

# REDESIGNING LEARNING SPACES: WHAT DO TEACHERS WANT FOR FUTURE CLASSROOMS?

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## ABSTRACT

The concepts of future classrooms, multimedia labs or active learning space has recently gained prominence in educational research. Evidence-based research has found that well-designed primary school classrooms can boost students' learning. Also, schools' principals, teachers and students are requesting for more flexible, reconfigurable and modern classrooms' layouts, where technology and active pedagogical practices can be incorporated into an easier way. Under the scope of TEL@FTELab Project (Technology enhanced learning at Future Teacher Education Lab) of the Institute of Education of University of Lisbon an empirical study was conducted with 82 teachers of elementary and secondary schools aiming to capture their vision about what the classrooms for the future should be. Data was collected through a focus-group methodology. Teachers were asked to form groups of 3-to-8 elements and challenged to build a 3D mock-up of their future classroom by using a 1:20 scale kit provided by the researchers. The process of the classrooms construction was videotaped and content analysis of the mock-ups was conducted. This article presents the results of the data collected, focusing specifically in the following aspects: descriptive key concepts of what is seen as a future classroom, spatial organization (different working zones identified by the teachers), physical elements (furniture and equipment) and environmental aspects (light, sound, air quality, temperature, colour, natural elements, comfort and security).

## KEYWORDS

Future Classroom, Learning Spaces, Pedagogical Innovation, Teacher Education

## 1. INTRODUCTION

The concepts of future classrooms, innovative multimedia labs, active learning spaces or next-gen schools has recently gained prominence in educational research. The number of studies in this field started to grow, yet most of them focus on higher education institutions, scarcely contemplating other education levels, and are related to the assessment of buildings renovation projects that did not consider the needs and wishes of the main stakeholders: teachers and students. This study aims to collect inputs from what one of these stakeholders – teachers - identified as relevant for the development of the classrooms of the future for elementary and secondary schools.

Considering school buildings external factors, several authors have identified their impact on multiple human functions, including cognitive processes (Hygge & Knez, 2001) and well-being (Evans, 2003). Higgins et al. (2005) emphasize the significant impact that elements such as temperature, luminosity and acoustics have on school's internal environment. Montazami, Gaterell, and Nicol (2015) concluded that students and teachers' performance is influenced by the internal environment of buildings, specifically by factors such as noise levels, indoor temperature, air quality and lighting. These factors are positively correlated with students' learning and behaviour (Guardino & Fullerton, 2010), as well as their satisfaction (Butt, 2010; Hill & Epps, 2010) and academic performance (Barrett, Zhang, Davies & Barrett, 2015; Mendell & Heath, 2005; Samani, 2012). Through the years and very consistently, literature has been providing clear evidence of the effect that the overall design of the physical environment of learning spaces has on its users. More recently, studies have also alert to the privative impact that long periods of inactivity have on pupils' body health, as well as on its cognitive development and behaviour control (Hillman et al., 2014; Kilbourne, Scott-Webber & Kapitula, 2017). However, Imms and Byers (2017) advocate they the literature around this topic is still scarce and that this topic claims for more deep and robust research.

## 2. RESEARCH SCOPE AND METHOD

This paper presents the data collected under the scope of the Technology-enhanced Learning at Future Teacher Education Lab (TEL@FTELab) project. This R&D (research and development) project aims to develop knowledge that fills the need of powerful engaging strategies to support the development and adoption of innovative teacher education practices that can empower future teachers to efficiently act as educators of the succeeding generations. This three years project is organized in three phases. The Phase I is concerned with the design and setup of a Future Teacher Education Lab, a prototype of a future classroom for teacher training, as well as training modules developed in alignment with a 3D 21st century teacher skills framework. The Phase II focuses on piloting the training modules developed in phase I, in two consecutive cycles of implementation within 4 Master Programs on Teaching (Biology, Informatics, Mathematics and Physics). Each cycle of piloting includes the co-design of learning scenarios between teacher educators and student teachers and its experimentation in real secondary school classes of Biology, Informatics, Mathematics and Physics. Finally, the Phase III takes the data collected from the pilots conducted on phase II and produces a set of video cases, reviewed training modules and learning scenarios that together with the 3D framework compose a Teacher Education Toolkit, which aims to be the main outcome of the project.

The data under analysis was collected in the project Work Package 2 which aim to design the architectural space of an innovative classroom for teacher education, named Future Teacher Education Lab, a reconfigurable classroom organized into different working zones, built for promoting the development of different learning and teaching practices (more information available at <http://ftelab.ie.ulisboa.pt/#fte-lab>). To do so, an empirical study was conducted for collecting inputs of what such a classroom should be from different stakeholders: architects, designers, teacher educators, in-service teachers, future teachers and undergraduate students.

### 2.1 Participants

This paper addresses, specifically, the data collected from in-service teachers. 82 elementary and secondary school teachers took part of the empirical study; 59 women and 23 men. Teachers age range was between 26 and 52 years old. Aiming to capture their vision about what the classrooms for the future should be, a focus-group interview was adopted and 16 groups were formed, between March 2016 and July 2017. The group numbers range from 3 to 8 participants.

### 2.2 Procedures

Teachers were invited to participate in a Participatory Design (PD) process. This is a holistic research approach frequently used in the domains of design, architecture and urbanism. PD is an approach to design that attempts to actively involve the potential users in the design process to help ensure that the designed product/service meets the users' needs (Sanders, 2002). To support this process a 3D toolkit was created to promote a creative act of designing a future classroom 3D model. The manipulation of the toolkit gives the participants the ability to express their own specific ideas and to put them in practice by build a physical future classroom model. The toolkit was composed by a set of images, words, icons and symbolic pieces selected from data collected in a previous stage of the TEL@FTELab project (Pedro et al., 2017):

- . 3 principles (Pedagogy, Technology and Space) and 15 keywords (Innovation, Creativity, Dynamic, Collective, Autonomy, Inclusion, Flexibility, Collaboration, Engagement, Feedback, Multiplicity, Interactivity, Communication, Personalization and Equality), even though other principles and keywords could be added by the participants;

- . Colourful cardboards representing different types of learning activities/zones: Individual activities (beige), Group activities (blue); Technological activities (yellow), Ideas creation/brainstorming activities (purple), Projection/multimedia activities (green), 3D printing and digitalizing activities (red), Informal activities (orange) and 'to-be-defined' activities (white);

- . Printed symbols representing environmental properties: Trees, Gardens, Sun, Food, Ventilation, Temperature, Humidity, Comfort, Air, Acoustics;

- . 5 printed symbols and 9 words representing educational technology and digital devices;

- . 26 classrooms related pictures;

- . 3D blocks representing teacher (1) and students (1), windows (2), door (1); glass walls (2) and 10 wooden small boards representing furniture (tables, chairs, cupboards, puffs, room dividers);
- . 6 emotions related icons: 3 smiles (representing like, dislike and neutral expressions) and 3 colours (red, yellow and green representing respectively bad, medium and good conditions).

All the physical elements were 1:20 scale; the toolkit also included one polystyrene board 0,50x0,50m (10x10 m=100m<sup>2</sup>) that represents the classroom floor.

A session for data collection was organized upon a focus-group methodology. In the first part of the session, participants were asked to select the key concepts that best described their vision of what a 'future classroom' should be. They had to select one out of three principles and five out of fifteen words. Participants had 15-to-20 minutes to discuss and choose these concepts. In the second part of the session, participants were provided with a 3D toolkit and were asked to build up their future classroom, grounding their design and layout choices upon the selected key concepts. 20-to-25 minutes were provided to this task. Additionally, at the end, each group were asked to make a 5-minutes presentation, explaining their 'future classroom' mock-up.

Being aware of the constraints that were inherent to the provision of a toolkit (with a fixed set of images, words, icons and symbolic pieces), participants were provided with extra paper, colour markers, scissors and glue stick for creating any other type of elements that were seen as relevant but not findable in the toolkit. The instructions given by the research team emphasized that this activity should be seen as a free and creative act; participants should be involved in an open discussion process and this should result in the design of a future classroom 3D model.

The main goals of this session were twofold: (1) to understand participants' underpinning principles and concepts when conceiving and planning a future classroom environment; and (2) to comprehend how participants materialized these concepts into classroom teaching and learning spaces, by using the toolkit.

The following images show the edification process of the future classrooms, as well as an example of the outcomes of this data collection process.



Figure 1. Pictures of the Future Classrooms 3D Models: Process of Construction (1) and Final Mock-Up (2)

### 3. RESULTS

In order to analyse the 16 3D future classrooms mock-ups created by the participants, the research team looked at two main sources: i) the concepts, images, icons and symbolic pieces of the toolkit used by the groups, as well as the different activities zones created inside the classrooms space, and ii) the groups' oral presentations, video recorded. Part of the results that were found are presently reported, specifically: the keywords selected by the teachers to describe their vision of what a 'future classroom' should be, the type of learning activities and corresponding zoning, the physical elements (furniture and equipment) and the environmental aspects (such as light, sound, temperature, etc.). The number of concepts, images, icons and symbolic pieces related to each of these dimensions that were used by the teachers in their future classroom mock-ups were quantified and the total frequencies are presented in the following graphics.

Considering the 3 principles and 15 keywords provided by the research team, it was possible to see that in all groups the most often selected principle was Pedagogy (100%). Teachers explained that without serious changes in pedagogy, any change in space or any investment in new technologies would be worthless. The most selected concepts were Autonomy, present at all the mock-ups (100%) and Collaboration (10/16, therefore, 62.5%). Teachers highlight that regular classrooms tend to be organized with a layout that is mainly oriented to individualized learning and that it is also necessary to have learning spaces that support collaborative activities. Teachers referred that today, and more intensively in the near future, students must be stimulated to work autonomously as well as to work in teams and to communication with each other; therefore, classrooms should reveal the flexibility to effectively contemplate these different working modes.

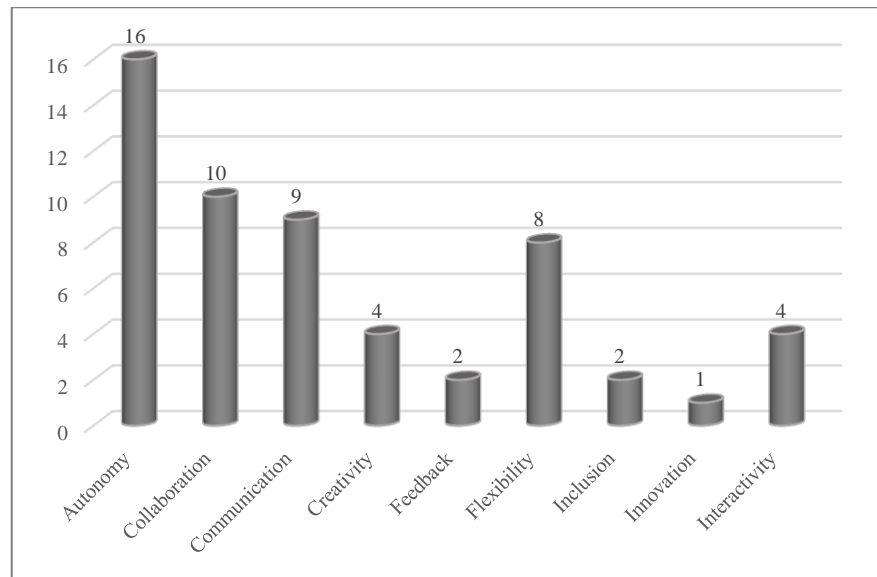


Figure 2. Keywords Frequency Graphic

The analysis of the spatial organization of the 16 mock-ups results reveals to be congruent with the previously described concepts. Teachers organized the classrooms mock-ups around different working areas and the most represented area was the one related to collaborative work; the ‘group activities’ zone was present in 87,5% of the 3D future classrooms mock-ups. It was also highlighted the benefit of having an area for students to work with technologies, mostly referred tablet and interactive/multitouch tables, as well as an area for Projection activities, with multiple display technologies that could support the presentation of multimedia educational content, by the teacher and by the students. It is also important to notice that in 50% of the mock-ups informal learning spaces were put inside the formal learning space that classrooms are by convention. The results also shown that, although most often, the layout of classrooms mock-ups was oriented by a zoning approach, where the classrooms were divided into smaller areas, 6 of the mock-ups (37.5%) represented the future classroom as an open space, where students and teachers could move freely and where tables and chairs were mostly removed from the picture and/or replaced by workbenches.

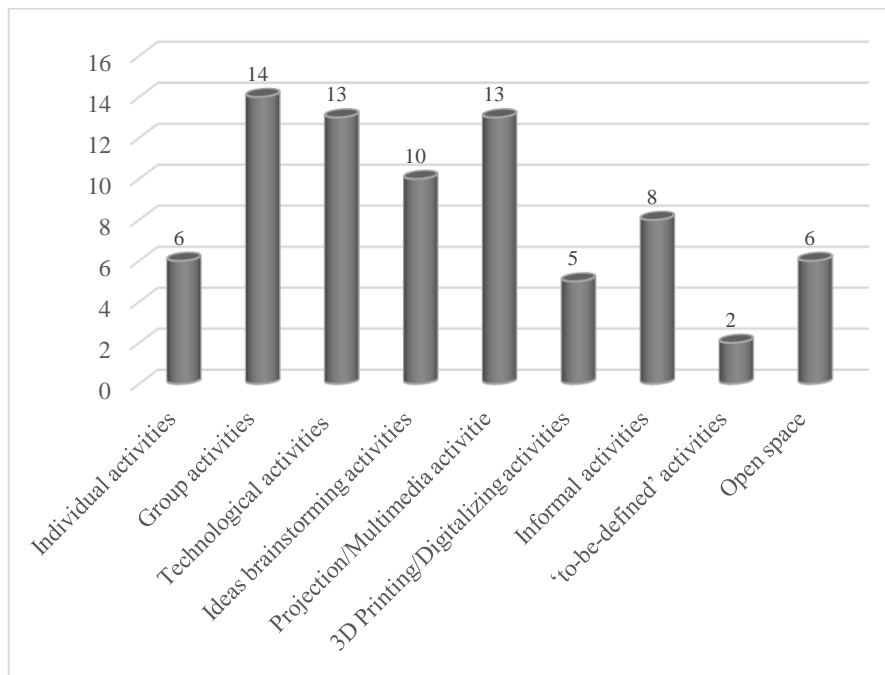


Figure 3. Frequency Graphic of the Types of Learning Activities/Zones

With regards to the physical elements displayed in the future classroom mock-ups, specifically furniture and equipment, the results evidenced that teachers report cupboards as one of mostly needed furniture in the future classroom. This was explained with the idea that today's classrooms already lack places for storage (students' backpacks, coats, etc.) and that, in the future, classrooms must have even more educational tools and supplies for students to use, and that these tools (analogical and digital) should have a place to be securely kept. Cupboards were present in 93,75% of the mock-ups. Different types of tables, or tables that could be configurable into different formats, were also referred, more often tables that could support collaborative work between small or large groups of students (62.5%). Furniture that could support students working in different body positions, as standing desks or puffs, was also presented as a relevant add-on. Teachers explain its benefits by describing the huge amount of time that students pass daily inside the classrooms, mostly seating down in the same chair, which most often lacks ergonomics. Indeed, chairs that are comfortable and that could be adjustable or personalized were also referred as more suitable for the future classrooms.

The results also evidenced the relevancy that technology and digital devices should have in the future classrooms. Small, light and portable devices such as tablets and mobile phones were the most represented gadgets (56.25%) but other technologies, not so often seen in classrooms, such as interactive and multitouch tables, 3D printers and Augmented and Virtual Reality simulators were also represented inside the future classrooms models.

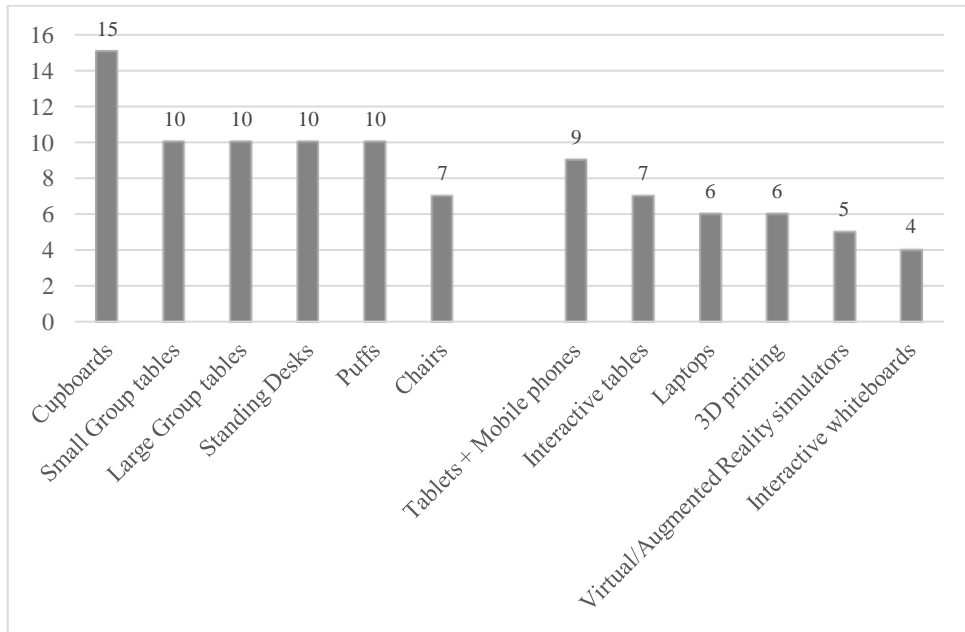


Figure 4. Frequency Graphic of the 3D Blocks and Educational Technology Symbols/Words

Finally, the environmental aspects of the future classrooms mock-ups were also examined, specifically luminosity, sound, air quality, temperature, colours, physical comfort, naturalness (elements link to nature) and people and equipment security. The number of icons related to each of these dimensions that were used by the teachers in their future classroom mock-ups were quantified and the total frequencies are presented in the figure 5.

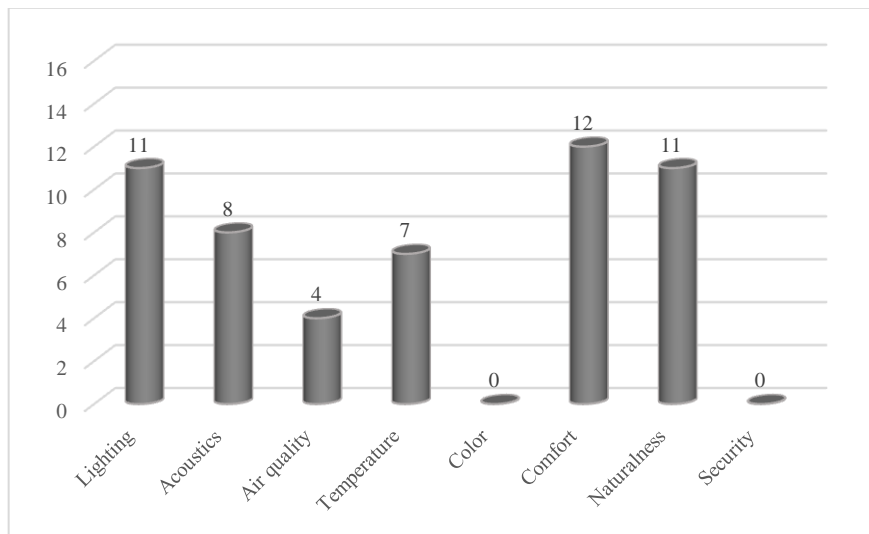


Figure 5. Frequency Graphic of the Printed Symbols Representing Environmental Properties

It is possible to see that teachers took in consideration the need for improving the level of comfort of the classrooms. 75% of the mock-ups included elements that represented concerns with the physical comfort provided to the classrooms users. 68.75% of the mock-ups also revealed the need to improve the luminosity of the classrooms, more specially teachers referred the need for more natural daylighting. With the same percentage, 68.75%, the future classrooms mock-ups reported the need for a more natural ambiance inside the classrooms. 50% of the mock-ups also showed teachers concerns for improvements on the room acoustics, more specifically with regards to noise control, considering that communication and team work is expected to significantly increase in the classrooms of the future.

## 4. CONCLUSION

An overall analysis of the mock-ups leads to the conclusions that none of the teachers' groups built for the future a classroom that present the same features of today's general classrooms. Though a lot of non-typical classroom elements were provided in the toolkit, no direct instructions were given for changes to be introduced in the classrooms layout, furniture or ambiance. Yet, a significant level of differences could be found on teachers' future classroom mock-ups. One specific group of teachers referred to the mock-ups as 'unclassrooms' archetypes'. The results found in this research project proved that today's teachers feel the need to shift from teaching in a classroom to teaching in a space fully committed to support new learning approaches (NLII, 2004). Teachers' models of the future classroom showed that teachers claim for a space that enables learners to actively manage their learning process and to engage with each other, a space that promote autonomy, dialogue and group work. Learning was mostly referred as an active and social process and future classrooms must be design with that in mind. Also, the future classrooms should support multiples types of learning activities, therefore space must be seen as divisible and furniture must be reconfigurable. Digital technologies must be well accommodated and teachers and students comfort must be assured.

The presence of nature elements inside the classroom, as well as clear concerns with lighting and acoustical engineering of classrooms should be addressed. Light can activate students' attention and improve their academic results (Barrett et al., 2015). Also, the quality of auditory perception and control of environmental noise clearly improves communication and promotes working efficiency (Hygge & Knez, 2001; Scannell et al., 2016) and this should be considered as teachers claim for classroom designs that effectively support collaborative activities inside the classroom space.

From a practical perspective, these findings are relevant for architects and school boards that aim to (re)design school building and classrooms, yet these are also valuable for teachers that want to improve the quality of life of their teaching places. (Small changes can rapidly be made; for example, changing the layout of the room, create a visual link between the indoor and nature outdoors or changing the colours of one wall.) The findings are also relevant for rethinking teachers' initial and continuous training as the modernization of the classrooms spatial and social environment, as well as its adequacy to the adoption of teaching practices that promote active and collaborative learning are still neglected. The further stages of the TEL@FTELab aims to address this topic, focusing specifically on teachers' education programs (on Biology, Informatics, Mathematics and Physics) and on how these can increase preservice teacher awareness of the impact detained by learning space configuration and elements, analogical and digital, on teachers' pedagogical approaches and daily teaching practices.

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