion and elaboration. Projection screen surface is from 2 to 4 m^2. The projector supports at least WXGA (1280 * 800/720 pixels).
	An advanced situation offers an interactive whiteboard (84”) as second screen presentation or as virtual writing medium.
	The number of seats in the meeting room is about 10, sometimes up to 30. Tables are unattached and chairs are on casters for easy arrangement of collaborative settings. Power sockets are available on the wall. Wireless network is available for 25 concurrent apparatus.
	The advanced situation facilitates videoconference for inter-university meetings and (inter)national online collaboration between teams and or staff.

4.4 (Digital) Exams & Computer Practices

Exams still are the testing moments for students to demonstrate what they have learned. It is about knowledge, understanding and application, about comparing their personal construct with the institute's learning objectives. For universities it is an instrument for easy determining the students' progress, especially with large cohorts. In the near future digital testing for campus education is bridged with the upcoming online practices of tomorrow.

Current situation:

Paper testing and digital testing are both applied for thousands of students in certain time periods. Large halls are dedicated for the exam periods. The university supplies exam laptops and computers in case of digital testing.

The institute also supplies computers for practices with complex and expensive software in dedicated computer spaces. Cognitivism is leading for such computer practices.



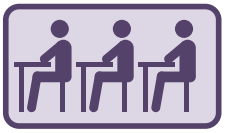

Future situation:

Testing happens on paper or via computers dependent on the courses. Timetabling these paper and digital exams happens indifferently. One day all testing is on paper, the other day it is digital. Sometimes such paper and digital tests are scheduled at the same day, sometimes even in the same hall. Staff needs time to transform a large hall from a paper-based exam situation to a computer-based exam and vice versa. Such transformation takes a few hours for several employees dependent on the number of desired seats. A new tableset has been designed to facilitate such transforming in a much easier way. The computer's display can be hidden right under the tabletop together with keyboard and mouse as the picture-series hereunder shows.





Table 5: Exams & Computer Practices Pictograms

	The standard situation offers halls for large-group paper exams. Some halls can be transformed for digital exams by carrying in up to 500 laptops. An advanced situation offers entrance control with RFID readers to only accept authorised students, see http://homepage.tudelft.nl/9c41c/Zaaltoegang/Zaaltoegang.pdf
	Digital testing is also a standard situation, but dependent on lecturers' demand. The advanced situation with integrated tables for testing both paper exams and computer exams is coming soon. The transformation from computer table to normal writing table can be done within 5 to 10 seconds with these new tablesets.
	The standard furniture for exams are height adjustable tables and chairs, although hardly anyone uses this feature.

	Computer practicals and IT courses are standard situations. Even practicing for digital exams in computer halls is becoming mainstream. A special situation is revolving furniture for computer practices for both frontal and group assignments with chairs on casters.

4.5 Commons for All Education Spaces

One should consider not only the local circumstances when an overhaul of learning spaces takes place. Management, maintenance and general issues that count for all teaching and learning spaces are to be considered. Thus far we have list the following topics to be addressed:

- Door of education spaces locked electronically and entrance only possible with RFID card.
- Outdoor indicator if the teaching or learning space is in use. The indicator should be linked to the audio-visual installation.
- Electronic and synchronised clock in every teaching and learning space and adjacent corridors.
- IP camera monitoring for every teaching and learning space for remote management issues, occupancy and utilisation, student behaviour study, etc.
- Activating the AV-IT installation of a teaching or learning space with personal campus card.
- Wireless for 40 concurrent users in lecture halls and for 25 concurrent users in classrooms and meeting spaces.
- Standardised documentation of AV-IT installations on specific data sheets.

5 CONCLUSION

This paper shows our approach to transform present education spaces along pedagogical guidelines. It is about enticing lecturers, instructors, teachers and students to change their inert educational behaviour through the provision of features and possibilities facilitated in the education space, in other words providing the appropriate affordances.

Building and renovating new teaching and learning spaces thus far follow standardised procurement policies. Subsequently, the audio-visual installation is replaced with a similar one but newer, as it counts for furniture too. Such automatic replacements must stop; developments in education have to be considered when preparing education spaces to sustain pedagogical change. If appropriate pedagogy affordances are absent or counterproductive then nothing encourages its users and progress within education remains undoable.

Contemporary literature advises to make education spaces flexible in order to force a breakthrough in the inert situation of non-changing higher education. The assumption goes that flexible spaces facilitate multiple practices, which on their turn should give rise to educational change. Unlike this advice, we recommend to retrofit current education spaces for a single pedagogy only. Own experiences with flexible spaces and a multitude of features have been showing that it discourages lecturers, teachers and instructors to use any of the provided possibilities. Such over-featured spaces simply do not work and are similar to multi-tools that have drills, circular-saw and reciprocating-saw attachments or Swiss pocket-knifes with screwdrivers and can-opener. Those smart things are sometimes interesting but a professional still prefers a dedicated saw and a real screwdriver. Hence our recommendation is to design education spaces dedicated to specific pedagogies. Doing so encourages teacher and learner to behave in ways where the specific teaching or learning space was developed for [11].

Timetabling is the very first supporting process to be adapted in order to handle the several pedagogical classes [15]. Teachers, lecturers and instructors absolutely have to be booked in the right education spaces that support their new pedagogy once they have made such effort. Therefore timetabling agents have to deal with all education space classes and must consider an affordances planning next to capacity planning.

6 DISCUSSION

Provision of teaching and learning spaces that facilitate certain pedagogies is very important. The adaptive and Structuration Theory [8] has taught us that users will adopt the offered affordances. Still teaching staff need additional support, sometimes just to be triggered, sometimes through didactic discussions or sometimes with plain help. Universities need to be keen on services that support teaching staff. Where personal assistants used to be available to assist the lecturer, today a shared service centre must deliver the once so personal care. Acting adequately to keep the lecturer's workload low is a challenge since economic cuts have been taken place.

Ergonomic issues, such as sightlines, sometimes demand multiple presentation screens in education spaces. Still, students prefer just a single screen positioned at the front. This means that sometimes concessions must be made to let bad viewing spots for granted. A second screen on the other hand for virtual chalk is accepted without comment. This counts even so for video conferencing and especially for the 4-quadrant system.

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