CONTEMPORARY MANAGEMENT OF LEARNING SPACES AIMS AT EDUCATION QUALITY NEXT TO SEAT CAPACITY

Delft University of Technology (TU Delft) has been changing its management over learning spaces enormously. Student numbers have doubled since two decades resulting in a situation that classes could not fit any longer within education spaces of their own faculty building. Slowly a dynamic shift came into being where larger classes were scheduled over different university buildings. At the same time, a new challenge came up because the operation of the existing lecture halls and classrooms differed enormously over campus.

In 2014 a Taskforce Education Spaces was formed to cope with this shifting situation. They came up with a 10 years transformation plan proposing a two-fold strategy: 1) governance structure for all parties involved in education spaces (education, real estate, IT, facilities), and 2) guidelines defined in a Cookbook Education Spaces based on contemporary pedagogies in collaboration with teaching staff and students.

Today, TU Delft holds over 26.500 students and the numbers continue to grow. Lecture halls and classrooms are managed centrally, and the building policy aims at mono-functional buildings henceforth i.e. no more combined premises for research and education. TU Delft has been deciding to put education first with building projects. Quality of education features within education spaces took its place next to seat capacity and readability became very important.

This paper describes education features that influence readability including the visualization with our interactive education spaces configurator TUDesc.

Readability in Lecture Halls and Classrooms

Chalkboard-pedagogy is essential for teaching a talking-writing way of reasoning at our scientific and technical university. Natural science lecturers love the chalkboard when explaining theorems and proofs. While thinking aloud they simultaneously produce and write arguments in successive order on the board, which can be digital or erasable whiteboard too. In such way, their reasoning becomes visible. Students see the process and structure of the systematic arguments that appear on the board, they gain the ability to recognise patterns and interconnections with this chalkboard pedagogy. They have to take notes, because they must think with their eyes and hands themselves. Therefore, being able to discern every presented character is essential.

Readability is a complex set of ergonomic variables, such as strain free sightlines, eye height dependent on applied furniture and hall, distance of the presentation screen to first and last row, the screen's size and its position on the wall, and the quality of the presented image or written content. Readability is based on having a good visual acuity.

No clear figures were available to arrange a proper readability. Only rules of thumb, such as a character height - distance ratio of 1 to 200 or five times the diagonal of the screen. For such reason fieldwork was done to come about with figures to be able to read subject matter in education practices all over campus. Character heights of written formulas were collected from boards in lecture halls and classrooms. Followed by collecting PowerPoint presentations analysed in relation to the screen dimensions. Regulations for signage indoors and the optician's way of work to correct people having a visual acuity of 100% visus based on the Snellen Chart.

Proper readability needs a viewing angle of 17 arcminutes to be able to discern strange characters in unfamiliar formulas. It shall be at least 14' when using electronic displays due to the better contrast. The angles were tested in practice with independent people, although students as young people do sometimes have eagle eyes.

Cookbook Education Spaces and its Interpretation

The collected data was analysed and transformed into readability figures placed in tables in the Cookbook Education Spaces. However, interpreting these tables is not always straightforward for third parties, e.g. figures about reading distance and related ceiling height are continuously variable, but only a few are presented in the table. Table 1 presents a Cookbook table. Inter- and extrapolation make persons doubting and hesitating to make decisions of which they are not certain how it will work out for the education space.

Table 1: Advised minimum dimensions for projected image at given reading distances
(Taken from Cookbook Education Spaces version 2.0 April 2018)

Reading distance	Projected Character Height (17'- 20')	Minimum Projected Image Dimensions	Minimum Ceiling Height in Tiered Lecture Halls	Minimum Ceiling Height in Flat Level Lecture Halls
8 m	4.0 - 4.7	180 * 101 cm	158 + 210 + 20 = 388 cm	100 + 140 + 20 = 260
10 m	4.9 - 5.8	240 * 135 cm	186 + 210 + 20 = 416 cm	135 + 140 + 20 = 295
12 m	5.9 - 7.0	280 * 158 cm	214 + 210 + 20 = 444 cm	160 + 140 + 20 = 320
14 m	6.9 - 8.1	330 * 186 cm	242 + 210 + 20 = 472 cm	190 + 140 + 20 = 350
16 m	7.9 - 9.3	380 * 214 cm	270 + 210 + 20 = 500 cm	215 + 140 + 20 = 375
18 m	8.9 - 10.5	430 * 242 cm	298 + 210 + 20 = 528 cm	-
20 m	9.9 - 11.6	480 * 270 cm	326 + 210 + 20 = 556 cm	-
22 m	10.9 - 12.8	530 * 298 cm		-
24 m	11.9 - 14.0	580 * 326 cm		-

Visualizing Readability and Sightlines makes it easier

Now the Cookbook Education Spaces has been taking a step further. Misinterpretations must be prevented for parties working in lecture halls and classrooms. Thus, we have been deciding to visualize important education features, such as readability, sightlines, capacity and accessibility. With our application called TUDesc (TU Delft Education Spaces Configurator) one is able to define the several parameters important for proper readability.

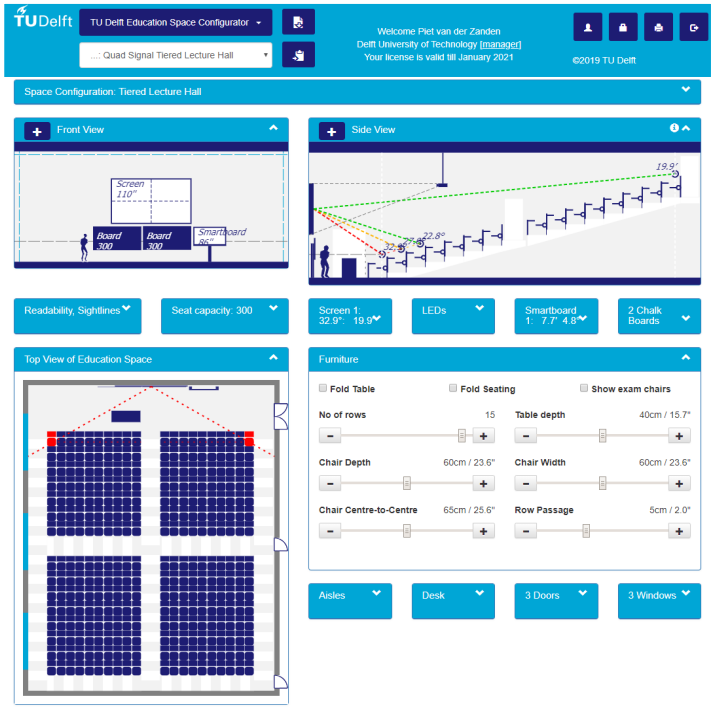

Figure 1: Impression of the TU Delft Education Spaces configurator TUDesc