NOVIGADO

ACTIVE LEARNING AND INNOVATIVE TEACHING IN FLEXIBLE LEARNING SPACES

Guidelines

in Learning Space Innovations

Co-funded by the Erasmus+ Programme of the European Union

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Novigado project consortium

Introduction

The overall objective of the Novigado Project is to support schools and related stakeholders in the transition from a conventional and teacher-centred classroom into teaching practices that promote active learning with the support of innovative learning environments and use of relevant Information and Communication Technologies (ICT). The Novigado Project's meta objective is to stimulate the development of key competences (European Commission, 2018) and transversal skills (UNESCO, 2013) among students as crucial for their society's well-being and for their functioning in the pandemic-affected environment and the post-COVID-19 world.

Within the scope of the project, the Guidelines were constructed based on a desk research and literature review on flexible and innovative learning environments, and on teachers' and students' practices from the classroom that support both active learning and innovative teaching. As Partner Organisations, running the Novigado Project, we believe learning spaces can play a crucial role in stimulating not only active learning of students, but also innovative forms of pedagogy in the classroom or school spaces. Therefore, this publication will focus on both aspects: the theoretical background of what, according to scientific research results, should be a modern and pro-learning school environment today, and the practical approach from classrooms – how to organise and use the school space to achieve best results in learning or teaching.

This document supports the subsequent phases of the Novigado Project: creating the Capacity-Building Programme for pilot schools, organising the Pilot Evaluation Scheme for the school pilot implementation, designing the Active Learning Scaleup Instrument and the Online Scenario Tool as well as having strong connections to the Active Learning Reference Framework.

Chapter 1. The Learning Environment Today and Tomorrow

More and more educators and policy-makers understand that teaching methods as well as educational content must be changed to suit the 21st century. They call for the shift towards student-centred, active learning which has the potential to prepare the young generation of learners for the challenges ahead of them in the ever-changing world. This shift cannot be enacted unless the educational context is changed, including methods, spaces and priorities. This chapter presents the reasons that justify this change as well as practical insights related to creating future-ready school environments.

1.1. Why Up-to-Date Pedagogies Are Needed to Help Students Acquire New Competences in a Future-Ready School

In the world where we can observe the transition from the industrial economy and society to the information/knowledge economy and society (Wagner, 2009; Resnick, 2017; Mattila, Silander, 2015; Scottish Funding Council, 2006), more and more educators and educational experts stress that we "have to rethink, reimagine and reconceptualise education – teaching and learning – for the 21st century" (e.g. Wagner, 2009). A dynamically changing, knowledge-based economy creates an increasing demand for a "more qualified, highly skilled, creative and flexible workforce" (Scottish Funding Council, 2006, p. 3). According to Mattila and Silander (2015), editors of a publication entitled "How to create the school of the future – Revolutionary thinking and design from Finland," it is the learner who is at the centre of change, as the focus of learning moves away from the teacher, textbooks and teaching, and towards a learner-centred, learning process-based and personalised learning.

In order to identify the new skills which would help students have a successful career in the world where humans are more and more frequently replaced in different work tasks by robotic machines and/or AI, and to find out what competences would help students to be lifelong learners as well as active and informed citizens, Dr Mark Wagner consulted senior executives and analysed workforce readiness reports. The result of his research was a list of the following skills, which he calls "survival skills that every young person will need": critical thinking and problem-solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analysing information, curiosity and imagination (Wagner, 2009).

Six years later, the Partnership for 21st-century Skills, which came up with the Framework for 21st-century Skills (Partnership for 21st-century Skills, 2010), decided to stress the importance of the skills which are essential for successful learning, teaching, assessment, working and living in today's digital economy (Kivunja, 2015). Accordingly, experts agreed that the list which had already included critical thinking, communication, collaboration and creativity, deserved to be called "the 4Cs – 'super skills' for the 21st century". Before moving to learning space

issues, let us consider the importance of each of those skills, which are supposed to allow students to be successful in economic and social life.

1.1.1. Critical Thinking

As early as 2006, the Scottish Funding Council published a paper entitled "Spaces for learning: a review of learning spaces in further and higher education", in which the authors noted that we were observing a change towards a knowledge-driven model of economy, in which the focus on factual knowledge was being replaced with the critical thinking ability (Scottish Funding Council, 2006). Critical thinking, closely linked to problem-solving, can be understood as "an individual's ability to use a number of his or her general cognitive processing skills which fall into Bloom's high-order thinking levels of analysing, evaluating and constructing new ideas or creating" (Kivunja, 2015, p. 227). More and more employees of the most successful companies are involved in the process of continuous improvement, which requires them to be equipped with critical thinking and problem-solving skills (Wagner, 2009). The knowledge-driven economy requires people to solve unfamiliar problems, but while addressing those problems, they need to take care of others, to care for society, the environment and the whole world. Thus, school is the place that could and should help students develop critical thinking.

1.1.2. Communication

Kivunja (2015) defines effective communication as getting your desired message across effectively to your target audience. Wagner (2009) points to the fact that quite often college teachers and employers complain about the inability of school graduates to communicate effectively. Communication skills have always been important, but the instantaneous mix of people of different cultures that has been enabled by 21st-century information, media and digital technologies has made the need for effective communication more apparent and more vital than in previous generations (Kivunja, 2015). Therefore, it is crucial that schools focus on developing communication skills that would help students not only during their education, but also after graduation and upon entering the job market.

1.1.3. Collaboration

According to Wagner (2009), collaboration has ceased to be spatially bound to one place and now it happens across the globe. Consequently, the collaboration skills required from prospective employees need to include cultural awareness as well as technological expertise. To be able to teach collaboration, teachers, who in traditional schools worked (and sometimes still work) individually, should also be encouraged to experience teamwork at first hand either through team teaching or being part of a working group. Learning should occur in a collaborative setting (Mattila, Silander, 2015). The potential of collaboration can be appreciated not only in teaching and learning, but also in all walks of life after school (Kivunja, 2015). Teams and teamwork are essential to develop and implement any projects in most public, private or non-governmental institutions.

1.1.4. Creativity

Mitchel Resnick, the father of the Scratch programming language and platform, goes even further and believes that in the still accelerating world in which conditions that influence our success or failure are constantly changing we need education that would foster the development of what he calls the creative society (Resnick, 2017). According to him most schools around the world place a higher priority on teaching students to follow instructions and rules than on helping them develop their own ideas, goals and strategies. He argues that in most schools, students spend too much time in a passive way: sitting at their desks and listening to lectures or completing worksheets. He cites Cathy Davidson, who in her book entitled *Now You See It* argues that approximately two-thirds of today's students will need to perform jobs that have not yet been invented. Mattila and Silander (2015) observe that today's primary school students will enter the job market within the next twenty years, and "the technologies or job titles they use may not have been invented yet, but the school should nevertheless be able to rise to the challenge" (p. 99). To achieve this, we need to help students develop as creative thinkers. Resnick believes that life as a creative thinker can bring not only economic rewards, but also joy, fulfilment, purpose and meaning.

In order to update teaching methods so that they allow for developing new skills, we need to abandon what Froebel (the inventor of the first kindergarten) called a broadcast approach to education in which the teacher's role was to provide students with information while standing in front of the classroom, and in which students' activity was limited to writing down what was said and where discussion was almost non-existent (Resnick, 2017). Education should cater for various learning styles and individual preferences, which cannot be achieved just through frontal teaching. When designing new types of learning environments, one should consider three main learning styles, i.e. "learning by reflection" (which is a solo activity and, as such, requires space that would support this mode of learning), "learning by doing" (based on the ideas of Piaget from the 1950s according to which active engagement and practical tasks can have a positive effect on learning and which gave rise to the Project-Based Learning (PBL) method), and "learning through conversation" (based on the Vygotsky theory of social constructivism and requiring spaces that cater for group interaction). Thus, formal teaching spaces for large groups with a "sage on a stage" are becoming less common than smaller, less formal settings where students learn from one another as well as from their appointed teachers' (Scottish Funding Council, 2006). However, when evaluating the effects that learning spaces have on education, one must also consider how exactly those environments are used, i.e. what pedagogical methods, techniques, or teaching and learning styles are utilised. Learning spaces should be treated as tools suited to particular tasks and designed to support the particular mode of required learning (Scottish Funding Council, 2006).

1.2. Why Flexible Learning Environments Are Essential to Support Up-to-Date Pedagogies

Neill and Etheridge, the authors of "Flexible Learning Spaces: The Integration of Pedagogy, Physical Design, and Instructional Technology", argue that "the traditional classroom with its fixed arrangement constrains teaching and learning to one-way, linear flows" (Neill and Etheridge, 2008, p. 2). They also note that student-centred, active and social learning requires a flexible space. They describe the outcomes of a project in which a flexible learning space was created from an existing classroom. According to them, and also Mattila and Silander (2015), any transformation of this kind involves three factors: pedagogy, architecture and technology.

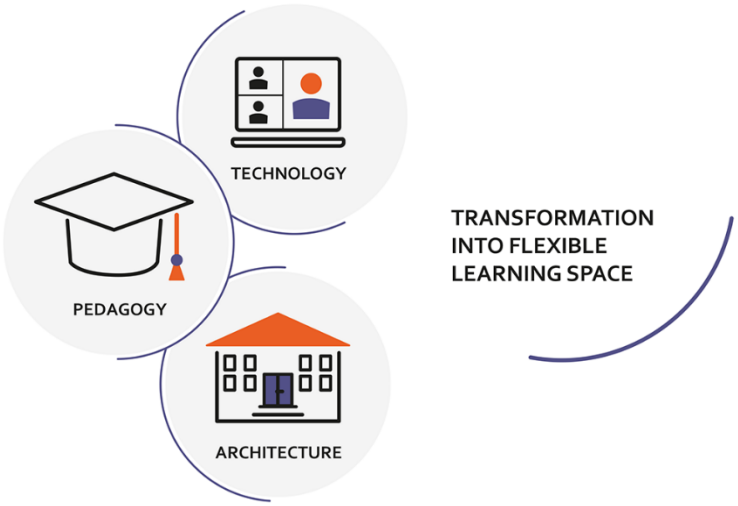


Figure 1. *Transformation into a flexible learning space involves three dimensions of the change: pedagogy, technology and architecture.*

In their project, Neill and Etheridge included the need to shift from directive instruction to more student-centred methods, changing the physical space from fixed seating arrangements to flexible furniture to model the learning space as the need arises, and changing the instructional technology from the one suited for multimedia presentations to decentralised computing and networking (Neill and Etheridge, 2008). The goal was to create a classroom suited for multiple modes of delivering instruction through varied pedagogical approaches to create multiple learning experiences. According to their findings, the flexible learning space obtained as a result of the project "increases student engagement, collaboration, flexibility, and learning," (Neill and Etheridge, 2008, p. 1) making the classroom more suited for innovative approaches to teaching and learning than a traditional classroom. On the other hand, the study does not support the view that classroom flexibility itself changes the behaviour of educators. Those teachers who understand its potential seem motivated to use the features this space offers. "As instruction moves towards co-creation of the learning experience, the flexible, networked classroom provides an appropriate physical setting" (Neill and Etheridge, 2008, p. 7).

1.3. Innovative Learning Spaces

In the contemporary literature, we can find many different terms for innovative learning spaces. Some authors call them Active Learning Classrooms (ALC) (Baepler et al., 2016), others, Innovative Learning Environments (ILE; Mahat et al., 2018) or Next-Generation Learning Spaces (NGLS; Radcliffe, 2008). Regardless of the term used, they are classes where regular learning takes place, but they are designed deliberately to promote active learning (Talbert, Mor-Avi, 2019), the outcome of a dynamic relationship between the space design and pedagogy which enables the students to achieve the best possible learning outcomes and develop 21st-century skills (Mahat et al., 2018). Modern pedagogical approaches emphasise the importance of active learning for successful education. Active learning is student-centred, involves solving real-world problems, receiving feedback and involving higher-order thinking skills like analysis, synthesis, and evaluation. To be successfully engaged in active learning, pedagogy should be aligned with the physical environment where learning takes place (Osborne, 2016).

Elkington and Bligh (2019) argue that space (physical or virtual, individual or social) has an impact on students' learning of. Carefully designed spaces can encourage collaboration or competition, discussion or individual work, engagement or boredom. Brown and Long (2006) argue that deep learning can take place when students are active in the process of learning, and take multiple roles (e.g. listening, giving feedback, mentoring, presenting, etc.), and when they engage in a range of collaborative activities (e.g. group work, discussions, creating collaborative documents). Pedagogical principles stemming from what we know about learning should drive the changes we make in the learning environments. Traditional learning spaces rarely encourage social learning and metacognitive skills development.

Katarina E. Kariippanon (2019) is one of the researchers stating that flexible learning spaces have a positive effect on the behaviour of students. She compared classroom activities in traditional classrooms with lessons taking place in flexible classrooms. The study suggests that the varied, adaptable nature of flexible learning spaces, coupled with the use of student-centred pedagogies, facilitated a higher proportion of class time interacting, collaborating and engaging with the lesson content. Kariippanon concludes the positive effect of flexible learning spaces may translate into beneficial learning outcomes in the long term.

Practitioners like Kayla Delzer (Javanghe, 2019) have witnessed a positive impact on learning and engagement and motivation of students after implementing flexible seating. It is important that learners can make their own choices, also with regard to seating options. Moreover, providing more opportunities for movement improves oxygen flow to the brain, core strength and overall posture. The design of the environment is pivotal in engaging students with their learning. However, this must go hand in hand with changing teaching cultures and practices.

According to some research (see e.g. OECD, 2006, Chism, 2005; Ramsden, Entwistle, 1981), innovative learning spaces provide multiple benefits to the students (personalisation, development of collaboration, skills, creativity and technological literacy) as well as teachers. As cited by Mahat et al. (2018, p. 14), "an effective learning environment, is one that:

- makes learning and engagement central;
- ensures learning is social and often collaborative;
- is attuned to learners' motivations and emotions;
- is acutely sensitive to individual differences;
- is appropriately demanding for each learner;
- uses assessments that are consistent with its aims, with a strong focus on formative feedback; and promotes connectedness across activities and subjects, in and out of school (Dumont and Istance, 2010)."

Byers performed a systematic meta-analysis of studies investigating the relationship between learning environments and learning outcomes. Of the 5,521 articles, 21 were included in the analysis meeting rigorous methodological criteria of the study (Byers et al., 2018b). This clearly shows how few sound studies there are and the need for further investigation. The studies reviewed led to the conclusion that learning environments, especially those defined as the outcome of a dynamic relationship between space design and pedagogy which enables the students to achieve the best possible learning outcomes and develop 21st-century skills, positively impact student achievements (see Brooks, 2011; Byers et al., 2014). On the other hand, the study review by Talbert and Mor-Avi (2019) found that there are no major significant differences when it comes to quantitative measures of student achievement (e.g. grades) between innovative and traditional classrooms, but reported qualitative changes when it comes to skill achievement ("21st-century skills", see e.g. Byers, Imms, 2016; Chen, 2014; Beichner et al., 2007). The authors concluded that students may need to adjust to the space and learning methods before positive results are seen. The analysis also showed that the quantitative results show greatest differences for low-achieving and minority students, demonstrating the greatest benefits for these groups (see e.g. Oliver-Hoyo et al., 2004).

Open-plan learning spaces seem to have a negative impact on achievement. However, the students learning in open spaces seem to achieve better results in measurements of creativity, collaboration and persistence which cannot be measured using standard testing (Byers et al., 2018b). Mahat noticed that open spaces are no longer the standard as they pose a lot of issues with noise management that have a negative influence on students' well-being (Mahat et al., 2018). On the other hand, they promote flexibility which can be achieved by offering a variety of working spaces of different height, diverse seating, modular furniture as well as spaces both for individual work and group work to cater not only for different learning activities but also different learning styles.

According to the meta-analysis (Byers et al., 2018b), the innovative space can account for 7-10% of the variance in academic achievement whereas the physical aspect of it (e.g. improved lighting, acoustics, air quality, etc.) accounts for 10-16% of the variance.

Some studies (e.g. Nissim et al., 2016; Byers, Imms, 2016; Scott-Webber et al., 2014) also showed positive impact of innovative spaces on the student engagement (Talbert, Mor-Avi, 2019). They noticed a significant reduction in failure rates among university students in ALCs in comparison to traditional classrooms. Many studies reported that students experienced increased motivation and willingness to participate actively in class, as well as enjoying

increased interaction and deepened relationships with their peers and instructors. Also, the faculty members reported more satisfaction with their role and relationships with students (see e.g. Ge et al., 2015, Whiteside et al., 2009).

Bradbeer (2016) noticed that students enjoy new generation learning spaces a lot due to their collaborative nature. However, the open space does not necessarily change the pedagogy and can cause multiple issues for the teachers. Open spaces make teachers go out of their comfort zones – in traditional classrooms they are used to working in isolation with greater autonomy and privacy and less visibility. In open spaces, their identity might be challenged. Working in modern open spaces requires what Fisher (2004) calls a "spatial literacy" – knowledge of pedagogical approaches fitted to the space.

Nowadays, it is not only the physical space that matters but also technology-enabled or even virtual space. The development of technology enables us to broaden the learning environment beyond the building by using interactive tools (especially within cloud services and platforms), live-streaming, peer-to-peer online tutoring, etc. Studies show that students who learn in blended, technology-enhanced models achieve better results than students in traditional classes (Byers et al., 2018a). Technology offers a plenitude of possibilities to extend the environment outside of the school buildings and even greater flexibility, personalisation of learning, as well as increased engagement or a boost to deep learning (Mahat et al., 2018). Oblinger (2006) argues, however, that pedagogy and not technology should be put first. Contemporary pedagogical approaches emphasise the importance of experiential and collaborative learning, often enabled with technology, where students construct their own understanding. Designing learning spaces needs to reflect this issue.

1.4. The Third Teacher

It was Loris Malaguzzi who coined the name *The third teacher* for the classroom environment (Cagliari et al., 2016). The environment has a fundamental role next to the teacher and the other students in the classroom. Malaguzzi (1920-1994) was an Italian pedagogue whose principles lay at the basis of the so-called Reggio Emilia approach (from the name of the Italian region where early childhood and kindergarten schools were strongly inspired by his ideas).

For Malaguzzi, the child's first teacher is the parent, as she or he is the first guide in the child's education. When going to school, the child gets a second one, the classroom teacher. The third teacher is the school environment. According to Malaguzzi, the setting of the classroom and school should not only be functional but also stimulate the child's creativity. Environments must be flexible to allow teachers to be responsive to the interests of the children, and to stimulate them to construct knowledge together (Cagliari et al., 2016).

Although Malaguzzi targeted young learners in his work, the concept of the third teacher has been influential for all ages of education. Schools and classrooms should incorporate the idea of a workplace where individuals can explore and discover and foster their talents (Strong-Wilson, 2007).

1.5. Models for Introducing Learning Space Changes

In the literature, we can find a variety of models aiming to design or redesign the space on a small or large scale. Most of the articles refer to universities although the implications of the research can also be considered when thinking about changing the learning spaces at lower levels of education. The process of planning new spaces should be divided into three stages:

1. identifying the pedagogy that is the backbone of the school's philosophy,
2. aligning the pedagogy with appropriate spaces including seating arrangements and physical learning spaces,
3. building the spaces (Van Merriënboer et al., 2017).

This design is strengthened by research done in the NGLS project which explored the interrelationships between pedagogy, space and technology in order to develop the Pedagogy-Space-Technology (PST) framework – a set of questions which enable schools and universities to create innovative teaching and learning spaces (see table below). The order of the components of the framework is not accidental. Although the three elements are interdependent and influence one another in a cyclical manner, the beginning seems to lie with pedagogy, which will determine the shape and use of a space. And, conversely, the way the space is arranged will alter the pedagogy used. Similarly, the space will allow or prevent the use of certain technologies, and the technology will influence what the space looks like (Radcliffe et al., 2008).

Life-Cycle Stage		
Focus	**Conception & Design**	**Implementation & Operation**
Overall	What is the motivation for the initiative? What is intended? What initiated the project? Who are the proponents and opponents? Who has to be persuaded about the idea? Why? What lessons were learned for the future?	What does success look like? Is the facility considered to be a success? By whom? Why? What is the evidence? Does this relate to the original motivation or intent? What lessons were learned for the future?
Pedagogy	What type(s) of learning and teaching are we trying to foster? Why? Why is this likely to make a difference to learning? What is the theory & evidence? What plans will be made to modify programmes or courses to take advantage of the new facilities? What education or training for academics and other staff is built into the plan?	What type(s) of learning and teaching are observed to take place? What is the evidence? What evaluation methodology or approach was used and what methods were used to gather and analyse data? Who was included in the data gathering and analysis? Students? Faculty? Staff? Administrator? Senior Leadership? Facilities managers and technology staff?

Space (incl. environs; furniture and fittings)	What aspects of the design of the space and provisioning of furniture and fittings will foster these modes of learning (and teaching)? How? Who is involved in developing the design brief? Why? Which existing facilities will be considered in developing concepts? Can we prototype ideas? Who is involved in the assessment of concepts and detailed design? Why? What are their primary issues and concerns?	Which aspects of the space design and equipment worked, and which did not? Why? What were the unexpected (unintended) uses of the space and facilities that aided learning or facilitated teaching? Do these present ideas for future projects? How was the effectiveness of the use of space to aid learning and teaching measured? What were the different metrics used? Were there synergies between this and other spaces that enhanced learning?
Technology (ICT; lab and specialist equipment)	What technology will be deployed to complement the space design in fostering the desired learning and teaching patterns? How? In establishing the brief and developing concepts and detailed designs, what is the relationship between the design of the space and the selection and integration of technology? What pedagogical improvements are suggested by the technology?	What technologies were most effective at enhancing learning and teaching? Why? What were the unexpected (unintended) impacts (positive and negative) of the technology on learning and teaching? How did technology enhance the continuum of learning and teaching across the campus and beyond?

Table 1. *PST Design & Evaluation Framework as presented by Radcliffe et. al., 2009.*

Van Merriënboer et al. (2017) pointed out that the process of creating learning spaces is open-ended and creative, and must be done in cooperation between different stakeholders, most important being not only the architects and school management but also teachers, students and parents, as well as representatives of the local community. Participatory design allows for increased quality of teaching, making the teachers co-owners of the space, and increased student satisfaction with the learning process, and limits the discordances between the reality and expectations. It is important to remember that the choice of design should be influenced by clearly defined pedagogical approaches, agreed upon by leadership staff and teachers rather than by the desire for a more innovative space (JISC, 2006).

Bertram (2016) identified several factors that contributed to effective learning environments. From her investigation, it is clear that:

- learning space is effective when people using the space have control over it,
- school culture emphasises relationships,
- there is access to resources and technology,
- there is flexibility and sufficient physical space and there is site/master planning.

The key factors were control and a school culture in which relationships between students and teachers are highly valued. Also, the role of the school principal was identified as crucial, especially in modelling the values and culture and leading change.

Several recent projects have tried to describe what an ideal innovative learning environment would look and feel like. The OECD Innovative Learning Environments Project (2013) describes an innovative learning environments as:

- Learner-centred: focus of all activities,
- Structured and well-designed: role of teachers in supporting inquiry and autonomous learning,
- Profoundly personalised: sensitive to individual and group differences in terms of background, prior knowledge, motivation and abilities,
- Inclusive: sensitive to individual and group differences in terms of learning needs,
- Social: learning most effective when cooperative and in group settings.

According to JISC (2006), the design of innovative spaces needs to be:

- Flexible – to accommodate both current and evolving pedagogies,
- Future-proofed – to enable space to be re-allocated and reconfigured,
- Bold – to look beyond tried and tested technologies and pedagogies,
- Creative – to energise and inspire learners and tutors,
- Supportive – to develop the potential of all learners,
- Enterprising – to make each space capable of supporting different purposes" (p. 3).

Gee (2006) talks about human-centred design guidelines that are based on the assumptions that the human brain is social and uniquely organised and that we learn not only by focusing our attention but also unconsciously. On this basis, she describes several characteristics of human-centred learning spaces as follows:

- Healthful – ergonomic and comfortable.
- Stimulating – sensory, surprising, transparent or colourful, and mimicking nature.
- Balancing community and solitude – offering both private, quiet spaces and collaborative spaces.
- Adaptable – flexible, offering a sense of ownership, changeable and mobile, equipped with technology and places to make learning visible.

They are all convergent and reflect constructivist pedagogical approaches to learning.

When the trend of redesigning the space started, many stakeholders started to tear down walls to make the spaces as open as possible to make them most flexible. However, that poses management challenges when it comes to the physical properties of the space: sound and heat, as well as student activities. There are several ways to deal with it: for instance, creating spaces to fit for purpose or dividing the spaces using movable elements that can be used in a variety of ways. The spaces should also be versatile: support both student-centred and tutor-centred learning like presentations, discussions, project work and lectures (JISC, 2006). This mobile and divided space seems to be the current trend in educational architecture.

When designing a space on your own, it is worthwhile to ask yourself a series of questions (based on the list of 24 recommendations by Mahat et al., 2018):

Recommendation	Challenge
Innovative learning environments promote 21st-century skills development.	How can we design the space so that it reinforces 4Cs: creativity, collaboration, communication and critical thinking?
Innovative learning environments must take into consideration the importance of acoustics.	How can we design the space so that we can easily manage the noise levels?
Innovative learning environments need to take into consideration the implications of each type of space designed.	How will the students and teachers work within this space?
Innovative learning environments are more than just the physical environment.	What is the motivation behind the redesign of the space? What is the teacher's mindframe? What are the leading pedagogical ideas that guide teaching in our school? How are they going to be reflected in the design?
The flexible learning environment offers opportunities for teacher-teacher, teacher-student and student-student collaboration.	How can we design the space so that each of these collaborations is able to take place? How can we develop the teacher's understanding of collaborative approaches to teaching and learning? How can we create an environment for sharing among teachers?
Innovative learning environments should stem from innovative teaching practices that value reflection and ongoing feedback, student agency and autonomy, learning goals and success criteria that are visible and clearly defined, and safe and trust-based relationships between students and teachers.	How can we design the space that will allow these practices to be transparent?
Innovative learning environments should be able to allow for a variety of learning tasks and learning styles of different types of learners (student-centred).	How can we design spaces to be versatile and accommodate for both the individual work and group work happening at the same time?
Innovative learning environments should, finally, be able to allow diverse teaching practices that lead to lifelong and deep learning.	How can we design the space so that different teachers can use a variety of teaching methods in the same space?

Table 2. *Recommendations and challenges in designing the learning space.*

1.6. Virtual Learning Spaces as Ultimate Flexible Learning Environments

When attempting to design, develop and implement flexible learning environments, we often face various challenges, e.g. lack of required funding, expensive furniture or technological devices or scarcity of space. Considering that "traditional teacher-led, textbook-oriented and individual-focused teaching changes into an interactive network of social activity, with the goal of improved learning" (Mattila, Silander, 2015, p. 79), a new solution comes to mind. What if we tried to overcome those challenges by making use of the increasingly ubiquitous technology which almost everyone can have in personal devices like mobile phones, tablets or laptop computers?

Learning opportunities related to student-centred education are expanded by e-learning and mobile learning, which can complement traditional teaching modes to create successful blended learning (Scottish Funding Council, 2006). The offline and online learning spaces coexist and usually influence each other. Mobile devices, tablets and electronic learning environments change ways of working, freeing students from the traditional methods. Personalised technology allows students to connect to the same servers and cloud services regardless of whether they are at home, outdoors or at school. This has huge implications – it allows schools to make use of interactive and virtual learning environments which are becoming better and better at fostering collaboration, social interaction and creativity. Such environments can also be used to virtually link students who are physically present in different or shared spaces, i.e. regardless of whether some of them are at home, some are sitting in the same classroom and others may even be connecting from abroad (Mattila, Silander, 2015). Teachers around the world were forced to take this solution to a whole new level in the spring of 2020 during the of COVID-19 pandemic when many schools had to find a way to switch to online and remote learning modes.

Even before the pandemic, we had been observing a transition from more closed e-learning environments towards open learning platform solutions, where users can link to materials they have produced themselves (Mattila, Silander, 2015). Some of those learning platforms proved useful handy during COVID-induced remote learning. ICT platforms, such as Google Classroom and Microsoft Office 365, integrate a forum-like feature (respectively called "Stream'' or "Posts"), a video chat (Google Meet and Microsoft Teams), file-sharing (Google Drive and Microsoft SharePoint available through the Files Tab), editing and presenting tools, and various additional features which are systematically rolled out to expand the possibilities for students and teachers alike.

One of the challenges which may hinder progress is the traditional methods used at schools, which do not translate into the online world. Consequently, teachers who were trying to stick to the transmission method and who taught mainly by lecturing, faced increasingly noticeable problems with student engagement in remote education. On the other hand, those teachers who had previously used active methods, e.g. PBL, during their stationary classes observed that their students were more autonomous in distance learning, too. Mattila and Silander (2015) stress the fact that while most of the time spent in traditional schools is devoted to

"teaching with very little time left for other activities, in the school of the future working is learning, and it can be accomplished by diverse methods," such as simulations and project work.

Dillenbourg, Schneider, and Synteta (2002) define a virtual learning environment as "a designed information space" and a social space, where students are not only active, but also actors: they co-construct the virtual space. The fact that educational interactions take place in virtual learning spaces turns those spaces into places, where places are understood as settings in which people interact. The aforementioned authors of the paper "Virtual Learning Environments" cite Dourish, according to whom "spaces take their sense from configurations of brick, mortar, wood and glass, [and] places take their sense from configurations of social actions. Places provide what we call appropriate behavioural framing." Virtual learning environments might be represented in various forms, from the less sophisticated, text-based to rich, immersive 3D environments. What distinguishes virtual learning environments from other information spaces (e.g. websites that provide access to data) is the fact that they are populated. When teachers create classes (in Google Classrooms) or teams (in Microsoft Teams), they populate their learning platforms with real-life people, students who attend classes.

Virtual learning environments offer various modes of interaction: synchronous (as in chats) and/or asynchronous (emails, forums, etc.), personal (between two participants) or one-to-many or many-to-many, text-based versus audio and video. All those modes have an impact on learning interactions, in which students are not only recipients of information, but can also be designers and creators. The results of students' work may include not only text, but also websites, computer programs, and graphical objects.

> *"Many Web-based environments re-instantiate, in more recent technology, the founding principles of Freinet's project-based pedagogy, not only by their use of tools (for instance e-mail and web-page replace letters and printed newspapers used by Freinet), but also by their concern for multidisciplinarity"*
>
> Dillenbourg et al., 2002, p. 6

Thus, learning in virtual learning environments is much more than just using simple courseware by an individual student, it can resemble project work, as students are participants and contributors in the educational process (Dillenbourg et al., 2002).

Although they are often associated with distance learning, virtual learning environments are not restricted to remote education. In primary and secondary schools, they have the potential to enrich learning activities that take place in presential (offline) education. In blended learning, but also in hybrid education, which became one of the modes in which schools functioned during the COVID-19 pandemic, one student who spends part of their time in a brick-and-mortar classroom can be a member of an actual class, and a member of an online class created on a learning platform with the offline and online worlds overlapping, as "there is no need to

draw a boundary between physical and virtual worlds, the key is to integrate them, not to separate them" (Dillenbourg et al., 2002, p. 8). Internet-based activities can influence the way teachers teach and thereby contribute to renewing teaching methods. What is essential is not to try to emulate face-to-face interactions, but to experiment with new possibilities offered in virtual learning environments, e.g. supporting offline meetings with features of interactive whiteboards located in virtual space, which can be accessed by multiple students at the same time. Students may also connect with professionals and experts outside of school and teachers can explore the opportunities offered by virtual environments in relation to building professional development communities and making teaching a more collective effort, e.g. by various types of team teaching (Dillenbourg et al., 2002).

Teaching and learning in a virtual environment require adjusting pedagogical approaches and techniques used in a face-to-face classroom to web-mediated learning processes. Therefore, it is necessary to rethink pedagogy and focus on technology-enhanced learning to identify the efficient ways of learning on virtual platforms. The e-learning environment can be enriched through Web 2.0 enhanced learning, social networking tools and mobile learning opportunities. Bower (2017) presents some pedagogical approaches and explains how they can be integrated with technology, which may provide ideas on ways for adapting pedagogy to virtual learning environment design:

- Collaborative Learning – it can be facilitated through discussion forums, web-conferencing systems, virtual worlds and other potential multi-user access technology.
- Problem-Based Learning – students are encouraged to deal with an authentic problem to develop their metacognitive skills and collaborative work through technology that enables conducting research and modelling phenomena in groups.
- Inquiry-Based Learning – technological tools can be used for data collection and analysis, and presentation of the findings.
- Constructionist Learning – technology can be integrated for productive experience, such as creating robots or writing computer programs.
- Design-Based Learning – using multimedia design tools and applications, technology can facilitate reflection, discussion and creation of new products.
- Game-Based Learning – digital games can be beneficially used for educational purposes, learning content can be gamified and students can be asked to design games to enhance their 21st-century skills (Bower, 2017).

Virtual learning environments integrate various tools to support different functions: access to information, means of communication, various levels of collaboration, types of learning and management options. They reproduce most functions a brick-and-mortar school offers. "Technical integration supports pedagogical integration. For example, the designer has not to choose between self-instruction and tutoring, but decides to use both, self-instruction as the basis and tutoring when it is necessary" (Dillenbourg et al., 2002, p. 7).

Intensive interaction between users through some medium may lead to improved relations, and thus to the creation of a sense of community between participants. To achieve this objective, users must share the same goals, experiences and similar digital competences and

devices. Consequently, this process requires a lot of time as virtual learning environments should not be places where students absorb "the" culture, but places where they bring their own cultural practices, and co-construct new culture/cultures or at least find the opportunity to expand the existing culture (Dillenbourg et al., 2002).

Finally, virtual learning environments provide space for technical as well as pedagogical innovation. For teachers, a virtual space can be an open space where they can try new approaches. Teachers who use them often perceive themselves as pioneers, and, as such, they not only contribute to educational change, but, more importantly perhaps, develop the ownership of change. Dillenbourg, Schneider, and Synteta see the key impact of virtual learning environments on education in the fact that they have the potential to revitalise teaching offline, too, as teachers with experience in using virtual learning spaces view themselves more as facilitators than knowledge providers and tend to include more collaborative practices in their classrooms (Dillenbourg et al., 2002).

The use of interactive and virtual learning environments seems to be crucial in the era when social distancing might become a permanent feature, at least to some extent. It may allow for intensive group work which will happen in virtual groups through breakout rooms, which seem to be the equivalent of separate tables around which a group of three, four or five students could convene in a brick-and-mortar classroom. The same breakout rooms may be used to allow students to work in pairs. The difference with rearranging the way students are seated is that virtual learning spaces do not require any immediate remodelling of the actual classroom space and could be used even in classrooms where students' desks are arranged in traditional rows.

"Imagine yourself as a teacher in the middle of a classroom, wishing that you could change the learning environment simply by clicking your fingers in order to better demonstrate the issue to be learned. In a virtual environment, this is already possible"

Mattila, Silander, 2015, p. 116

Virtual learning allows students to work with their classmates, but also with other learners across the world. One of the advantages of the virtual world is that it is not bound by the laws of the real world (Mattila, Silander, 2015). And who knows, maybe virtual environments will become the basic mode of teaching/learning for schools in the future. If so, then it is worthwhile to learn how to design and use them most effectively. We believe this process has already begun due to the global COVID-19 pandemic and is likely to change the schooling model.

Chapter 2. Flexibility of the Learning Space: Pedagogical Concepts and Learning Activities

Traditional education is characterised by sameness. It is a one-size-fits-all pedagogical approach with an instructional classroom delivery and expected behaviour of the learners. These are the typical teacher-led activities with the focus on explaining and instructing, and limited interaction with students who are willing to answer questions aimed at the whole class group.

The learning space tells a story. While traditional classrooms have been developed to give all students a good view of the stage, innovative learning spaces promote a range of pedagogical values by their design, especially when it comes to active pedagogies.

Teacher's mindset

For a teacher, having active students means more than having them move all around the classroom. New furniture such as desk bikes do allow students to move during lessons, help them to concentrate, or sometimes help the teacher to deliver a classical lecture to moving bodies... but passive minds. This is not what we mean by students being active (for more on the active learning concept, please see the previous Novigado report "Active Learning Reference Framework for innovative teaching in flexible learning environments" at https://fcl.eun.org/novigado-results). As far as movement in class is concerned, it is thus more about moving towards learning opportunities or even moving as a learning activity. Indeed, active pedagogy aims at turning learning into a creative, self-reflected and meaningful process.

The key end-goal of active learning could be described as the situation where the autonomous learner no longer needs the teacher. However, becoming autonomous requires time, support or assistance (from a teacher or tutor), safe environments, trust, opportunities for trial and error, safe learning from mistakes… and the ability to learn from them. It also requires key competences in order to learn how to learn effectively (Perrenoud, 2002).

Key competences, new scenarios, new learning spaces

Many documents exist that describe key competences, also known as 21st-century skills. However, the Rubrics for 21st-century Learning Activity Design (Future Classroom Lab blog, Future Classroom Toolkit, 2011) developed within the scope of the Innovative Teaching and Learning (ITL) Research project provides the teacher with a practical model to embed these competences into lesson plans. Indeed, Irish researcher Deirdre Butler showed that students will develop collaboration, communication or ICT-for-Learning skills if the teacher actually targets those skills development as a learning goal when building his or her scenario (Butler, Leahy, 2011).

This implies building new scenarios with those new competences in mind. Such new scenarios ask for new interactions, new rights, new moves, new gestures, new postures, new tools and visual supports, which consequently requires setting up new learning spaces. A traditional layout doesn't necessarily have to result in a lower quality learning experience. However, other competences that we require from students these days can be brought more easily into practice in a flexible space where students and teachers are free to move toward new learning situations. Fixed classrooms have limitations and new learning environments offer opportunities.

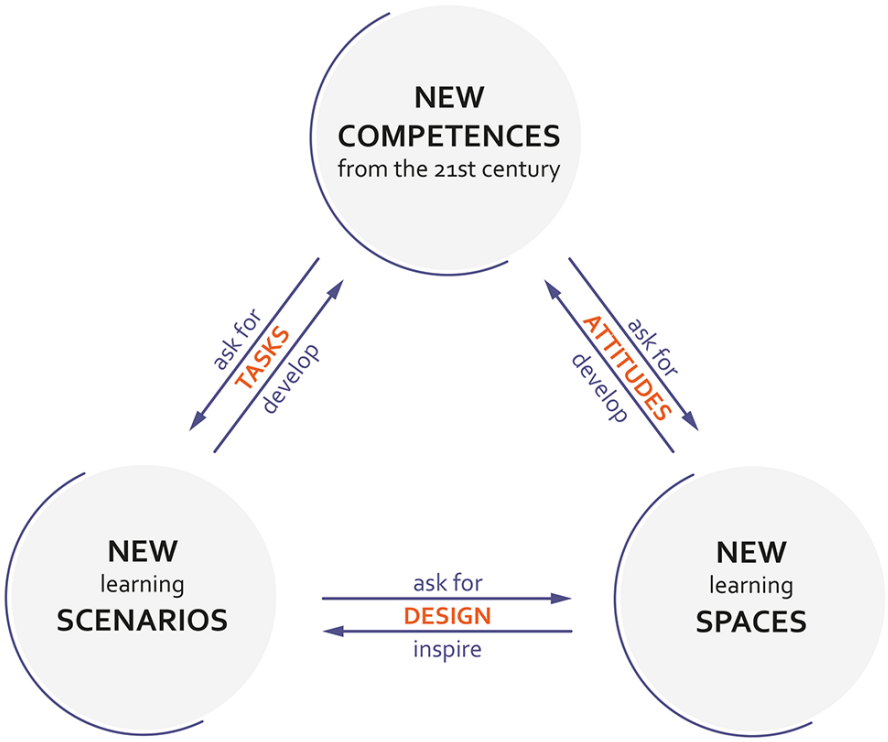


Figure 2. *21st-century model for innovative educational practices at schools.*

In this chapter we describe how active learning, key competence development and pedagogical concepts can be facilitated by design of the learning space with its furniture, equipment and technology. When fully considered and implemented into the learning scenario process, the learning space can act as a third teacher (see Chapter 1.4).

2.1. Adapting Lessons to Key Competence Development

How to plan a lesson with key competences in mind?

While in most countries curricula are content-based (what we learn), students tend to develop key competences through the way teaching and learning experiences are organised.

2.1.1. Rubrics for Lesson Planning

The rubrics below have been developed within the scope of the ITL Research project. For each of the six competences chosen by ITL Research, a diagram proposes several stages of development.

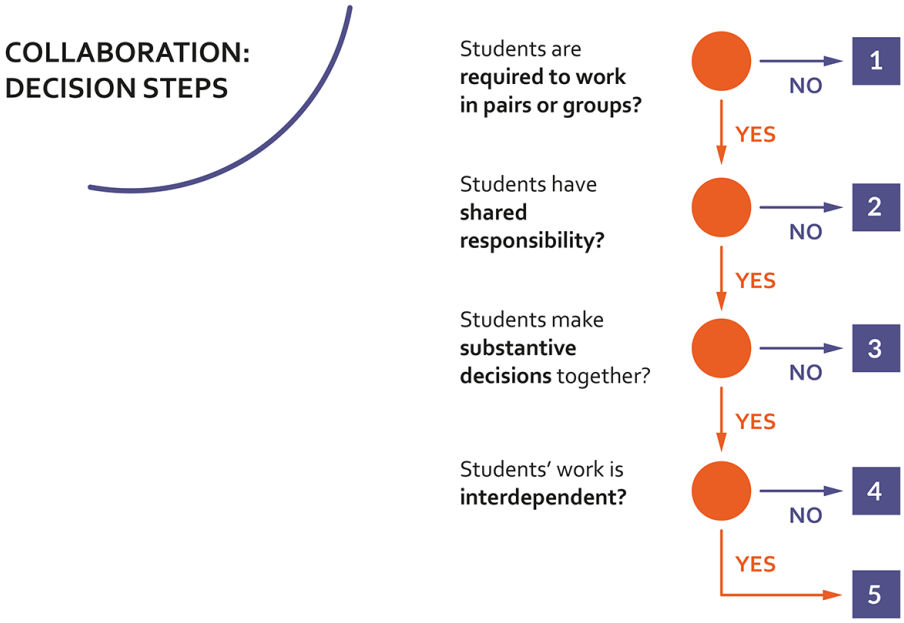


Figure 3. *Five development stages for collaboration in the classroom according to ITL research / Microsoft Partners In Learning.*

Being a teacher, how could I use the rubrics in lesson planning?

- Choose the competence you aim at developing in your students;
- Pick the corresponding rubric and assess your lesson plan according to the degree of development of the chosen competence. Use the questions from the diagram;
- Are you satisfied with the score your scenario reached? You can choose another competence;
- Not satisfied? Ask yourself: "What could I change in my lesson plan in order to reach the next stage of development?"
- Look at your lesson plan in terms of another competence…

Of course, you don't need to reach the highest stage in every competence! Improving your self-assessed score from 1 in one competence must already be very satisfying as it surely implies significant changes in your teaching process. Remember: organising the learning experience to develop a higher level of a key competence is one step forward to active learning and autonomous students!

2.1.2. Creating a New Learning Scenario – the Future Classroom Toolkit

In Section 2.1.1, we used the "lesson plan" term to describe a teacher's organisation of a lesson (or a unit). However, most of the time the lesson plan is composed of what the teacher will talk about, of what the students will work on and what they will learn or develop. As mentioned above, according to ITL Research Lab, the development of key competences doesn't happen in "*what we learn*" but rather in "how we learn": how students learn what they ought to learn, how they interact with one another in order to learn it, how a teacher guides them, helps and supports them. A teaching and learning experience, both defined by "what" and "how" the learning happens, is what we call a *learning scenario* (or an FCS: a Future Classroom Scenario). It explicitly describes the roles of teachers and students throughout the activities.

The Future Classroom Toolkit (see https://fcl.eun.org/toolkit) supports a creation process for such new learning scenarios: from identifying techno-pedagogical trends to actually building new learning activities. Five steps (toolsets) can be taken either individually or as a group of stakeholders. Indeed, the broader the diversity of stakeholders (such as parents, students or policy-makers), the greater the chances of creating a useful, usable and desirable learning scenario.

Toolset	As part of the FCS process (at school or system level)	As individual tools
1 – Identifying stakeholders and trends	Creating an FCS starts by involving a variety of informed stakeholders and working with them to identify trends and to define changes that are likely to affect schools in the future.	To identify who should be involved in any change-management process. Education policy-making processes should be based upon an informed identification of trends.
2 – Future Classroom modelling	To create a useful FCS, it is important to assess the maturity of a school in how it uses ICT for teaching and learning.	Self-review is used in many schools and countries to benchmark their current progress in adopting ICT effectively.
3 – Creating a Future Classroom Scenario	A face-to-face workshop activity for creating an FCS, as a vision for change.	Simply adapting and adopting an existing scenario from the FCS bank.
4 – Designing innovative Learning Activities	The FCS is used as inspiration for designing innovative Learning Activities, with guidance and support on the use of learning technologies.	An existing FCS can be used to create a number of Learning Activities.
5 – Evaluating innovation in the classroom	Learning Activities should be used in the classroom and evaluated to ensure they bring the desired innovation.	Existing Learning Activities can be used in the classroom and evaluated.

Table 3. *The Future Classroom Methodology by the EUN Future Classroom Lab.*

It is interesting to note that Step 2 can also be considered an opportunity to reflect on the key competences which the scenario should focus on developing.

FCL Toolkit Use Case in LP2I school (2015, France)

Teachers, students, parents, and researchers from Novigado partner Réseau Canopé, French Ministry of Education local representatives and furniture sellers formed a group of 20 stakeholders who gathered three times for half a day in spring 2015. Following the FCL Toolkit methodology, they identified three different trends and created three different learning scenarios. Learning activities were left to teachers for further development. The work is summarised in the table below:

Identified trend	Maturity model & Key competences	Scenario name	Scenario overview
Bring the real world into the classroom	Key competences: Skilled communication Knowledge construction Technology to... Investigate Present Interact with the "outside world"	The Initial Shock	Students explore the work of an author, an expert or any professional from the "outside world". The teacher secretly organises a virtual (or face-to-face) meeting with this very person. Students can ask questions, present and react, based on the previous work they achieved. The teacher regularly refers to this impactful moment throughout the unit for a meaningful learning, connected to the real world.
Facilitate collaboration among learners	Key competence: Collaboration Knowledge construction Technology to... Exchange Present Create	Experts	Based on the Jigsaw method. See Section 2.3.1.1. for more information.
Learn through projects	Key competence: Self-regulation Collaboration Communication Use of ICT for Learning Creativity Technology to... Investigate Develop Create Present	The Project-Based Learning (PBL) Wheel	This wheel describes seven steps to take to engage students in project-based learning. See Section 2.3.1.2. for more information. The dream phase is particularly important as it gives students time to identify room for choice and self-regulation and take ownership of the project. The ask phase brings an added value to key competences and active learning development by encouraging students to reflect both on their work and others', taking ownership of the success criteria and getting a chance to improve their final product.

Table 4. *Future Classroom Lab Toolkit as implemented by LP2I school, France, 2015.*

2.1.3. Learning Space Questions Raised by Learning Scenarios

Rethinking the teaching and learning process in terms of how the students will learn consequently raises the question of the physical environment. The new school form described by the triangle model above (see: Figure 2) suggests that the learning environment should be shaped to support teacher and students' interactions generated by the scenario. Indeed, developing collaborative learning will be difficult in a classroom with rows of desks facing the board. On the other hand, every teacher knows how difficult it is to get the attention of students while they are seated in groups.

How do we change the classroom setting for a perfect scenario match? In the PBL Wheel scenario above, we can imagine that students will be facing a range of learning situations and activities. Thus, do we need to set up a new classroom environment for every learning scenario we run? Just as scenarios should answer a specific need for developing a key competence, so learning spaces ought to be adapted to facilitate a specific scenario. The two concepts below help you tackle these questions and design a suitable learning space:

Flexibility

A teacher cannot switch classrooms every time he or she imagines a new learning scenario. A flexible learning environment with light or mobile furniture might help the teacher (and the students) shape the space in the best way to support the planned activities. But what could such a setting look like? This is where the second concept comes into play: learning (or micro) zones. A flexible classroom could then be described as being both a composite and a compromise of such learning zones.

Learning zones

A learning zone is a physical space designed for a specific type of learner activities. European Schoolnet's Future Classroom Lab created a list of six learning zones, labelled with key action words: interact, investigate, develop, exchange, create, and present (see Chapter 3). Each zone facilitates a certain type of activities by providing appropriate space, furniture and technology. It is important to note that the zones are described from the learner's point of view.

A single classroom is usually not large enough to be divided into six learning zones. The teacher can then either select, merge, or use flexible zones to adapt the classroom space to activities. Or different parts of the school can be redesigned to reflect different learning zones, thus providing the opportunity for them to be used and shared by many teachers and students during lessons.

2.2. Adapting Space to Learning Scenarios

How to design the ideal learning space? There are many ways. However, we would like to share some ideas and scenarios that are based on the experience of schools in the network of European Schoolnet.

2.2.1. Key Ideas for Learning Space Transformations

Here are some key ideas you need to consider before initiating the classroom space transformation:

- There is no perfect "one-size-fits-all" learning space.
- A perfect space is perfect for a pedagogical scenario (though it can inspire other scenarios).
- Along with learning goals, the active learning scenario takes into account the key competences teachers want their students to develop.
- "No furniture" is also furniture… Sometimes less is more.
- Small changes can be made to a classroom in order to make it more flexible. Key idea: different students work in different ways. For a single student, it also changes with the moment of the day, the task to achieve, the available space, etc. When students get to know themselves better, how they work best, the choices they make will be both faster and more relevant.

Figure 4. *Example of a DIY class – Collège Didier Daurat - Mirambeau, FR. (Xavier Garnier, LP2I archives)*

2.2.2. From Learning Scenarios to Classroom Settings – Seven Steps

Step	Example
Step 1: Set your learning goals (the "what") and the learning context.	Learn about European institutions by creating a podcast on the Brexit story.
Step 2: Select no more than two key competences you want your students to mobilise.	Developing collaboration.
Step 3: Use the rubrics from Section 2.1.1 to set the level of development you want to target with your students.	Highest level: "Students' work is interdependent"
Step 4: Create (for instance using Section 2.1.2 FCL methodology) or choose a learning scenario (the "how").	The "Experts" (see Section 2.3.1.1). In groups of four, each student takes on a role among four fields of expertise: an EU expert, a journalist, a British leaver and British remainer. Roles shared among students ensure the work is indeed interdependent. (See figure 5)
Step 5: Describe what the students will do throughout the scenario.	Students work in groups of four, assign and assume their roles, and eventually they discuss the final product. Then, they gather in "expert" groups according to their role, where they work on new resources and acquire knowledge. They eventually re-join their original group to bring new expertise to the group production.
Step 6: List some key space characteristics to facilitate students' work (individual work, group work, whole class gathering?...)	Mobile furniture (like tablet chairs) which allow quick reset of space settings for group reconfiguration, specific zones for experts' group work, breakout room for recording a podcast.
Step 7: Choose and/or adapt the learning space. Book a specific school space, in addition to your traditional classroom and/or change the setting of the tables and chairs according to the outcome of Step 6.	Ideally, a flexible learning space with tablet chairs plus a recording studio. DIY version: pairs of tables for group work, empty spaces with chairs only for certain experts (British leavers and remainers), mobile whiteboards for journalists, computer zone for EU institution experts, use of corridors and adjacent rooms for sound recording.

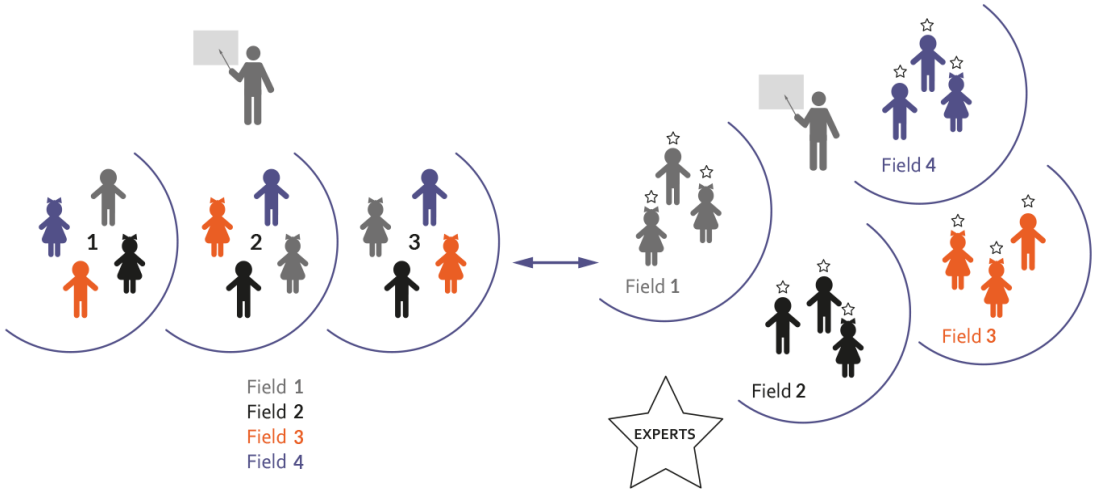


Figure 5. *Implementing fields of expertise in the classroom.*

2.2.3. From Learning Scenarios to the Future Classroom Lab

The Future Classroom Lab (https://fcl.eun.org) is an inspirational learning environment created by European Schoolnet in Brussels. It is a place for teaching and learning experiments and sharing practices within a community and with other educational stakeholders (industry partners, policy-makers, schools, etc.).

At a school level, building a local Future Classroom Lab (or a learning lab) (see: https://fcl.eun.org/guidelines) is an efficient way to both promote innovative teaching and enhance exchanges of practices. Such a learning environment will indeed be shared by different teachers and students of other subjects. New teaching methods such as co-teaching and flipped pedagogy are facilitated by a single and shared space on which the school chose to invest time and resources. Best practices, scenarios, ideas… even mindsets could then be disseminated throughout the school to impact both more classical classrooms and more classical teaching. A local Future Classroom Lab is also a good way to embody school innovation, and a physical object to think with.

FCL Use Case in LP2I school (2015, France)

With three different scenarios in hand, the LP2I's group of stakeholders imagined, along with Réseau Canopé members, three different rooms: one for each scenario. For instance, the "Experts" scenario implied forming groups, reshaping them into new groups… and reforming the original groups again! LP2I's team thus decided to use a 75m^2 room and take out all the furniture. They put write-on paint on the walls, added a few mobile whiteboards and picked mobile desk-chairs to quickly arrange the classroom settings for different kinds of collaboration. A big sheet of glass separates the room from the entrance, making it easy for visitors to observe classroom action. Technology only came second, after the photo below was taken: six TV screens for groups to display content, present and collaborate.

Figure 6. *Future Classroom Lab in LP2I school, France. (Xavier Garnier, LP2I archives)*

2.3. Six Learning Scenarios and Space Adaptations

2.3.1. Scenarios Overview

2.3.1.1. THE EXPERTS

This scenario is presented above in Section 2.2.2 along with an example from the classroom. It focuses on developing collaboration among the students by pushing group-working further. Indeed, each member of a group takes on a specific role and joins students from other groups with the same role in order to gain expertise (see table below for division of roles). Newly formed experts bring back their knowledge to help fulfil the task.

Student's role	Teacher's role
• Active and mobile. • Have a role, a responsibility. • Valued for being "experts". • Engaged in a bigger project they need others to complete. • Develop communication, collaboration and knowledge construction skills.	• Chooses the topic and the related fields of expertise which will determine the roles in the groups. • Keeps an eye on the time (from 100 min to several weeks!) and balances the weight of each phase in the scenario. • Regulation role: lets the students choose their role or help group decisions. • During experts' phase, the teacher might bring some differentiated input to expert groups. • Helps new experts share their knowledge within the groups.

***Table 5**. A student's and a teacher's roles in the Experts scenario.*

***Figure 7.** An "expert group" preparing an exercise for other students. (Xavier Garnier, LP2I archives)*

2.3.1.2. THE PROJECT-BASED LEARNING (PBL) WHEEL

The wheel on the picture below describes seven steps to take in order to engage students in PBL. One key element of such a pedagogy is the final product, which gives a goal and a reason to engage in research and learn by doing. But the PBL Wheel exposes other important aspects

which help prevent the project from being either too instructed and directed (too many constraints from the teacher, "only one good way" actions to take, etc.) or too focused on the final result/product (rather than on the learning outcomes).

The dream phase is particularly important as it gives students time to identify room for choice and self-regulation, and to take ownership of the project.

The explore phase is a divergent phase where students go through both online and offline resources and gather elements for their project. It's a classic phase in PBL pedagogy.

The map phase is also classic but nonetheless not easy. Students identify and select relevant information and organise it into communicable content.

During the ask phase, students are invited to present the work they have done so far to their peers and receive feedback from them. It brings an added value to key competences and active learning development by encouraging students to reflect both on their work and on others', taking ownership of the success criteria and getting a chance to improve their final product.

The remake phase brings schoolwork closer to real-world work situations by giving students a chance to reflect on the feedback they have received and improve their product.

The present phase is a classic ending for project-based activities. However, taking the audience into consideration and shaping the presentation accordingly is a real challenge which develops high-level communication skills. This phase can also be organised as a fair (see 2.3.1.4.).

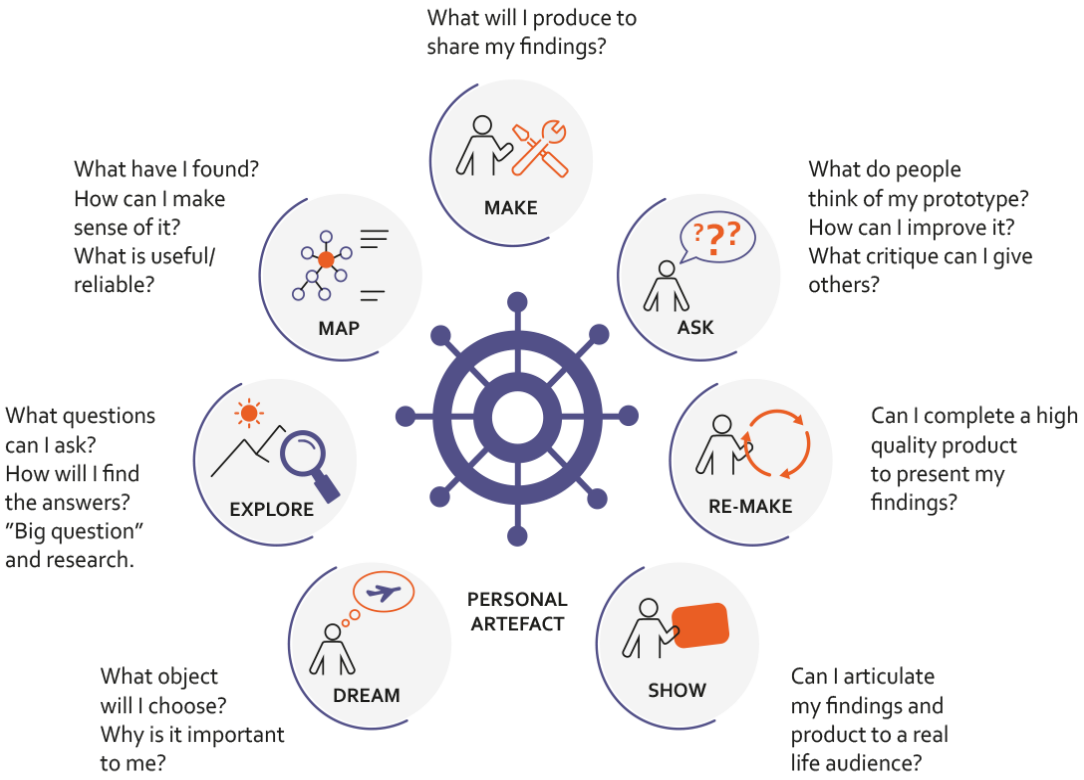


Figure 8. *The PBL Wheel developed by the Creative Classroom Lab Project (European Schoolnet, 2015).*

Student's role	Teacher's role
• Dream: creative, take ownership of the class project, self-regulated, look for compromise. • Explore: researchers, investigators. • Map: project managers, choice makers, planners. • Make: makers, creative problem-solvers. • Ask: evaluators, critics, communicators. • Remake: listen, consider advice, be persevering. • Show: speakers, communicators, "sellers" of their product.	• Dream: designer, inspiring source, coach, adviser. • Explore: guide, resource. • Map: helper, support provider. • Make: technical support, help the class to identify resource-students, facilitate collaboration and support between groups, reference for project goals (tasks and learning goals). • Ask: space & scenario designer, communication facilitator, critic. • Remake: coach, schedule keeper + see Make Phase again. • Show: host, participant, evaluator.

***Table 6**. A student's and a teacher's roles in the PBL Wheel scenario.*

2.3.1.3. COLLABORATIVE READING (TEAR UP THIS BOOK!)

A group of students explore a book or a part of it by tearing up pages and sharing the reading. Each student reads their own part and takes notes. The teacher gathers the class and helps build understanding of the book by giving the floor to volunteers with a reactive process more than a linear one: anybody can start sharing their notes no matter the place of the text in the narrative and anybody can react and give input based on what they have just heard from peers. The final product can be a summary, a diagram, a mind map, etc.

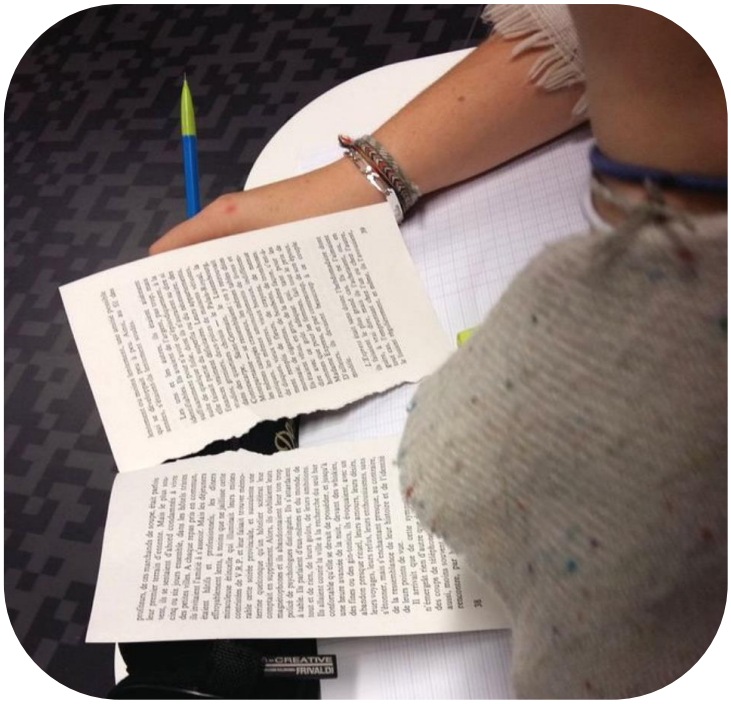


***Figure 9.** A student reading her share of a book in a Collaborative Reading scenario. (Xavier Garnier, LP2I archives)*

Student's role	Teacher's role
• Readers. • Develop an analytical mind. • Listeners, speakers. • Co-builders.	• "Rebel": transgresses an implicit rule: never tear up a book. • Disruptive director: helps question physical and intellectual dimensions of a text. Arouses students' reactions. • Organiser: puts the power of collective intelligence into action. • Supervisor: keeps the class calm for quality reading. • Knowledge co-builder: animates the construction of understanding.

***Table 7**. A student's and a teacher's roles in the Collaborative Reading scenario.*

2.3.1.4. FAIR-LIKE PROJECT ASSESSMENT

A fair-like assessment scenario is a chance for all the groups to present at the same time. The visitors mainly include project members but can also include outsiders. In the first part of the scenario, half of the class build a stand and present their project. The other half are visitors taking part in the assessment (either formative or summative depending on when it happens in the project planning). After half-time students swap roles.

Visitors are free to come and go. The teacher doesn't need to check the time and blow a whistle for visitors to switch from one stand to another. When properly set up, a fair-like assessment lesson runs on its own and frees the teacher to both enjoy their students' work and assess them. This freedom can also be used by the teacher to identify situations of success around them. This actually changes quite significantly the relation to evaluation as the teacher acknowledges skills in their students' actions instead of testing their ability to overcome a test.

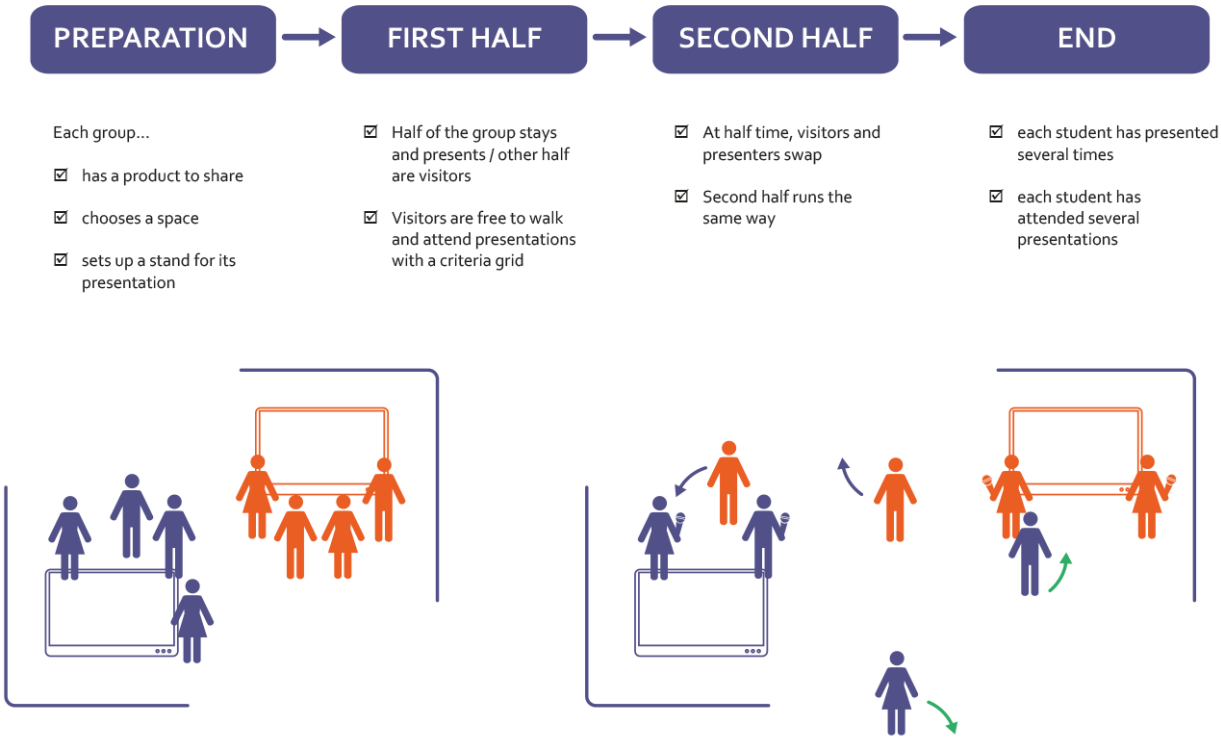


***Figure 10**. Organisation of Fair-like Project Assessment in the classroom.*

Student's role	Teacher's role
• Organisers: students take part in setting up the fair. Each group identifies a space and rearranges it in a stand from which presentations will take place. • Speakers: they present, argue, interact with visitors, showcase their products, etc. • Critical friends: as visitors, they encourage and congratulate hosts, give advice, propose possible improvements based on the project criteria. • Evaluators: students can also take part in peer assessment.	• Designer: anticipates available spaces, furniture and devices for stands, prepares visitor's criteria documents to ensure the quality of exchanges. • Observer: steps back and accepts being overtaken by the numerous interactions the scenario induces. • Evaluator: this can be an occasion for assessing both students' oral skills and group productions. A positive evaluation is expected as the point is to identify traces of learning and skills among active students. • Visitor: it is also possible for the teacher to "sit and relax", discovering students' final product and their wish to showcase it. • Project promoter: the teacher can spread the word and invite outsiders (parents, other students, etc.) to come and visit the Fair.

***Table 8**. A student's and a teacher's roles in the Fair-like Project Assessment scenario.*

2.3.1.5. KNOWLEDGE MARKET

In its simplest form, a Knowledge Market is organised by creating a three-column table: needs on the left, help offers on the right and a centre column "Object" in which students explain what they need or what exactly they can provide help for. Students then register in the table "both ways": one can ask for help on a topic but then propose to give a hand on a different matter. Tutoring groups are then naturally formed for every filled row of the table.

This scenario has different alternatives especially as far as the manner in which the teacher can ensure that students actually have the skills they claim they have and thus provide decent help. For instance, when the scenario is organised after giving back formative papers the feedback each student receives gives a clear signal to whether he or she can propose or need help. In this case, the Knowledge Market turns into a remediation time in which the teacher has free hands to come and help those who need it the most.

I need help on... (First name)	Object	I can help on... (First name)
Louise Eyal Lola	Ex 4 - Draw the line given its equation	Manon elias
Logan Eyal	Ex 4 - Find the equation of a line	Nathan Manon elias

***Figure 11**. Simple use of the Knowledge Market scenario in the classroom.*

Student's role	Teacher's role
• Reflexive learners. Students reflect on what they need. • Self-confident learners. Students express what they know and what they don't know. Asking for help is quite normal, a shared value among the class. • Tutors. Students teaching other students. • Active learners. Students decide what to work on. • Mobile learners. Students move around the learning space actively seeking learning opportunities.	• Scenarist: designs the activity. • Moderator: controls the activity's sound level, balances groups' size, supports and tutors students on how to help peers. • Observer: on the side. • Teacher: supports students who don't have a match or students with identified weak spots. • Supporter: encourages students' efforts and appreciates their progress.

***Table 9**. A student's and a teacher's roles in the Knowledge Market scenario.*

2.3.1.6. MOBILE DEBATE

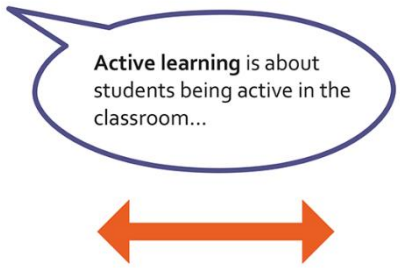


***Figure 12**. Sample of a teacher's statement that starts a debate in the classroom.*

A Mobile Debate is a whole class activity where the teacher shares a polemical statement on the board and asks the students to stand up and position themselves in space according to their opinion: those who totally agree on the right side and those who totally disagree on the left side of the room. Anybody who has a balanced point of view can stay anywhere in-between.

The main advantage of this scenario compared with a classic debate is that it both physically engages students and leaves no one without an opinion.

Student's role	Teacher's role
• Move on the line according to their opinion. • Must have an opinion (symbolised by positions on the line), even without speaking. • Listen to others' point of view and might change position accordingly. • Discuss, argue, reflect.	• Designer of the polemical statements. • Debate leader: decides who is to speak, helps students listen to one another, ensures compliance with the rules. • Compromise maker, synthesis helper. • Expert: during the debate (after closing it), the teacher may bring some external hindsight (research inputs, historical facts, figures, etc.).

***Table 10**. A student's and a teacher's roles in the Mobile Debate scenario.*

2.3.2. Competences / Scenarios Matching Table

The table below associates eight key competences with six learning scenarios presented in Section 2.3.1. It can be read in columns to find out which scenario develops particular competences. Or you can select one competence and choose among scenarios to focus on it.

	Experts (Jigsaw method)	PBL Wheel	Collaborative reading	Fair-like Assessment	Knowledge Market	Mobile Debate
Collaboration	■	■	■		■	
ICT for learning		■				
Knowledge construction	■		■		■	
Self-regulation		■				
Real-life problem-solving		■				
Skilled communication		■		■	■	■
Critical thinking		■	■	■		■
Creativity		■				

***Table 11**. Matrix of key competences and types of learning scenarios.*

2.3.3. Six "Ideal" Learning Spaces

For each scenario presented in Section 2.3.1 we may suggest a space configuration, furniture and settings. The guiding idea is to identify how the learning environment can facilitate both learning and development of key competences by offering the best conditions for the scenario's implementation. Thus, for each phase of a scenario, we list favourable environment features which can support learning activities.

2.3.3.1. HOW TO DESIGN A LEARNING SPACE FOR THE EXPERTS SCENARIO

Scenario	Favourable environment features
Goal: develop students' collaboration skills and self-efficacy.	Large quiet room. Breakout rooms. Mobile whiteboards.
Phases (based on the Jigsaw method) [+100 min]	
Phase 1: assigning roles: [+15 min] A topic is split into 3/4 fields, roles or perspectives, called the experts' fields. Teams of students are assigned a production such as a 2-min podcast on the topic. In each team, roles are shared among the students so that each student is THE expert in their field.	Group tables or mobile chairs. Access to production tools (applications, computers, mobile devices, etc.)

Phase 2: becoming an expert [+40 min] Self-defined experts gather by fields of expertise and collaborate to acquire knowledge and skills based on the existing knowledge within the newly formed group, research or documents/tasks shared by the teacher.	Enough free space for groups to be rearranged. Screen / whiteboards for sharing content, possibly breakout rooms for expert groups.
Phase 3: bringing the expertise back home [+45 min] The experts return to their original teams and bring their newly-acquired expertise to the creation of the expected product (such as the podcast mentioned above).	

***Table 12**. Organisation of the learning space for the Experts learning scenario.*

Environment specifications (summary): the "Experts" scenario generates a substantial amount of movement in the classroom. A wider space makes it easier to shape and reshape the groups. Corridors and/or breakout rooms can also be used in order to anticipate noise issues during collaborative work.

***Figure 13**. An "Experts" scenario in action at LP2I's Future Classroom Lab: mobile chairs facilitate quick modifications of the learning space. (Xavier Garnier, LP2I archives)*

2.3.3.2. HOW TO DESIGN A LEARNING SPACE FOR THE PBL WHEEL SCENARIO

SCENARIO	FAVOURABLE ENVIRONMENT FEATURES
Goal: create a final product to be shared as an occasion for learning.	Complex environment, connected to the whole school and beyond.
Phases	
Dream: students reflect (individually then in groups) on the theme, the topic and the final shape of their product, according to the teacher's requirements.	**Dream**: individual seating, any configuration can do. No technology needed.
Explore: they research "big questions", non-googleable questions and materials for answers.	**Explore**: group tables, computers, access to external resources (library,…), possibly going outdoors.
Map: they select resources, organise them and plan the work for building the product.	**Map**: group tables, "campfires", breakout rooms, corridors… any space where a small group of students can discuss quietly and make choices.

Make: "hands-on" phase. Students build their product, record their media, create their artefact.	**Make**: larger group tables, maker space, video lab, any space large enough for students to move and create. Noise issues to be anticipated.
Ask: peer and teacher review of the creations. An occasion to reflect on success criteria and learning outcomes.	**Ask**: main room, white boards for presentations, only a few chairs needed, participants mainly standing.
Remake: back to "hands-on", improving the product according to feedback.	**Remake**: back to Make configuration
Show: presentation of the product to a specific audience.	**Show**: theatre, platform, conference semi-circular setting for successive presentations. Or a large complex room for stands setting and simultaneous "fair-like" presentations (see Section 2.3.3.4).

***Table 13**. Organisation of the learning space for the PBL Wheel learning scenario.*

Environment specifications (summary): The seven phases of this scenario require very different space configurations. While a large classroom with light furniture can be quickly redesigned and help achieve most of the tasks, PBL will also require outside-the-classroom resources and spaces. Digital collaborative tools can help the teacher connect to his or her students when they are spread all over the school.

***Figure 14**. Peer feedback session to improve the product: "ask" phase of the PBL Wheel scenario. (Xavier Garnier, LP2I archives)*

***Figure 15**. Students collaboratively building a presentation. Digital and non-digital tools are combined to enhance creativity and interactivity. (Xavier Garnier, LP2I archives)*

2.3.3.3. HOW TO DESIGN A LEARNING SPACE FOR THE COLLABORATIVE READING SCENARIO

Scenario	Favourable environment features
Goal: analytically and collaboratively reach global understanding of a book or a long document.	Individual settings for quiet reading. Open space with displays / boards to share content and thoughts.
Phases	
Phase 1: sharing the book. The teacher may split pages of a book among his or her students, asking them to read their parts and take notes.	An empty space which allows free movement can be used for sharing the book.
Phase 2: individual reading. Students choose a comfortable and quiet space to read.	Spaces are chosen by the students. Some may prefer reading on a classic school chair at a table. Others may use a corner of the room and sit on the floor, sit on stairs in the corridor, etc.
Phase 3: pooling the notes. The teacher invites students to share their understanding. It's not a linear process, notes are shared according to questions raised by partial information already shared.	A main room where everybody can see and be seen. Students may form a circle, mobile chairs would help.
Phase 4: keeping tracks, summing up.	Displays and (mobile) boards can help sharing and organising content (e.g. mind-mapping).

***Table 14**. Organisation of the learning space for the Collaborative Reading learning scenario.*

Environment specifications (summary): While the collective phases of the scenario will imply the use of a wide common space, individual reading times will need an eclectic set of small spaces, little "caves" which students can create themselves, quiet places to sit in, whether inside or outside the classroom. This scenario thus perfectly suits outdoor learning.

***Figure 16**. Circle setting in Phase 3 of the Collaborative Reading scenario: pooling understandings. (Xavier Garnier, LP2I archives)*

2.3.3.4. HOW TO DESIGN A LEARNING SPACE FOR THE FAIR-LIKE ASSESSMENT SCENARIO

Scenario	Favourable environment features
Goal: have groups present their final product simultaneously, several times.	A large (open) space. Possibility of creating smaller spaces for stands (mobile separation walls, boards…)
Phases	
Preparation: each group has a product to share, chooses a space and sets up a stand for presentation.	Smaller spaces must be created from a bigger one. It is also possible to use smaller adjacent rooms. Corridors can be useful extensions of the space.
First half: half of the group stays and presents / other half are visitors. Visitors are free to walk and attend presentations with a criteria grid.	Display devices (TV screens, projectors, etc.), fixed, mobile or portable boards, writable walls, hooking tools (clothes pegs, pieces of string, pins, etc.).
Second half: at half-time, visitors and presenters swap. Second half runs the same way.	It is possible to draw a map of the room before the fair and ask the groups to choose where they want to set their stands. They may also ask for specific presenting tools.
End: each student has presented several times, each student has attended several presentations	

***Table 15**. Organisation of the learning space for the Fair-like Assessment learning scenario.*

Environment specifications (summary): Building their stands, students can feel they own the space. Complex spaces may inspire a host toward creative settings. Need for technology may also be a significant criterion when choosing the spots.

***Figure 17**. Students using corridors to extend the space of their classroom. They also get more light here. (Xavier Garnier, LP2I archives)*

***Figure 18**. First half of a Fair-like Assessment scenario, students host or visit stands. (Xavier Garnier, LP2I archives)*

2.3.3.5. HOW TO DESIGN A LEARNING SPACE FOR THE KNOWLEDGE MARKET SCENARIO

Scenario	Favourable environment features
Goal: establish helping relationships among the class based on the student's diversity of needs and skills.	Group tables and small tutoring spaces.
Phases	
Preparation: the teacher prepares a three-column layout, either on a digital collaborative document or on a simple whiteboard (see an example in Section 2.3.1.5). The centre column can either be pre-filled with topics or left blank for students to fill in according to their tutoring offers and needs.	A classic teacher's zone to display the collaborative document (using a projector or a screen.) Alternatively, the three-column table can be drawn on the main whiteboard of the room.
Registration: students write their names in the first column if they need help and/or in the third column if they offer to help.	Easy access to this "display zone" may then be granted to students who come and write their names in the table.
Tutoring: once a row is full, students choose a space and start helping one another. Once problems are solved, they may leave the help group either to look for help or to become tutors on a different topic.	Group tables for tutoring. Extra spaces for smaller groups (like one-to-one tutoring). One or two larger zones with a (mobile) whiteboard for individual students teaching to a larger group.
Testing: a small quiz can be provided to evaluate the impact of the scenario on students' progress.	Light chairs may help quickly redesign the space for individual tasks (completing a quiz, writing a "what I learned today…" reflective summary, etc.)

***Table 16**. Organisation of the learning space for the Knowledge Market learning scenario.*

Environment specifications (summary): A classic classroom with group tables works fine. Additionally, smaller spaces for one-to-one tutoring and a larger space with a second whiteboard for student-teaching-to-a-group situations can support the scenario by facilitating explanations. Portable whiteboards can support an outdoor version of the scenario.

***Figure 19**. Tutoring phase of a Knowledge Market scenario. Smaller boards support outdoor learning. (Xavier Garnier, LP2I archives)*

2.3.3.6. HOW TO DESIGN A LEARNING SPACE FOR THE MOBILE DEBATE SCENARIO

Scenario	Favourable environment features
Goal: To develop students' communication and argumentation skills. May be used to introduce a topic and/or highlight students' representations of a topic.	Medium-sized clear space with a whiteboard.
Phases	
Set-up: a part of the room is cleared so that students can gather and stand in front of the class whiteboard. The teacher explains the rules of the debate and how to position oneself on an imaginary line.	A standard classroom can be used with a minimum of changes. Mainly the front space should be cleared of furniture.
Positioning: a polemical statement is displayed (or written) on the board. Students position themselves on the line according to their views on the statement.	A corridor is perfectly shaped for this scenario. Outdoor spaces may also be appropriate. In both cases, sound issues may be anticipated.
Debate: the teacher launches the debate by giving the floor to the "extremes". Only one student speaks at a time. The teacher may then give the floor to moderate students, possibly reaching a compromise.	A projector: in the digital version, a slideshow may alternate a "polemical sentence" slide with a "hindsight" slide which may serve as a conclusion before moving to the next sentence.
Hindsight: the teacher can display extra inputs on the topic, adding facts, scientific arguments, reliable information, etc.	
Back to Positioning: a second statement is displayed, and the class may repeat the two last phases above.	

***Table 17**. Organisation of the learning space for the Mobile Debate learning scenario.*

Environment specifications (summary): Mobile debates need no furniture. Students are free to move around an empty space. While they do so, they can coordinate their body and mind for more efficient reflection. Indoor spaces will bring advantages sound-wise while outdoor spaces might provide a different connection with nature, possibly clearing minds for fresher ideas. It can also be a way to balance activity types if, for instance, students are asked to write a summary of the debate, back in "normal" class. The technology is optional as hindsights can be given by the teacher without necessarily displaying digital content. A version of this type of activity can be seen in one of the scenes of a film entitled *Freedom Writers* with Hilary Swank. You can watch this scene in YouTube or if you scan this QR code:

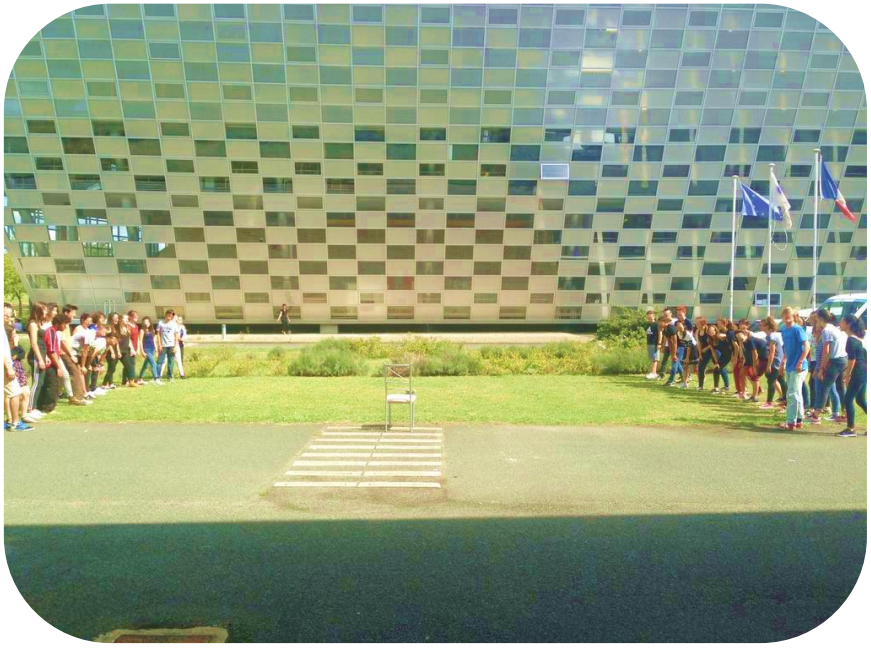


***Figure 20**. Integration day at LP2I. An occasion to combine encounters, (mobile) debates, and physical activities. (Xavier Garnier, LP2I archives)*

Chapter 3. Spectrum of Innovative Learning Spaces

The basic concepts of organising learning in schools, as well as classroom layouts and, to some extent, their equipment, have remained more or less identical for the last decades. At the same time, we cannot deny that many schools have made serious efforts to move away from traditional learning spaces and traditional teaching practices. Indeed, innovation is not only dependent on architectural changes and investments in equipment. It comes in the first place with a different vision of learning, resulting in a changed mindset in teachers and consequently, different behaviour in learners. Pedagogical changes are also possible in classrooms with the basic, traditional equipment of chairs and tables. Providing just innovative learning spaces and investing in equipment and technology may not be a change agent as such. However, taking some steps to rethink the learning space, and the integration of educational technology, provide opportunities for current changing views on pedagogy.

In this chapter, we describe the spatial tools we use to organise learning, from the basic elements such as chairs and tables, to classrooms with learning zones, to learning spaces in the whole school and beyond the school. As explained in Chapter 1, we try to present links with pedagogical concepts because, as has been said, space design may facilitate pedagogical views and everyday practice in classrooms.

3.1. Dynamic Classrooms

Discussions about innovation in education often start by pointing at the traditional classroom layout where students are seated in rows facing the teacher positioned in front of the board. This observation may be a good starting point for the discussion, but the seating arrangement is by no means the end of this debate.

Admittedly, the shape and disposition of the traditional classroom respond to the historic and cultural origins of schooling. Since then, some social and technical evolutions have occurred, and we have questioned pedagogical settings mainly regarding the authority relations between learners and teachers, the figure of the teacher as a unique knowledge keeper and giver, the availability of information and, naturally, the learning space and time.

The traditional classroom set-up as portrayed above is not to be avoided in all circumstances. It is rather one of the possible layouts teachers can implement to deliver a learning scenario. The learning space configuration determines, or at least influences, the type of interactions teachers and students can have. However, flexible spaces can host a greater variety of activities.

A classroom layout with rows is, however, not something we should take for granted. Therefore, furniture needs to be flexible to prevent the classroom becoming fixed, which certainly has pedagogical consequences. The space tells a story. Space design and the positioning of the learners and the teacher have, without doubt, a direct link with the pedagogical visions, but also relate to the well-being of the learner.

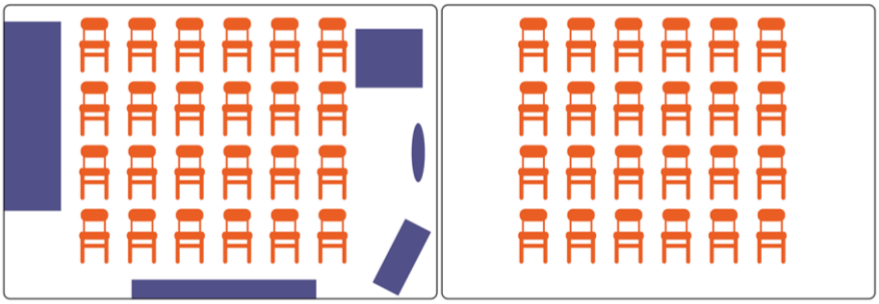
3.1.1. Orchestrated Seating Shifts

Giving free seating options to students has its value but the direct influence on pedagogical concepts may be a bit vague.

Designing and changing the classroom layout for a specific purpose makes it clear that space is an important factor in learning and can be seen as a third teacher (see Chapter 1.4).

3.1.1.1. FREE THE FLOOR

The traditional configuration of the classroom with fixed rows certainly impacts and limits the pedagogical format. The most important step to consider while introducing changes is freeing the floor. Quite often classrooms contain not only chairs and desks but also other objects that, in many cases, don't play any role in the learning process and are just in the way. Freeing the floor and investing in easy-to-move furniture are the first steps in making innovative changes.

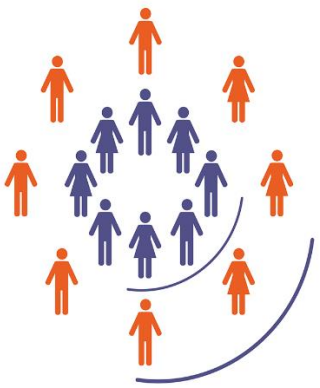


3.1.1.2. EXAMPLES OF DYNAMIC FORMATS

The following examples of dynamic formats require smooth changes in the classroom layout and/or easy movement of the learners. The different configurations support stages of pedagogical formats.

Fishbowl

The idea of a fishbowl is to divide the class into two groups with an inner circle having a discussion on a certain topic, and with an outer circle with observers, each observing one speaker of the inner circle. After the discussion, the participant of the inner circle gets feedback from his observer based on a rubric/checklist. Afterwards, the roles change for a second discussion.



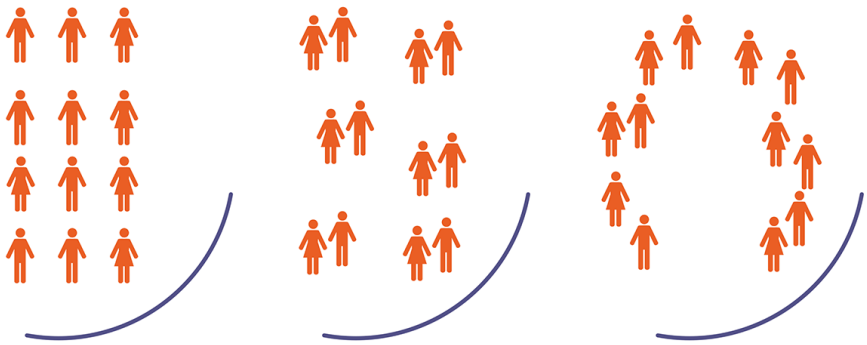
Think-Pair-Share

The Think-Pair-Share format comprises three steps:

Think: all the students reflect individually about a question/problem/concept given by the teacher.

Pair: the students work in pairs and after each sharing their individual reflections from Round One, they try to come to a consensus.

Share: All the outcomes of Round Two are shared and discussed in plenary.

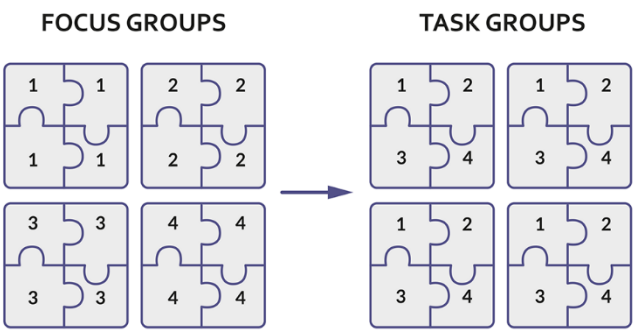


Jigsaw

In a Jigsaw format, the teacher assigns parts of a text or a task to different students in the group. The activity takes place in two rounds.

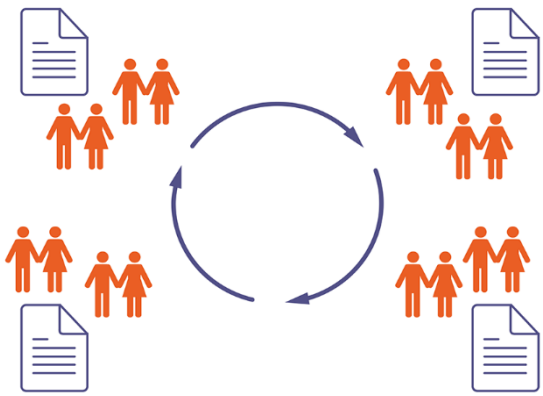
Round 1: the learner meets other students with the same text and role. They discuss the text to get a better understanding.

Round 2: the actual task round. Each student acts as an expert in his part and contributes to the task with his/her expertise.



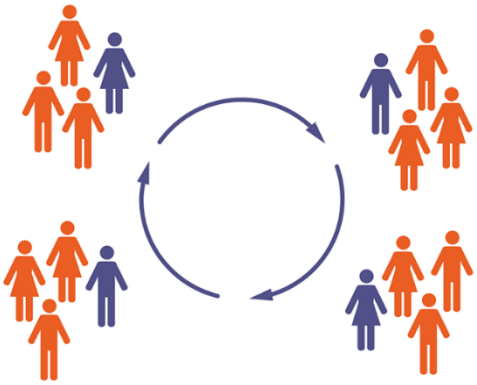
Carousel Brainstorm (Walk About, Talk About)

The teacher puts large sheets of paper with questions or topics in different places in the classroom and divides the class into the groups equal to the number of sheets. Each group gets 5-10 minutes to brainstorm ideas on the topic. When the time is up, they move to another poster.



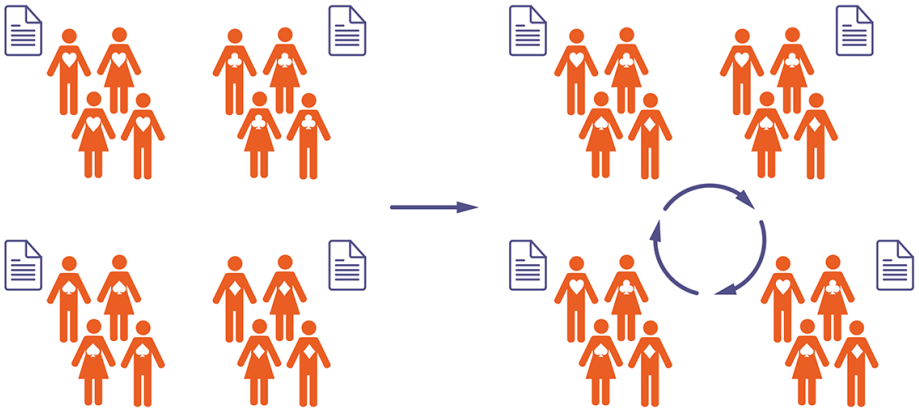
Stirring the Mix

Students discuss a topic in small groups under the supervision of the teacher, then one student moves to another group to explain what they have learned.



Gallery Walk

In the beginning, students work in small groups on a certain topic assigned by a teacher. The teacher provides materials for each group, and each group creates its visual presentation (e.g. a poster) of a topic. Then, they are divided into new groups and rotate between the stations teaching one another about the content they were working on.

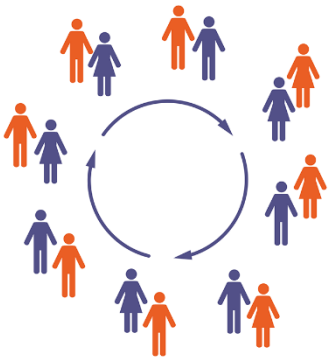


Philosophical Chairs

At the start of the debate, the debatable statement is read aloud, and students divide into positions based on whether they agree or disagree with the statement. It may also take the form of a continuum where students stand in a half-circle. Students take turns to defend their position.

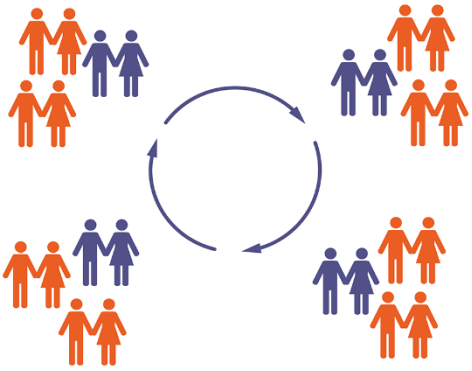
Concentric circles (Speed Dating, Onion)

Each student in the outer circle is paired with a student in the inner circle. The teacher asks a question which they need to discuss. After that, they rotate and a new discussion question is asked.



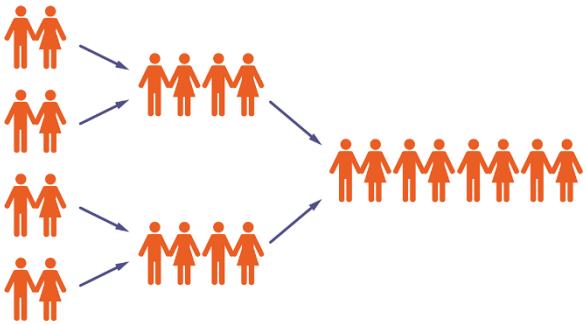
Cover-stations

Students are split into groups of 4-6. They are assigned a question to discuss. After that, two students from each group are asked to move to another group where they share the key ideas from the previous discussion, and the whole group is asked another related question.



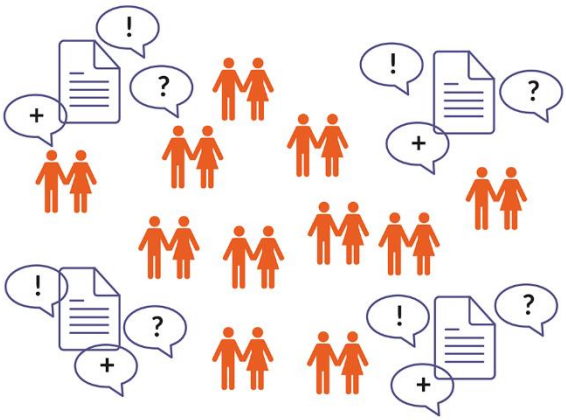
Snowball discussion

Students start to discuss a topic in pairs. Then, the discussion continues with joined groups of four, then eight, and increasing numbers until coming to a discussion with the whole class.



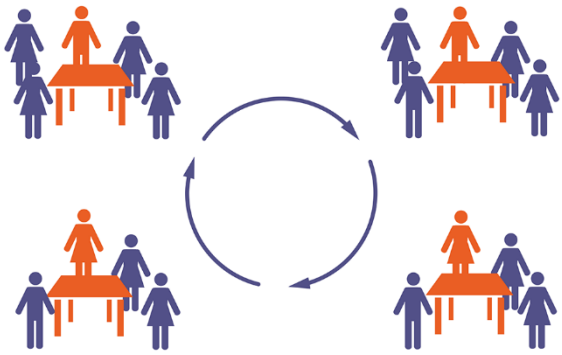
Chalk Talk

Students silently write on big sheets of paper posted around the room. They post questions, and respond to or comment on other contributions of other students.



World Café

Students discuss a question in small groups at tables, and they write or draw their ideas on a paper "tablecloth". Each table has a moderator. After 15-20 minutes, the participants move to a new table. The moderators stay at the table and explain briefly the ideas written on the paper by the previous group. The new members give their comments and add additional ideas. A similar procedure for the next round(s).



3.1.2. The Dynamic Classroom in Covid Times

Maximising physical movement and providing students with the choice over where they learn is at the core of the ideas presented in these Guidelines. Covid times made us reflect once more about how to use the learning space. For obvious reasons, the classroom environment no longer allows for orchestrated seating options. A virus threat brought us back to a fixed classroom where learners keep their distance. Schools were obliged to keep the distance between desks as it was carefully set and movement in the classroom was limited. This has an clear impact on pedagogy and the principles of active learning.

However, one could ask whether it is really the right time to be talking about learning space design from an innovative pedagogical perspective.

Movement and Choice

Students' movement and choice are key to optimal learning, but now we must prevent spread of the Coronavirus at schools.

Even so, we should not totally exclude physical movement. Having students stand for 3-5 minutes behind their desks to listen to the teacher talk can keep the brain oxygenated and primed for learning, according to Robert Dillon (Dillon, 2020). Giving students permission to stand along the sides or at the back of the room or even the chance to sit on the tops of their desks will promote choice and supply variation to a room that has been sterilised by its arrangement. In some locations, moving learning to an outdoor space is an option, and, when available, it can provide the movement needed for greater engagement and joy in the learning process.

Create a serene environment

Schools had to come into action in short notice when allowing part of the population back to school. More can be done to create a classroom with respect for the safety precautions than just turning chairs upside down to prevent students from sitting in a certain spot. The Covid classroom should be a serene environment where all unnecessary objects and clutter are

removed. The classroom design must incorporate the virtual presence of students who attend the lesson from home.

Physical and Online Learning spaces

At least in the near future, our time with students may not have daily consistency, so it will be essential to design the time in our physical spaces to support the whole child's progress, Dillon states (2020). Face-to-face time shouldn't be a content blitz filled with the voice of the teacher, as most of this can happen in asynchronous learning. In-class time should be used in the first place to promote conversation and relations within the community. It is worth stressing that it is essential to listen to the concerns and emotional needs of the students, to lower their stress and support and assist them in this particular time.

Digital learning spaces have become a daily reality and need to be set up so that platforms provide easy access to resources and learning tasks. User friendliness also requires minimising the digital clutter in virtual learning spaces.

All of these variables will require educators to design the learning environment with the flexibility that allows students to move fluidly between physical and virtual learning spaces.

3.1.3. Engaging Live Sessions with Video-Conferencing Systems

A popular comment from the first months of the pandemic was that some teachers had learned more in that time than in all their previous career. Obviously, this was true for the field of remote learning and teachers were open enough to test various options and tools. The emergency of the Covid crisis, with teachers and students in lockdown, forced educators to connect through video systems and interactive platforms. Although bringing this type of teaching into practice was indeed a most valuable achievement by different stakeholders, the type of interaction with students was in many cases quite traditional. Online teaching, especially where the education system institutions required schools to teach in line with the "normal" lesson plan, brought back lecturing. Students in many schools became passive listeners again. This is proof that even the most innovative and modern technology may strengthen the most conservative way of teaching. This is not the schooling we should go for in the 21st century.

Translating a dynamic classroom to a virtual or partly virtual world is a complex matter. It is not possible just to copy existing frameworks. Mastering new technologies is one thing but assuring the quality of learning and bringing active learning into practice are other matters. Remote learning requires a balance of live sessions and asynchronous engagement of students in various configurations.

Teachers who gave more freedom and ownership to learners before the Covid crisis were better prepared for the new paradigm, unexpectedly appearing in schools. By now teachers have learned that simply copying the former time schedule to deliver lessons online does not work. Spending the whole day in front of the screen both for a teacher and for a student is not always feasible, nor productive and may not be healthy, either.

However, live sessions with students are important in many ways. A school is not just a place to learn, but also a place where young people grow and socialise. Giving students a sense of belonging under the leadership of a teacher as a mentor is crucial. Therefore, live sessions need to incorporate as much interaction and involvement as possible among learners and not strengthen their isolation in their homes.

Many teachers feel uncomfortable with the freedom students have in a remote setting. They want to have a direct grip on students, and it seems difficult for them to assess properly the level of engagement, and the well-being of their students. However, the same applies for in-class teaching. Many teachers still prefer teaching in a traditional set-up to have control over the process. They want to see the faces of all students, initiate and monitor their actions. Giving more freedom to students by making them work in smaller groups requires a different type of classroom management. In a remote setting, it seems to be even more difficult.

3.1.3.1. LIVE SESSIONS AND BREAKOUT ROOMS

Video systems have built-in tools to engage students. As individuals, they can take part in polls, they can use the chat to give comments or ask questions. Furthermore, of course, students can switch on audio and webcam when given permission by the teacher. Many teachers organise sessions in plenary with all students present in the same virtual room, all the time of the lesson. This is rather not an effective education as too often students lose attention after a couple of minutes of video lecturing. When their cameras are turned off, they often start doing other "more interesting" things. So live sessions with the teacher on the spot should rather be limited and other forms of interactions should take place.

Most video-conferencing systems offer the option of breakout rooms to divide students into smaller groups during video calls for shorter periods of the lesson. During breakout sessions, students can speak freely to one another. Because of the small group size, they do not need to ask permission to speak. During breakout sessions, students are in principle interacting without the supervision of the teacher.

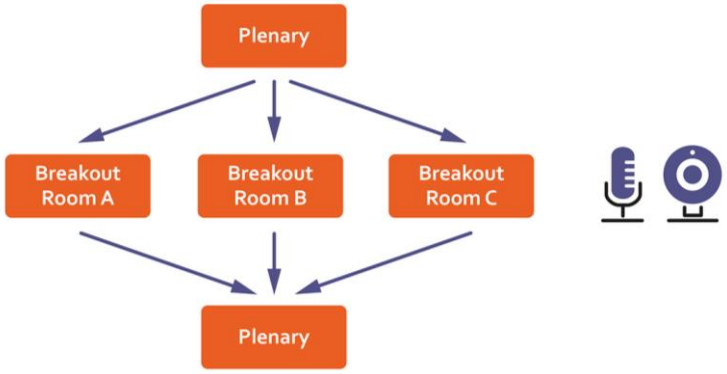


***Figure 21**. Breakout rooms can be used to engage students during online lessons with video-conferencing tools.*

The lesson would start and end in plenary with all the learners and a teacher together. In the process, breakout sessions can be organised for group work. In fact, the structure is identical to that of an onsite lesson with group work.

The integration of virtual breakout sessions is definitely a way of activating learners but needs some technical and pedagogical skills.

3.1.3.2. TIPS AND TICKS FOR BREAKOUT ROOMS

Teachers can create breakout rooms during live sessions and can either divide students at random or manually. They should match the amount of time and number of students to the task. Depending on the activity, they can create groups of three to eight people. The length of a breakout depends on the learning activity. Thus, teachers should try different durations and get feedback from students to find the optimal length of time (Lam, 2020).

Clear instructions and tools

When students are sent away to the breakout rooms, normally they will be on their own without the opportunity to put a direct question to the teacher. However, some video systems offer a feature for students to call the teacher to join their breakout session. The learners need to be informed about the duration of the breakout session as well as about the assignment.

A shared document or digital canvas can be shared before the breakout session starts. Online shared documents can be used to display the instructions, but also to collect the work of the different groups.

Roles for students

Assigning roles will help students start the conversation and support equitable participation. Possible roles include first-to-speak, note-taker, reporter, timekeeper, equity monitor, or questioner/devil's advocate (Lam, 2020).

Role of teacher during breakout sessions

Teachers have the opportunity to visit breakout rooms. Instead of staying in the main room, teachers can pay random visits and pop into breakout rooms. In fact, these visits are similar to the teacher who is at the side during group work in the classroom from time to time to check progress or answer clarifying questions.

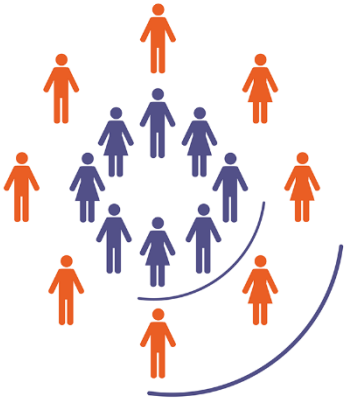
Teachers also have the possibility to send messages to all the teams in the breakout rooms. Messages can be sent about the remaining time or to share other directions and helpful reminders.

3.1.3.3. ADAPTING DYNAMIC FORMATS TO THE COVID CONTEXT

Since students need to respect social distancing in schools, dynamic classrooms with shifts and movements are not allowed for the time being. Technology can be the answer to bring dynamic formats into virtual practice. ICT could also offer a solution to implement active learning in a hybrid or remote setting, as well.

Teachers must find creative solutions to adapt dynamic formats to the current contexts. Exploring the options of a video-conferencing system offers solutions. Some examples:

Fishbowl



In a Fishbowl discussion (see above), half of the students take part in the actual discussion and each of these participants is observed by another member of the class.

When making use of a video-conferencing system members of the discussion get speaking rights and the moderator (teacher) gives permission to speak when a student raises his hand. Meanwhile, the observers try to summarise the point of view of the speaker, and they have been assigned to fill in an additional rubric/checklist to assess the speaking skills.

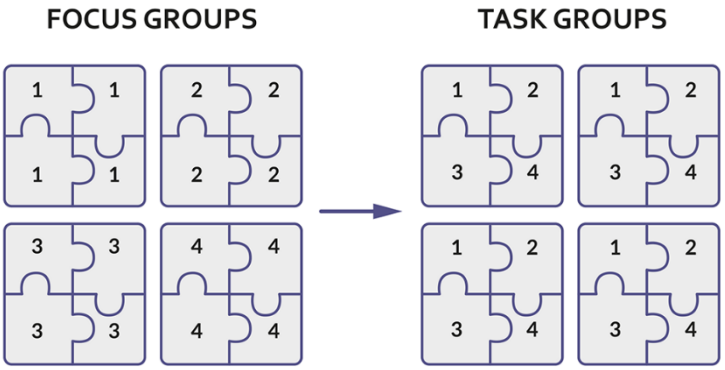
In the feedback round, the observers can create an online document with their report about the speaker they observed. The report contains a summary of the speaker's main arguments, as well as feedback making use of a checklist or rubric.

In breakout rooms, the speakers and observers can discuss the report.

Jigsaw

In a Jigsaw format (see above), the teacher assigns parts of a text or a task to different students in the group. In the first round, the members of a group all read, study and process the same part of the article. In the next round, the students act as experts to other group members who have studied a different part of the text. The second groups have all the expertise to complete a task.

Breakout rooms can offer a solution to the dynamic format described.



3.2. Learning Zones

Traditional classroom teaching practices are characterised by a one-size-fits-all approach, meaning that all teaching takes place in the same fixed environment addressing all students in a school in a similar way. Modern learning spaces can provide a lot of variations in the environment with the aim of supporting a variety of pedagogical approaches, as well as personalised learning. The learning zones concept combines a specific design of the classroom with an innovative pedagogical concept.

3.2.1. Thornburg's Metaphorical Learning Spaces

One scholar who had an important influence on the redesigning of learning spaces is American futurist thinker David Thornburg, who dedicated part of his life's work to issues of educational technology and education systems (Thornburg, 2014). Long before technology made its way into schools and classrooms, he developed the idea of learning zones in a classroom.

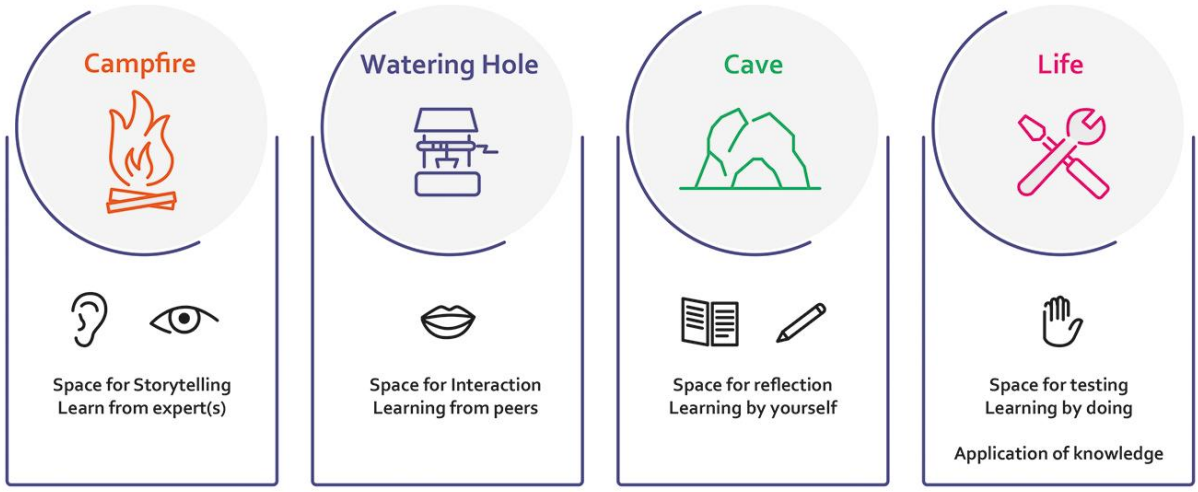


***Figure 22**. Metaphorical learning situations as presented by David Thornburg.*

In his book *From the Campfire to the Holodeck* (2014), Thornburg describes four metaphorical learning spaces and learning situations in which humans have learned for ages. Although technology brought a revolution to education, these four metaphors for learning have remained the same.

3.2.1.1. CAMPFIRE

The Campfire is the place for storytelling, which has been a mechanism for teaching for many centuries. It is the lecture space, where a group of students learn from one individual (teacher, presenter, fellow student) at the same time. Although this type of setting is overused in our current educational system, and is criticised by many, it has, according to Thornburg (2014), a place in the full scenario and should not be entirely eliminated. Campfire sessions must be in balance with the other metaphorical learning spaces, but even more important is the way teachers use the lecture time.

Campfire sessions must not reveal all the answers but set the scene and be the start of the learning journey. Quite often they destroy the chance to make discoveries. Traditional lectures do not stimulate real thinking. Campfire sessions should provide just enough information to drive a student to discovery. The focus should be on asking questions and more precisely on developing the driving question(s) of the lesson.

According to Thornburg, the campfire must be integrated into the PBL formats.

Campfire sessions are good to set driving questions. Campfire sessions should set the scene and be the start of the learning journey.

Not only teachers can be storytellers, but short videos can also act as storytellers with the same functionality. The additional benefit of using short video clips is that campfire settings can be part of a blended approach and made available for students to watch them in their own time.

Using video as storyteller of a technological campfire is the basis of a flipped classroom approach. The lecture part of the full teaching scenario moves to the home and private environment of the student and frees classroom time to be spent in different learning zones.

According to Thornburg, blended learning has in a way become the norm because learners spontaneously consult online resources nowadays.

3.2.1.2. WATERING HOLE

The Watering Hole is the space for social learning among peers. The learning takes place through conversations between learners. The idea is that social interaction generates triggers leading to a next level of understanding. The need for conversation is high after a lecture.

Schools must create environments where conversation and exchange is permitted and encouraged. In reality, the learning opportunities afforded by dialogue are too infrequent when students are positioned in rows. Flexible and comfortable furniture promotes conversations between students. Thornburg also points out that social interactions bring students to learn new things the teacher is not even aware of.

3.2.1.3. CAVE

As well as learning from a storyteller at a campfire and from peers at the water hole, learners also need a space for reflection. The cave, as Thornburg calls it, is a solitary space with privacy. Cave spaces are geared towards self-directed learning. The cave is one of the types of spaces most lacking in schools. With this sense of privacy, caves provide the right condition for students to process on their own. Newly built and innovative schools nowadays provide more of these cave spaces. Thornburg also points out that enough time needs to be provided for students to use cave spaces without interruption.

3.2.1.4. LIFE

Thornburg suggests the fourth learning zone should be called Life. It is the space where students can demonstrate what they have learned and where this knowledge can be applied in a meaningful way.

Traditional labs have existed for a long time where students performed science experiments, often first demonstrated by the teacher. Instead of replicating standard experiments. Thornburg states that Life spaces must give freedom to experiment and explore, rather than giving every student the exact same task to perform. He promotes the use of open-ended questions and a transdisciplinary approach to make the Life space a versatile environment for a variety of activities.

Life spaces must also support the idea that learning often comes through tinkering, building and making.

The idea of a Life space does not necessarily have to be physical but can also be more conceptual as long as students are granted the freedom to learn.

3.2.2. Learning Zones and Pedagogical Verbs

Learning environments must accommodate the different ways of students' learning. An effective environment is one that can offer a range of different facilities rather than the already mentioned traditional one-size-fits-all space where most students are doing the same thing at the same time.

Variety of the learning environment brings benefits in two ways. First, there is the so-called living-room effect. The open and flexible classroom creates a homelike atmosphere of comfort and freedom, and this feature impacts the motivation and efficiency of the learners.

For the second benefit, innovative learning spaces must be intentionally designed so that they have a clear functionality and relation with the pedagogical verbs you want to promote.

3.2.2.1. SIX LEARNING ZONES OF THE FUTURE CLASSROOM AT EUROPEAN SCHOOLNET

The Future Classroom Lab was opened on the premises of European Schoolnet in Brussels in 2012. The space presents the model classroom with six learning zones. Each zone represents a particular pedagogical idea and provides furniture and equipment best suited to facilitate the pedagogical concept (to learn more, please visit: https://fcl.eun.org/learning-zones).

The six learning zones could be divided into two groups. The first group (namely Interact, Exchange, Develop) expresses different modes for interaction between a teacher and learners. The second group (Investigate, Create, Present) relates to different stages of the lesson scenario or educational project.

Interact

The interact zone refers in a sense to what Thornburg (2014) would call the Campfire (see 3.2.1.1. above). The teacher acts as the expert in front of the classroom and/or as a kind of master of ceremonies leading the learners through all the steps of the learning scenario.

In fact, the Interact zone, as described above, tells us something about the role of the teacher and the student. We could describe a continuum starting from the traditional "sage on the stage" in front of passive listeners, to the approach of a teacher aiming to engage everybody in the classroom by trying to make learners co-actors of the play, rather than just the audience. The latter description is quite often the best practice possible for teachers who don't have the means to make changes in the classroom layout and need to stick to a fixed classroom.

Interact sessions where teachers keep control over every single step, will continue to play their role in education and are certainly valuable if only some conditions are integrated.

Trying to involve everyone is one of the conditions for having active learning take place in a classroom set-up that may look traditional at first sight. Traditionally, teachers try to ask questions when they want to involve students. They expect students to raise their hand, and then the teacher will select one or more students to answer the question. This approach is not always successful in enhancing the participation of every student, and to give the feeling of being an actor in the play. It often results in a small group of recurrent winners. Moreover, teachers in many cases tend to manipulate the involvement and responses of the students to arrive at the end of the story they had in mind. In this way, they don't have a proper overview of the problems of the learners.

Interact sessions must be in balance with other zones (pedagogical verbs). Interact sessions must be added with intervals and alternate with learning activities where students have more freedom without having to follow the track and pace imposed by the teacher. Interact sessions are, for instance, relevant at the start and end of the lesson or scenario. At the start, Interact sessions can set the scene; teachers can deal with core concepts or introduce the driving question if the scenario is project-based. Students can brainstorm or take an entrance ticket to share or reflect on prior knowledge of the topic.

At the end of the lesson, Interact sessions can be implemented to conclude the learning process, organise feedback and make the students take exit tickets or other ways of feedback.

In the Interact zone, students must have visual and auditory contact with the teacher as he/she leads the process of the classroom activity. In most cases, the teacher uses a board or canvas as a tool. The fact that students are oriented towards the teacher doesn't necessarily mean they must be positioned in rows. The horseshoe or even island layout where students are seated in groups permits teachers to address every student and at the same time students have visual contact with one another. The ideal option is to have flexible and mobile furniture to reshape the classroom to other layouts.

Instead of a teacher selecting a student to answer a question, all students must have the opportunity and the task to formulate an individual answer to the question. In some schools,

students all have small writable boards to write down their ideas or they make use of their mobile devices. Nowadays, technology offers a wide range of solutions to have the voice of each student heard. With 1:1 devices, students can send their individual data to collaborative boards, and they can take part in brainstorms, take quizzes and polls, etc. In this way, all students own the classroom board, whereas it has been the privilege of the teacher in the past.

However, it is good to stress that Interact sessions, especially when they are the main format of the lesson, have the tendency to have a one-size-fits-all culture because there is often one ongoing conversation led by the teacher.

Exchange

Nowadays much importance is given to making students collaborate with others in the classroom. The teamwork can take place at different stages of the scenario, for instance while investigating, creating and presenting. The quality of collaboration is composed of ownership, shared responsibility and the decision-making process within groups. Collaboration in the 21st-century classroom is not limited to face-to-face and synchronous communication, but can easily take place online, and asynchronously.

Furniture and classroom layout have an impact on stimulating collaboration in the classroom. Flexible furniture is certainly an important factor, but in fact teachers generally have the control over the space in which they teach because they set up the space as they see fit, whether the furniture is mobile or not, before the lesson starts (Brøns, 2021). The teacher must allow the students to co-create the space and give learners the power to choose places and furniture to work at.

Very often we see that after an activity or when the day ends, the space is “tidied up”, which means that the furniture will be returned to the traditional setting.

ICT can certainly help to create a broad variety of communication and collaboration activities (Davidsen, Georgsen, 2010).

Develop

Learning must not be limited to the time spent under the direct supervision of a teacher. Schools need to encourage and prepare students to become self-directed, lifelong learners. The Develop zone is a space for independent learning. It facilitates learning in a more informal way, and in many ways brings freedom to students. Students can carry out schoolwork independently at their own pace and style either on their own or in small groups, but they can also focus on their own interests.

Develop zones can be created in a classroom but quite often these cosy, homelike environments are part of the whole school building (especially in corridors and niches).

Investigate

Most teachers are aware they should not always act as the “sage on the stage”. Instead of listening to lectures with explanations, students must do their own research and build their knowledge. The investigate zone facilitates inquiry- and project-based learning to enhance

students' critical thinking skills. Students are encouraged to discover for themselves; they are given the opportunity to be active participants rather than passive listeners. The Investigate zone connects to a driving question challenging students to come up with their creative answers.

The Investigate zone provides easy access to real-life data and to tools to examine and to analyse. Investigation can take place by reading, observing, conducting science experiments, organising surveys, using robots, etc.

Students learn how to find quality resources and how to manage information.

Create

The idea of creating and making is interwoven with the investigate phase. Instead of just being content consumers, learners should be content creators. The Create zone provides materials and equipment where learners can create their own product to showcase their learning provides materials and equipment.

In the Create zone, learners go beyond a simple repetition of information. They make a transfer of the acquired information to a new piece of content as a result of analysis, synthesis and evaluation. Creating and making new artefacts are ways of processing learning. Creating gives ownership and offers possibilities for personalised learning. It allows learners to exercise their imaginations, and to innovate.

Present

In earlier days, the audience of the student was often limited to just one person: a teacher. The teacher was in most cases the only one reading or viewing the student's work. However, learning has become more social. Students share what they have created. Not only do more and more teachers organise peer-to-peer assessment, but also group work systematically forms part of the learning scenario.

3.2.2.2. FURNITURE

Furniture plays an important role in facilitating the pedagogical verbs described above. Imms (2020) mentions four aspects in assessing appropriate furniture for schools:

Functional need – furniture needs to be flexible, mobile, and support teachers and students in meeting their learning goals.

Comfort, safety, and health – furniture needs to address ergonomics while also enabling ease of movement around a space.

Usability – furniture should be intuitive for the user and not require significant training to learn how to adjust or move items.

Psychological appeal – furniture should have an appealing finish that attracts students in and sets the desired ambience for the learning environment.

3.2.2.3. IMPLEMENTING THE LEARNING ZONES

There are some misconceptions about the implementation of learning zones. In the first place, learning zones refer to pedagogical concepts. They are in fact pedagogical statements of what you consider important for the learning process. Often you see these keywords displayed on the wall. The main idea of the learning zones is that you provide the right conditions and tools in the classroom to support these pedagogical verbs. In a classroom with dedicated learning zones, students have easy access to appropriate spatial configuration and equipment, so they can do certain activities related to one or more of the promoted pedagogical verbs.

In reality, the idea of the classroom zones must be treated with flexibility in many ways.

If a teacher displays pedagogical verbs on the wall, it doesn't mean that for all these concepts separate, fixed zones need to be created. With flexible furniture, the classroom can be reshaped and zones can be created on the spot. Classrooms could, for instance, be easily reconfigured to support collaboration and working in groups too, or to allow students to present their work in an informal setting.

Even if zones have been created as areas with a clear separation, it is not realistic for learning zones to be big enough to accommodate all students. Some teachers make their students rotate, but in general future classrooms with learning zones should be versatile enough to host a wide range of activities in the whole space even though the activity ideally takes place with the perfect dedicated tools and furniture. For instance, bean bags may be the perfect match to listen to a podcast, but it is also possible on a bench in another part of the classroom.

In fact, the learning zones may overlap. The Future Classroom in Brussels has six zones promoting six pedagogical concepts. As you can see in the figure, the furniture and equipment provided in some of the zones are interchangeable. Learning zones like Interact, Exchange and Present have in most cases a verbal core, and so flexible furniture is important for these zones. The zones like Investigate and Create may need some hardware to support the activities, and this could be provided in the connecting or overlapping Investigate and Create zones. Finally, the Develop zone promotes independent learning and all areas where students can find intimacy either for personal work or group work can be used. Develop or Create zones can also be organised outside of the classroom.

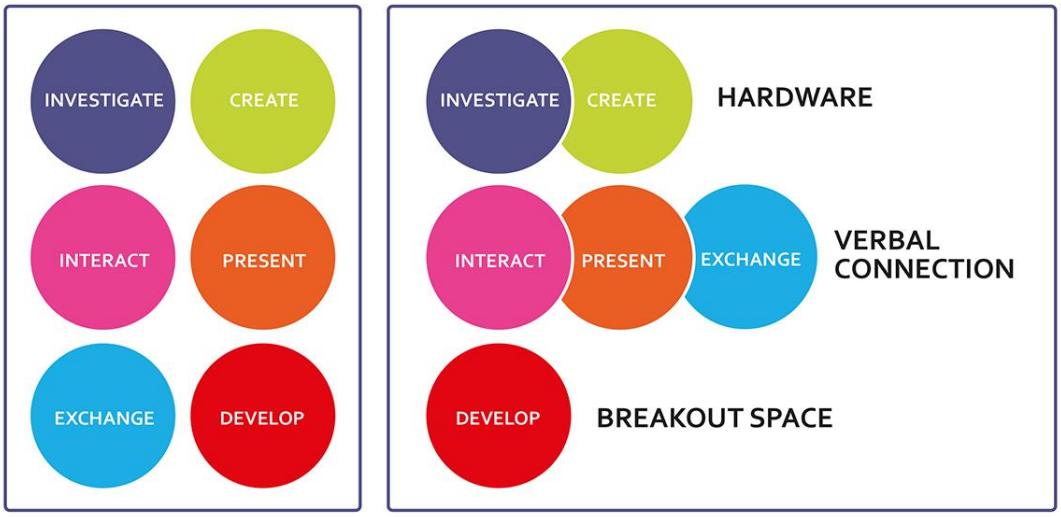


***Figure 23**. Learning zones and learning space organisation.*

3.3. Learning Spaces in Schools

The concept of the traditional classroom defined how "traditional" schools have been designed. Traditional schools are in fact collections of similar isolated classrooms connected by corridors. Mostly they don't invite learners to use the whole school as a common learning space. Learning takes place in closed boxes where teachers cover one academic subject after another, in a fixed time slot, and for a fixed group of students.

Innovative schools have taken a different approach and considered the whole school as a potential space for learning. Many traditional schools try to integrate spaces that are underused in the school building and even explore spaces outside the school as potential spaces for learning. At the same time, they cooperate with organisations or members of the local community to share spaces and make them available for after-school activities.

3.3.1. Spatial Parameters

Many times, in these Guidelines, we have referred to the traditionally fixed and static classroom with the stereotyped roles for both teacher and students. When rethinking how we organise learning we need to introduce a set of parameters that describes the role as well as the relation and positioning of both learners and teacher. It is clear to us that the learning space is no longer limited to the traditional classroom.

Role of the Teacher	Positioning of Learners	Space Format
Teacher-led	Alone	Public
Teacher at the side / Teacher as coach	Small groups	Private, limited distraction
Independent learning	Together	Fully virtual

***Table 18**. Relation between the role of a teacher, positioning of learners and the learning space.*

Role of the Teacher

It is clear that the role of a teacher has spatial implications. A teacher who wants to guide the students through every single step of the lesson (teacher-led), will need direct and visual (or virtually visual) contact with his/her students. If the students get more freedom (e.g. in group work), the teachers don't need to have this overview of all the learners and vice versa. With teachers at the side and acting as coach, students can take more distance from one another and use, for instance, breakout areas outside the classroom, or other common spaces. With independent learning, we even can go one step further. Students get full freedom for the task, and the direct supervision of the teacher is gone. Obviously, this gives even more freedom with the use of the learning spaces.

Positioning of the Learners

The positioning of the learners refers to the social element of learning. In some cases, students work individually on a task. They could also work in smaller groups, or the learning takes place in a plenary with communication with all the students.

Also, this social element has spatial consequences. It is not only a matter of practical organisation but also of comfort.

Space format

The different roles of the teacher can be combined with the different social positions of the learners. The actual spatial conditions can vary in the type of privacy and distance. Activities taking place in a classroom are by default public because all learners have visual and auditory contact with the rest of the class group and with the teacher. Some schools nowadays create learning spaces where groups of students can work in private or with limited distraction by other learners. When working virtually, mostly from home, the physical contact is completely diminished.

Imms (2016) presented the different seating options with the parameter of distraction (visual and/or auditory) and the number of learners involved in an activity.

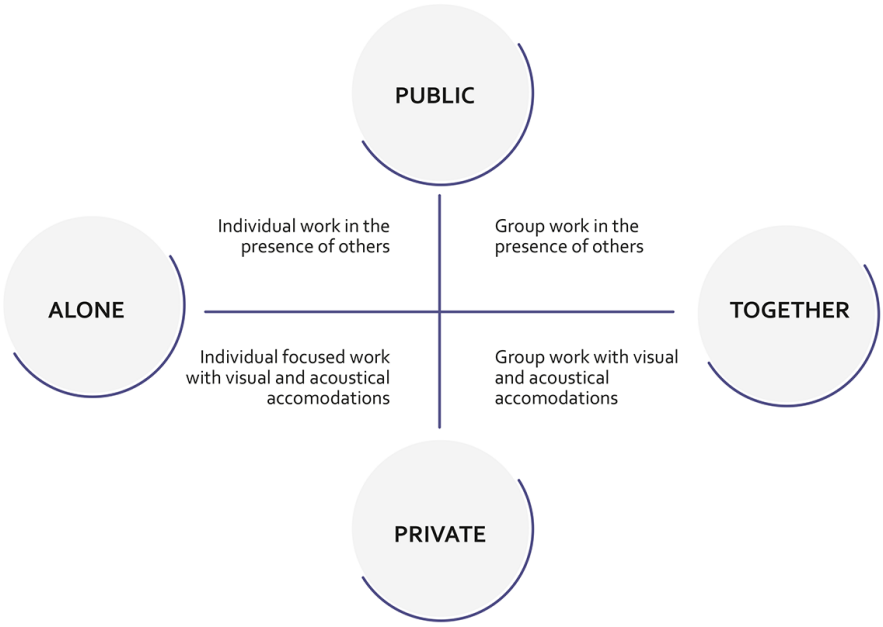


***Figure 24**. Learning and different social positions of learners.*

3.3.2. Spatial School Typologies

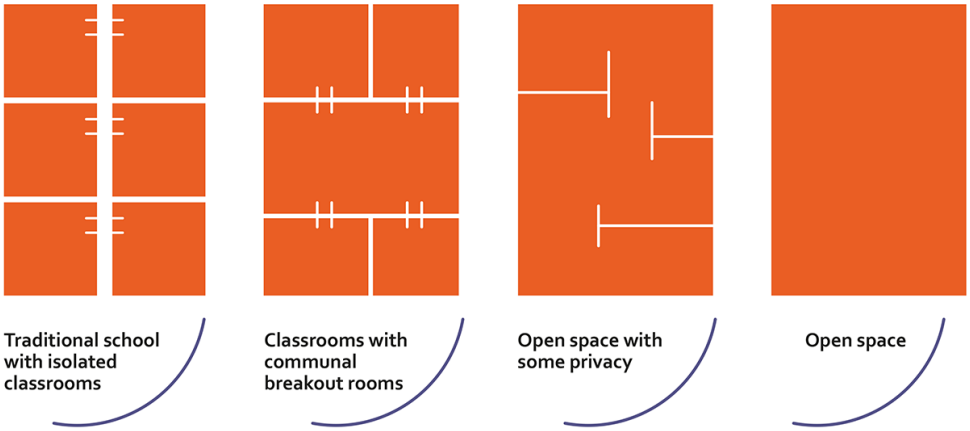


***Figure 25**. Reconfiguration of the learning space.*

The figure shows a continuum of how learning can reconfigure from being placed in isolated classrooms to an open space with the whole school redesigned as one big classroom. Many schools with the traditional design of box-shaped classrooms are now looking for ways to expand the physical space and to explore connecting some underused spaces like corridors, niches and in-between spaces of the school. In the second school model above, you see classrooms which have access, if wanted, to a large common in-between space. The consequence of using shared spaces in a school building is that students have at least visual eye contact with students of other classes who may use the space at the same time. Teachers can also deliberately mingle students for shared activities with two or more class groups (see below).

The third and fourth options in the figure go beyond the idea of the isolated classroom as the core element of the school design. By default, several class groups and their teachers can share a common space and leave behind, almost or completely, the spatial division made by separate classrooms.

The third option offers discrete areas with more intimacy, privacy and with less visual and auditory distraction. This last option is sometimes called the barn, where the idea of the separate classroom is totally abandoned.

Imms (2017) defines different types of spatial typologies and presents a continuum starting from the classroom as the default learning place shifting to the school as a common learning space with the traditional classroom as an exceptional format.

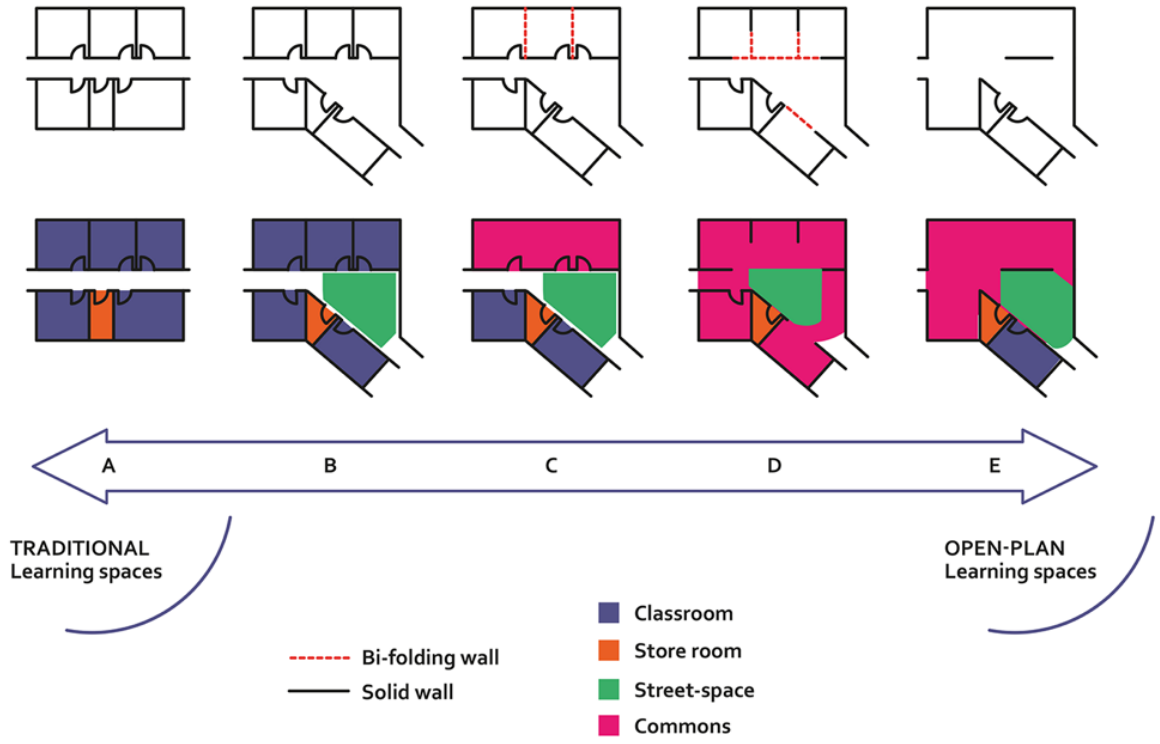


***Figure 26**. Spatial typologies (Imms, 2016).*

Imms also indicates that innovative design does not automatically lead to innovative pedagogical practices. Changing a traditional learning environment to an innovative learning environment is part of a transition programme involving all members of school staff, and leading to effective use of the whole space. The description of the continuum does not express a causal relation between the space and the quality of pedagogical approaches (Imms, 2016).

3.3.3. Transforming Schools

Adapting a traditional school with fixed classrooms to more open and flexible learning environments requires adaptations to the existing infrastructure and architecture. There is a (long) process of changes starting from easy, affordable and possible by authority of teacher and school to difficult, expensive and depending on authority of government or school board.

Hard architecture concerns building of schools and extensions, but also internal changes regarding refurbishing and redesigning spaces where walls are removed, doors replaced, etc. These types of changes are in most cases not decided by a school or teachers, but need approval and funding provided by a higher level. Soft architecture comprises changes that may be in the power of the local board and teachers.

Of course, in the first place, schools need to reflect on the pedagogical needs, then make changes in the learning environments of the school. The challenge is to find a match between the pedagogical need and the feasibility of the architectural concept.

3.3.3.1. CHANGE MATRIX

Tondeur (2019) has developed a matrix to help schools transform their physical spaces. He maps different parameters on X and Y-axes. On the X-axis, there are some pedagogical principles, and the Y-axis contains architectural solutions.

The Pedagogical Axis

On the pedagogical level, there is a need for the following environments. The list is not exhaustive but is based on observations of schools. The different areas can be linked to 21st-century skills.

- **Communication is everything:** The focus is on communication between learners and teachers, but also between just students, or between just teachers.
- **Learning together:** The focus is on real collaboration either among the learners of one class group, or among learners from many class groups.
- **Individual talent:** Every student is different and has her/his own talents. Every student must get the opportunity to develop at her/his own pace and level.
- **Hands-on:** Learners want to be active. We learn not only by listening, but also by doing and making.
- **Well-being:** A school is more than a place for learning. Students want to be in a comfortable environment where they are respected as persons.
- **The school is not an island:** Learning no longer takes place in the isolated school. Schools want to bring learning activities into the real world. Learning can also happen outside of the classroom.

The Architectural axis

On the architectural axis, Tondeur lists five strategies to find a solution for the pedagogical parameters. They include pieces of soft and hard architecture and apply to the classroom, the school and beyond.

***Figure 27**. Five strategies to find a solution for the pedagogical parameters of the architecture. Modified from Tondeur (2019).*

- **Run-it:** Every school has underused spaces, or spaces that could be added to the spaces where learning takes place. They could be corridors, halls, niches, in-between spaces, attics, etc.
- **Split-it:** Subdividing spaces into different zones. This could be done by adding a wall, but also by rearranging furniture and using, if needed, dividers.
- **Connect-it:** Making connections between existing spaces in the school building (physically, visually, functionally).
- **Add-on:** Adding extra spaces to the school building (building or acquiring neighbouring buildings or even adapting the grounds outside the building for a specific pedagogical activity).
- **Go Beyond:** Using spaces in the environment of the school (e.g. public facilities) and sharing spaces of the school with the community for after-school activities.

3.3.3.2. OVERVIEW OF LEARNING SPACES

It is important to consider the whole school (and beyond) as potential space for learning and step away from the idea that learning should only take place in a standardised classroom. It is not realistic to turn every classroom into spaces that "have it all".

Based on school visits and desk research, Tondeur (2019) gives some examples of existing learning spaces. In his *Inspiratiegids voor Klasinrichting en Scholenbouw*, he describes learning environments in and outside the school building. They are either spaces suitable for plenary sessions with the whole class group or micro-spaces for individuals. Some of the spaces are suitable for general classroom activities, others for more specialised activities. A few examples:

General teaching

- Lab 21: Spacious classroom, with learning zones (Future Classroom).

Specialised spaces

- Black box: isolated, closed environment to create multimedia products.
- Fablab: workspace with manual equipment to create artefacts and prototypes.

Micro and common spaces

- Cocon: spaces for individual learning with little distraction.

- Forum: space where students sit closely together to listen or view a presentation or performance.
- Coffee corner: space where students can sit together in an informal way.
- Learning street: corridor used as breakout space with intensive use of the walls.
- Working bubble: area for group work with limited distraction.

3.3.3.3. LEARNING SPACE SPECTRUM

Changes in learning environments don't happen overnight. It is a complex and step by step process including developing a pedagogical vision, staff commitment and budget matters. Heidi Hayes Jacobs (2017) has developed a learning space spectrum starting from small classroom changes to open innovative learning environments in the school and beyond.

The graphic shows the different stages of innovation.

***Figure 28**. Learning Space Spectrum (Jacobs, 2017; by courtesy of Heidi Hayes Jacobs).*

The spectrum shows how teachers and schools can start with the most basic changes such as moving furniture and fixtures to create a more accommodating environment.

Stage 1: Rearrange classroom spaces. Teachers work with what they already have. It could be rearranging furniture, moving furniture in and out.

Stage 2: Upgrade and replace furniture. Replacing dated standard seating with a wide range of chairs, tables that are ergonomically matched to the age and stage of the children.

Stage 3: Repurpose & remodel learning spaces throughout the school. Creating additional learning spaces outside of the classroom by repurposing and adapting spaces throughout the school.

Stage 4: Design & build an addition to an existing structure both external & internal. Building extensions or making fundamental changes to the internal school structure.

Stage 5: Employ outdoor and community spaces. Learning can take place outside of the school as well in community spaces or elsewhere outdoors.

Stage 6: Plan total new school design with a wide array of learning spaces & purposes-. Building a total new school that reflects an innovative vision created and shared by all school stakeholders.

Stage 7: Create new form of modern learning environment. Moving away from the current notion of a school towards designs of learning spaces for specific student populations with their specific needs.

Chapter 4. Learning Environments and Challenges for Schools

There are several reasons why we should change or at least adapt the learning space in our schools to make it more flexible for pedagogical purposes. Innovative/flexible learning environments can help to:

- Develop students' autonomy;
- Engage students in learning;
- Enhance cooperation between students;
- Apply the more sophisticated and effective use of ICT;
- Support learning outside the classroom;
- Support differentiating learning;
- Secure low-ability students;
- Promote benevolence;
- Give a desire / motivation to learn;
- Provide a physically, mentally and morally comfortable environment.

However, the introduction of innovative learning environments can also pose some serious challenges to all the stakeholders of the teaching and learning process. They can be divided into three categories: those related to the mindset, to the toolset and to the skillset. In the end, virtual learning environments are already important and becoming even more crucial elements of a school in the 21st century.

4.1. Challenges Related to the Mindset

The tremendous shift towards innovatively designed learning areas requires making significant alterations in attitudes, and moving away from a fixed mindset towards a growth mindset, which may be radically challenging, distressing and uneasy. Change does not come effortlessly, and giving up old habits or beliefs and creating new ones demands hard work (Benade, 2017).

In the beginning, the reasons for the innovation may not be clear for many teachers, they may not identify why the renovations are required and may wonder if the renewal can really meet the demand for reshaping teaching and learning. Teachers may feel frustration or discontent because of a lack of participatory discussion of the motives for transforming the space, and not taking teachers' ideas into consideration while designing. Therefore, transformation in the learning space entails careful preparation through mutual decision, collaborative discussion, co-planning, negotiation and having a shared vision of the new space that teachers can commit to. For an effective shift from traditional to innovative learning environments, teachers, and students, and even parents should have an active voice and ownership in the learning space design (Niemi, 2020).

It is also crucial that school principals are visionary, open to innovation and supportive of the new practices regarding renovation in learning spaces. The school principal can act as the key

leader for transforming the learning environments as a facilitator, realising that it is necessary to move beyond the usual ways of learning and develop 21st-century skills in learners (Kariippanon, Cliff, Okely, Parish, 2020). For the paradigm shift in learning and teaching to take place, the expertise and skills of the principals are required to support teachers and school staff, and principals should work with them collectively towards the goal of innovating the learning environment (Fletcher, Everatt, Mackey, Fickel, 2020). In addition to providing the necessary time, resources and opportunities for planning, the role of the principal is significant in including the whole school in this initiative, by acknowledging the significance and value of different perspectives. School leaders should pioneer the transition process by creating a shared vision and ownership for goals, values and future practices in the learning environment, supporting a motivational climate among the school staff and thus developing the school as a community (Niemi, 2020). They should also have a flexible approach for the innovations in the learning spaces to be adaptive to the local realities.

In fact, not only school leaders and teachers but also students need to change their attitudes when the learning environment undergoes a considerable change. Design of learning space reflects school identity and values. If students use different spaces in a school autonomously, they develop their sense of belonging, which promotes their well-being in school (Duthilleul, 2019). Contrary to popular belief, a school is not a set of closed rooms, classrooms are not just for daily teaching, corridors are not only for passage, and laboratories are not just for experiments. Learning can take place everywhere and innovative schools should provide opportunities for learning anywhere. For instance, the inclusion of common areas as learning spaces makes more average learning space per student. Corridors, hallways, floors and schoolyards can be used as individual, pair or group learning spaces.

Students also need time to shift to flexible learning spaces. In innovative learning environments, students are expected to collaborate and behave more autonomously for their own learning, which they need to master. Self-management, or self-regulated learning, which is essential to personalised learning, is facilitated through collaborative learning in flexible spaces. On the other hand, it will take longer for some students to adapt to this flexibility and have freedom to choose after many years of strict and controlled learning, and they should be supported to gradually become more autonomous in their own learning (Benade, 2017).

As pointed out by Benade (2017), a unique space is not necessarily required for teachers to be innovative and progressive. Nevertheless, space helps to support innovation in teaching. Although teachers think that the traditional classroom set-up promotes didactic instruction more, sometimes teachers may tend to change their ideas, but not their practices. Especially during stressful situations and tiring contexts, teachers may easily switch to default modes of teaching, old and well-known strategies for managing the classroom. Therefore, Benade concludes that a flexible learning environment does not guarantee a transition to modern teaching and learning practices, but it is an enabler.

Summing up, it is not possible to change teachers and students immediately as soon as the learning space is redesigned or just renovated. The space, teacher activity and students' perspectives reciprocally affect one another, and the adaptation to a new learning space is a

process that is influenced by making practices habitual and getting used to the complex network of relationships with students and other teachers (Deed et al., 2020). In this challenging process, an openness to adaptation and collaboration with staff and students for solutions, reflecting a supportive school ethos and being open to learning, may be beneficial in changing the mindset. Creating an innovative school atmosphere that promotes iterative, ongoing quality improvement and enabling development by trial and error, cycles of planning, acting and reflection or observational learning, may facilitate the transition phase and help proceed in the desired direction (Kariippanon, Cliff, Okely, Parish, 2020).

4.2. Challenges Related to the Toolset

In ideal situations, the new learning environments should be designed with mobile, ergonomic, reconfigurable furniture and digital technologies available for use anytime and anywhere in the classroom. Innovative learning space should meet the needs of users (i.e., students and teachers) with flexible furniture and technological equipment in terms of pedagogical objectives (Duthilleul, 2019). Teachers should be able to focus on their primary goal, which is concentrating on students and their learning needs, without having to spend too much time moving around the different parts or zones of the learning space, and the design should be arranged accordingly (Niemi, 2020). Teachers and students may come across some challenging issues regarding the design and layout of the new learning space that need to be overcome.

Some teachers may think that the physical design and furniture of the learning space cannot sufficiently address different learning practices and groupings as they expect them to. In other words, there might be a mismatch between the physical design and teachers' preferred activities, in terms of being flexible and transformative enough (Niemi, 2020). According to Kariippanon et al. (2020), in the selection of furniture and space design, schools may prefer either collaborating with external consultants and experts or choosing their own furniture and design by themselves. While working with the external consultants, organising interactive workshops with the school staff and helping them reflect on their needs, wishes and requirements to co-create a learning environment based on the unique pedagogy, context and culture of the school might be a really effective solution. However, if the budget is limited, schools may not choose to seek external advice and may design space with varying pieces of affordable furniture, thus not sticking to a specific set of furniture (Kariippanon et al., 2020). Both options have advantages and disadvantages in overcoming the challenges caused by inappropriate furniture selection or ineffective classroom layout. The key point in both situations is to enable teachers to have a greater voice and carefully consider student needs in the design process.

Another problem is related to the layout of the physical space during learning practices. The "open" characteristic of the innovative learning spaces and the rise in the level of physical mobility may cause noise, disturbances, interruptions or distractions among different student and learning groups, which leads to stress and concentration problems for both the teachers and students, especially in crowded classrooms or team-teaching contexts. In a traditional classroom, it is easier for the teacher to identify noisy and troublesome students, but in a

flexible space it is more challenging. Additionally, if the teachers and their students change locations and move around the different parts of the space too often, the teachers fear that learning may become fragmented and therefore ineffective.

The problems related to these issues can be solved through careful planning and scheduling (Niemi, 2020). According to the results of a study by Kariippanon and colleagues (2018) on the perceptions and experiences of school staff using flexible learning environments, teachers recommend setting classroom expectations and boundaries regarding the ways for engaging with the space and furniture, while dealing with behaviour management. Moreover, some design elements for acoustic measures (such as glass walls or curtains) can be incorporated to decrease the level of noise, which is an indispensable result of teaching and learning in a flexible space. The classroom setting can also be negotiated with students, which could lead to an interesting learning experience, both for students and teachers.

Integrating the technological equipment into the new space design might also create some challenges. If various technologies are included randomly in the learning environments, then the chances are small that these technological devices will be conducive to learning, so the addition of digital technologies should be planned well and in line with learning objectives (Özerbaş and Erdoğan (2016), as cited in Fletcher et al., 2020). Moreover, it is possible to benefit from a technology consultant to interpret the school's needs and specify systems that will address them. Technology on its own cannot influence learning positively; the important thing is to use technology effectively so that it has a good impact on learning, which is possible through well-established pedagogical perspectives.

Teachers mostly need a renovation/reconfiguration of their traditional schools or classrooms instead of building a new school or classroom because of the interplay between pedagogy, space and technology. Yet, it can be seen as time-consuming, expensive and risky for administrators, teachers and parents. To prevent this fear, re-designers or architects must consult the users of the space, discuss and cooperate with all stakeholders to form a mutual mission. They should take students' developmental needs, likes and dislikes, and teachers' ideas about learning, as well as curriculum content, on board. If they want to elaborate further, they can research the users' expectations of the space, examine good examples, and sketch the space out. Furthermore, re-designers can repurpose pre-existing materials to keep costs down. Thus, they can transform their mission and objectives into activity settings to design the learning environments of the future.

4.3. Challenges Related to the Skillset

A quick transformation only in the external decoration will not in itself bring the required positive impact on learning. A shift from traditional classroom to innovative flexible learning space also requires first making adaptations and changes in pedagogies, which can be profoundly affected by the teacher competency levels. To possess the adaptability and proficiency to evolve their pedagogical practices, teachers should be upskilled for active learning and innovative learning environments. Teachers need to be supported in the transition to the new spaces because they need time to adopt and implement new pedagogy,

materials and technological devices appropriately (Duthilleul, 2019). In other words, they must all learn how to use the "new" learning space. A research study conducted by Fletcher, Everatt, Mackey and Fickel (2020) on innovative learning environments indicated that teachers are more likely to support flexible learning environments and the use of technology for pedagogical purposes as they gain more experience in these innovative learning spaces.

Adaptation to new learning environments may cause contradictory feelings about the changes in some teachers, being unsure of expectations, and uneasy feelings of getting out of the comfort zone (Niemi, 2020). This is the first challenge to deal with. Teachers who are used to controlling the lesson, the students, the materials and the tools most probably find the radical change in the space really challenging. According to Benade (2017), even if some teachers appreciate the value of decentralising learning and teaching, they may revert to their common and familiar means of teaching.

Teachers are challenged to look at teaching practices differently in new learning spaces. Pedagogy gradually shifts from teacher-directed learning to a student-centred approach. They begin to employ innovative pedagogies such as Project-Based Learning, differentiated instruction and integrating technology for personalised learning. The fact that students and teachers do not have stable spaces to work and interact may bring induce worries about having "overly-fragmented learning" for teachers, and teacher-directed learning may seem necessary for such practices as explaining and showing complex concepts that are hard to understand without the teacher's support. Therefore, the changes in educational settings should include a bottom-up process, not a top-down approach, because the needs and wishes of the teachers need to be taken into consideration while developing school practices (Niemi, 2020).

Transforming the learning spaces requires and challenges teachers to collaborate more, engage in team planning and share responsibilities. Teachers develop co-teaching practices in the flexible spaces for interdisciplinary courses and collaborate with other colleagues for team teaching. Benade (2017) explains that while it is advantageous for creating variety and novel learning opportunities, it can be highly uncomfortable for some teachers at the beginning, as they have higher levels of resistance to change, because of being observed and working in sight of other colleagues, contrary to habitual, privatised teaching. The transition from a conventional one-teacher lesson to innovative co-teaching practices requires leaving the comfort zone, which takes time. Once the team of teachers start working harmoniously, in a non-judgemental manner, the lessons can be smoother and more efficient. To make it possible, the team dynamics should be managed well. Teachers can support one another and use their strengths to empower the teaching of another colleague in simultaneous, interdisciplinary lessons in innovative learning environments (Benade, 2017).

A phased, gradual approach might also help to effectively implement pedagogy change and transformation in the design of physical space. It is better to start with more motivated and convinced, voluntary school staff than choosing a top-down process and including the whole staff for innovating the learning environments. Thus, teachers and students may have the opportunity to experience by observing, using, reflecting on, evaluating and adapting to new spaces. They can see the spaces in action and re-evaluate the impact of the learning space.

Peer-to-peer support among colleagues may encourage accepting the new design, especially when these reluctant teachers are afraid of change (Kariippanon, Cliff, Okely, Parish, 2020).

The other challenges are distraction and noise, which require teachers to make changes in their management skills. Kariippanon (2018) describes how collaborative work, crowded and open-plan spaces may cause noise. In addition, as a result of increased focus on collaboration, inadequate self-discipline to stay on task, the design and furniture, the freedom to work in different parts of the classroom and being less observed by the teacher, students may easily become distracted. To cope with these issues, teachers need to help students stay on task, finding solutions by thinking outside the box. Therefore, it is beneficial to develop teacher proficiencies with sustainable capacity building programmes on how to use flexible learning spaces productively.

Physical change in the space entails support for pedagogical change, to fully benefit from the opportunities an innovative learning space provides. Therefore, providing teachers with high-quality professional development opportunities can upskill teachers pedagogically to design, create and fully benefit from the spaces. Professional Learning Communities (PLCs) might be effective to encourage teachers to share experiences with their colleagues and increase knowledge on ways of improving their teaching (Kariippanon et. al., 2020).

4.3.1. Behaving and Learning in Innovative Learning Spaces (Student Perspective)

When there is a change in the learning environment, it will impact teachers' pedagogy and students' learning behaviour as the key component of the teaching and learning process. Today, technology is an integral part of innovative learning environments, and students perceive technology as a natural component of their lives. In addition, most of them have many digital devices and software tools to integrate into their learning activities (even if not all are used efficiently). There are some studies observing and determining the impacts of innovative learning environments on teachers and students. For example, Davies et al. (2013) reviewed 210 school projects on flexible learning space for learning and found that the space fosters students' performance, especially their creativity and communication, and teacher professionalism. In addition, Byers et al. (2014) claimed that innovative learning spaces impact students' attitudes, level of engagement and learning experience and produce better academic performance.

The study by Benade (2017) focusing on the impacts of flexible learning environments and examining the practical, lived experiences of teachers and students reveals that the transition from traditional classrooms to flexible learning environments enables active learning. When beneficial, the changes in the student work and attitudes are explained as follows:

- Innovative learning spaces have brought about higher levels of differentiation in group-forming and collaborative working patterns.
- Higher mobility in the learning space and freedom to choose where to work help reduce student misbehaviour and disengagement, unlike a single-cell class space

where fewer spatial opportunities arise in redirecting students to get motivated for their work.

- The freedom of choice over learning programmes or some learning practices makes the students feel empowered in their learning. They become more self-regulated, thus increasing their level of autonomy.
- As there is more personalised teaching and learning, students realise their programme is not teacher-centred. They are able to show higher levels of reflexivity, state their individual needs and change their learning preferences.
- Flexibility and mobility create opportunities for using various spaces for different purposes, in addition to more varied and intensive use of mobile technological devices.
- The open atmosphere of the learning space enables more socialisation, thus improving collaboration and a wider network of relationships among students.

As can be seen, innovative learning environments bring about an increase in students' active engagement levels. Byers, Imms and Hartnell-Young (2018) have also ascertained that students spent more time creating, refining and giving peer-to-peer feedback thanks to the spaces enabling greater differentiation in learning activities. Therefore, it can be concluded that when pedagogical changes are made, the modifications in the learning space contribute to the shift in the power dynamics between teachers and students, who are viewed as equal partners in learning. In brief, flexible learning spaces foster student-centred pedagogy, self-regulation, collaboration, student autonomy and engagement, resulting in more enjoyable, comfortable, inclusive and interactive learning (Kariippanon et al., 2018).

4.3.2. Managing Teaching in Innovative Learning Spaces (Teacher Perspective)

For teachers, new learning environments with flexible design and innovative technologies mean resorting to different skills and methods for arranging teaching and changing their behaviour and attitudes towards learning. According to Deed et al. (2020), teacher agency is a key issue and major driver for adaptation in teaching practices in contemporary learning environments; and it is enacted in different ways for adaptation in classroom practices in accordance with contextual, social, cultural, organisational, spatial and pedagogical factors.

In their study, Deed et al. propose the Model of Enactment for explaining how teachers change practices and develop agency while adjusting their teaching to flexible learning environments. According to this model, in the process of adaptation to innovative learning environments, teachers go through the following stages: Awareness, Experimentation, Coherence. In the Awareness stage, teachers encounter and identify the new spatial opportunities for different pedagogical practices, which leads to a shift in mindset. In the Experimentation stage, teachers try out various ways of integrating pedagogy into a new space, modifying teaching practices by trial and error, but the teacher agency and the innovative practices are not yet stable. In the Coherence stage, the teachers come to a situation where they can consciously integrate space and pedagogical practices in a coherent manner. Transition to Coherence entails teacher agency as an active learner (Deed et al., 2020). The stages imply that teacher adaptation is a gradual process, and effective teaching in flexible learning environments takes time. Several

studies indicate that shifting from conventional learning environments to flexible spaces yields positive results in terms of teaching and learning. According to the study by Nambiar et al. (2017), teachers focus on more learner-centred pedagogy afforded by technology in innovative learning spaces. Teachers are facilitators in the classroom, and they assign students tasks that involve collaboration and group work.

In a study by Byers, Imms and Hartnell-Young (2018), the teachers and students in a secondary school in Australia were observed and the impacts of transition to innovative learning environments were evaluated. The results showed that after the spatial transition from the "front fireplace teaching position" to flexible learner-centred design, a significant decrease was observed in the proportion of time spent by all teachers in direct instruction, making didactic teaching no longer their dominant pedagogical model. Moreover, if needed, teachers began to use didactic instruction in a more focused, refined and responsive manner for student understanding, by increasing the questioning and class discussion and providing feedback during the course. This indicates that the space orientation challenges teachers' pedagogical preferences and raises awareness to change their mindset and already-existing techniques. After a certain amount of time, the teachers changed their teaching significantly so that it was possible to differentiate student activities, including creation, appraisal, refinement and practices of their own works. Other changes include differentiation in the student interaction, from only the individual or whole class work to mixed grouping format, and using technological tools less for transmitting information, more for connection and collaboration among students.

In parallel to these results, Benade (2017) concluded that teachers are observed to be more active and energised and move among the student groups, engaging in supportive interactions with students and evaluation through observing students continuously. They can take on multiple roles such as workshop facilitator, large group instructor, or supervisor. Most of the teachers working in flexible learning environments have commented that these learning environments have enhanced their teaching experience – including collaborative teamwork with colleagues, mutual benefit from shared expertise, mutual support through co-teaching within the same space, being free from isolation in traditional classrooms, and the possibility of working with s greater number of students in a motivating manner.

Accordingly, it can be concluded that flexible learning environments enable generating a fundamental change in teacher practices. As teachers get accustomed to the learning space, the changes become more permanent and increase their efficiency over time. Teachers make more conscious choices over integrating innovative and active pedagogical approaches and use technology productively for learner-centred practices over time.

4.3.3. "Surviving" and Teaching in a Virtual Learning Environment

Virtual learning environments are flexible and recreational environments that represent electronic emulations of the multidimensional natural world (Thomas, 2009). While a physical learning environment may influence students in such powerful ways that they promote "enhanced learning" and "emotional attachment" to the environment (Graetz, 2006), virtual

learning environments facilitate networking of social relationships and decentralisation to solve problems and accomplish learning goals. Students' network of social relationships in virtual environments is more complex and less predictable because it is guided by their own preferences and priorities. Virtual learning environments are not student-centred or teacher-centred environments. In this regard, rather than hierarchical structure, decentralisation promotes a personally motivated network, which supports collaborative learning and engaged learning (Kirschner, 2004; Thomas, 2009; Weller, 2007). Student engagement or active and meaningful involvement is the cornerstone of the teaching and learning process. So, both physical and virtual learning environments should encourage engaged learning.

Bostock (2018) argues that during distance learning, beyond the physical and temporal distance, students and teachers encounter a virtual separation caused by the psychological and communication gap; the meaning loss or misunderstanding can happen between the teacher instruction and student comprehension. This situation results in feelings of isolation and disconnectedness for students as their motivation and engagement levels decrease. In order to deal with this, the teachers should:

- Set clear expectations for participation, pacing, progress, learning goals and assessment,
- Structure the level of flexibility and rigidity of the pedagogical methods, personalised strategies and practices according to the students' profile and learning needs on virtual platforms,
- Provide various learning materials to the students and present them in interactive and accessible ways,
- Arrange the dialogue and interaction patterns among the content, teacher and the students for receiving better responses, creating discussion, collaboration, sharing experience, personalised feedback, etc.

The teachers need to determine the suitable amount of autonomy, dialogue and structure for virtual learning environments based on the needs of the students (Bostock, 2018). Accordingly, it can be said that teachers should determine the optimal level of engaging students in virtual learning depending on their student profile.

In virtual environments, teachers come across some other challenging problems as well. Among them the technical issues, lack of sufficient digital competencies, time management, keeping students motivated, ensuring security and data privacy, adapting to distance learning and lack of in-person interaction can be counted as the most prevalent. Accordingly, teachers have some worries about how to create a high-quality learning environment. Integrating virtual potentialities through digital learning platforms requires pedagogical skills for ensuring better learning environments. Moreover, introducing new technology and new pedagogical practices demands new ways of working and new teacher competencies such as technical, cognitive and social skills (Gynne, Persson, 2018). Therefore, teachers need to revise their design of the teaching process in terms of teaching and learning and assessment strategies. Here below are some suggestions that they take into account in the process of teaching:

- ICT skills: Teachers should improve students' ICT skills based on the use of computers to obtain, evaluate, store, produce, present and exchange information, and to communicate and participate in collaborative networks over the Internet (European Parliament and Council Recommendation, 2006).
- Safety: Teachers should create a safe virtual learning environment for students. Moreover, they should develop students' digital competence, which means safe and critical use of ICT, and educate them in good online habits, online courtesy and risks. Thus, they help students develop positive digital identity.
- Span of the course: Content should not be too long hence provoking dispersion and not short enough to create disconnection between learning concepts.
- Facilitation: Teachers should manage the psychological learning atmosphere and engage students in the learning process.
- Interaction: Teachers should facilitate students' social interaction with one another, hence, they should support collaborative learning. The differentiation in student and teacher interaction should be enhanced through activities that require various interaction patterns, such as mixed-grouping, whole class, pairing and individual work.
- Contents: Teachers should create and use digitally compatible and motivating contents. The contents should be designed in a way that enables learners to actively participate in their own learning.
- Materials: Teachers should prepare user-friendly and accessible digital materials.
- Assessment: Teachers should assess students' outcomes in order to facilitate their progress and learning. However, the format of assessment can be limited in virtual environments. Therefore, teachers should choose carefully what way of assessment is best for students. Formative assessment might be a good alternative to summative assessment, and there are a variety of online tools in assessment for learning during the process.

Furthermore, virtual environments open new ways for classroom management. Managing an online classroom entails updating and revising well-known classroom management techniques for teachers. Involving students in establishing the codes of conduct and rules for online courses might be a good starting point. As virtual learning is new to most of them, creating their unique norms for e-learning environments can be appealing and they are more likely to obey them. Another important point is to use technological tools proficiently and test them before lessons. Getting to know and trying the technical properties and functions of the new applications and digital tools will save teachers from student distraction. In addition, having continuous contact and healthy one-on-one relationships with students through online contacts or via telephone, by engaging the parents as well, develops connections and facilitates managing student behaviour online. Most importantly, by acknowledging that getting accustomed to virtual learning takes time and improves gradually, starting slowly and progressing step by step may ease the transition to virtual learning spaces both for the teachers and the students.

Today, there is no need for a specific location of learning; students can learn anywhere and anytime. Therefore, boundaries between physical and virtual environments will be vaguer as innovative technologies and augmented realities become more prevalent.

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